Governing Openness for Development: A Mechanism-Based Theory of Open Development as an Endogenous, Knowledge-Centered Paradigm in African Contexts

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ABSTRACT

This article develops a mechanism-based theory of open development as a distinct, knowledge-centered development paradigm grounded in endogenous growth theory and the economics of knowledge. Although open development is widely invoked in policy and practice through initiatives such as open data, participatory platforms, and open educational resources, its conceptual boundaries and developmental logic often remain underspecified, leading it to be conflated with digital development more broadly. To address this gap, the article defines open development narrowly as development processes organized around institutionalized openness, including reusable knowledge resources, participatory knowledge production, and networked diffusion. It identifies three core mechanisms through which openness may shape development outcomes: expanded access and usability of knowledge, networked recombination and diffusion, and feedback-driven collective learning. Drawing on interdisciplinary scholarship in development studies, endogenous growth theory, ICT4D, and human development, the article explains how these mechanisms may contribute to capability expansion, inclusion, resilience, and institutional responsiveness in African contexts. At the same time, it argues that these outcomes are contingent on governance arrangements, power relations, participation capacity, and ethical safeguards. Analytical illustrations are used to clarify theory–practice alignment rather than to claim causal attribution or continent-wide generalization. The article concludes by advancing governed openness as a policy orientation and by outlining implications for mechanism-aligned evaluation and future comparative research.

1. Introduction

International development has undergone a marked shift in both practice and theory as knowledge, information, data, and digital infrastructures have become central to economic and social transformation.

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Development is increasingly understood less as a one-way transfer of capital, expertise, or technology from "developed" to "developing" contexts and more as a relational and institutionally mediated process shaped by local agency, learning, and the circulation of knowledge through domestic and transnational networks (Sen, 1999; Stiglitz, 2011). Within this changing landscape, "open development" has emerged as a prominent but still conceptually unsettled label for development approaches that foreground openness, participation, and networked knowledge production (Bentley, 2014; Smith & Reilly, 2013).

In this article, open development is defined narrowly as development processes organized around institutionalized practices of openness—such as open data, open access to knowledge, open learning resources, open-source collaboration, and ICT-enabled participatory problem-solving—that expand opportunities for locally grounded learning, innovation, and collective action (Bentley, 2014; Smith & Reilly, 2013). This definition is intentionally restrictive because openness is often treated too loosely in the literature, becoming synonymous with "digital development," "ICT4D," or "innovation" even when the underlying interventions do not involve durable arrangements for sharing, reuse, and collaborative knowledge production (Heeks, 2010; Smith & Reilly, 2013). In the present study, open development is therefore treated not as any development intervention that uses digital tools, but as a paradigm in which openness functions as a core institutional principle shaping how development problems are framed, how knowledge is produced and circulated, and how solutions are iteratively refined through networks.

The focus on openness matters because knowledge differs from conventional development resources. Unlike physical capital, knowledge can be shared, adapted, recombined, and diffused through networks without being depleted, and under enabling institutional conditions its circulation can generate cumulative learning and increasing returns (Romer, 1990; Stiglitz, 1999). For this reason, the paper draws on endogenous growth theory and the economics of knowledge to clarify why, and under what conditions, open and networked knowledge practices may matter for development outcomes (Romer, 1990; Mansell, 2014; Stiglitz, 1999). This theoretical anchoring is especially relevant where development outcomes depend heavily on problem-solving capacity, institutional learning, and the ability to adapt external ideas to local constraints rather than importing "best practices" wholesale (Stiglitz, 2011; Stiglitz et al., 2010).

The African policy and development context provides a particularly important setting for this theorization, but it should not be treated as uniform. Across African countries, open data initiatives, mobile platforms, digital public services, open learning systems, and collaborative knowledge networks have attracted considerable policy attention. Yet their developmental effects remain uneven and deeply conditioned by infrastructure, governance, institutional capacity, and social inequality. Recent scholarship on data governance, digital infrastructure, and platform power in Africa has made this especially clear, showing that openness does not operate independently of questions of capability, stewardship, sovereignty, and asymmetrical control over digital systems (World Bank, 2021; African Union, 2022; Chigwada, 2022; Langley & Leyshon, 2022; Osei, 2024; Effoduh, 2025). Research data management scholarship similarly underscores that meaningful openness depends not only on access but also on architectures of metadata, storage, preservation, retrieval, sharing, and reuse (Njagi & Njoroge, 2025). A credible conceptualization of open development therefore requires not

only an account of its promise, but also clear boundary conditions that specify when openness is likely to enhance development capabilities and when it may instead reproduce exclusion, dependency, or capture.

Despite growing scholarly and practitioner interest, the open development literature remains theoretically thin in several recurring ways. First, many studies emphasize descriptive inventories of "open" initiatives—such as open data platforms, crowdsourcing systems, and open educational resources—without clearly specifying the mechanisms that link openness to development processes and outcomes (Bentley & Chib, 2016). Second, openness is frequently treated as a normative agenda—implicitly beneficial because it appears participatory or transparent—rather than as an analytically bounded paradigm with identifiable trade-offs, institutional requirements, and predictable failure modes (Bentley & Chib, 2016; Smith & Reilly, 2013). Third, the concept often expands to cover a wide range of digital interventions, which dilutes its explanatory power by grouping together initiatives with fundamentally different logics (Heeks, 2010; Smith & Reilly, 2013). Fourth, more recent debates on data governance, platform dependency, and digital power in African contexts have not been sufficiently integrated into the theorization of open development, leaving the concept less historically current and less regionally grounded than it should be.

This article addresses these gaps through a conceptual theory-synthesis and theory-elaboration approach. It does not claim novelty through new empirical data; rather, its originality lies in offering a more analytically precise mechanism-based framework for understanding open development than is typically found in the existing literature. Specifically, the article makes four contributions. First, it conceptually discriminates open development from adjacent frameworks by specifying openness as an institutionalized practice of sharing, reuse, participation, and collaborative knowledge production rather than as a loose synonym for digital development or ICT adoption. Second, it systematically links open development to endogenous growth theory and the economics of knowledge, thereby clarifying why openness may matter in developmental terms. Third, it identifies three core mechanisms through which open development may shape outcomes: local knowledge production and recombination, networked learning and diffusion, and iterative problem-solving through participatory feedback loops. Fourth, it clarifies the implications for evaluation and governance by arguing that open development's value is often expressed through capability expansion, resilience, and inclusive access to knowledge and opportunities—outcomes that may not be adequately captured by growth-centric indicators alone.

The study is guided by two questions: (1) How can open development be theorized as a distinct development paradigm relevant to African contexts? and (2) What types of societal benefits, risks, and governance challenges does open development generate that are not well captured by conventional development models and metrics? These questions are pursued through a conceptual theory-synthesis of development theory, ICT4D scholarship, knowledge-based development, and emerging debates on data governance and digital inequality, with analytical illustrations used only to clarify mechanisms rather than to claim causal attribution or continent-wide generalization.

The remainder of the article proceeds as follows. Section 2 establishes the theoretical foundations of open development by integrating endogenous growth theory and the economics of knowledge with development-paradigm debates. Section 3 discusses how these mechanisms may translate into societal outcomes—particularly capability expansion, resilience, and inclusive innovation—while also

examining predictable risks such as exclusion, capture, and uneven participation. Section 4 specifies the core mechanisms and boundary conditions of open development, distinguishing it from neighboring concepts and identifying the institutional and capability requirements that shape its effects. Section 5 uses analytical illustrations to clarify how the framework operates across different openness modalities without claiming uniform applicability across African contexts. The conclusion summarizes implications for research and policy design, emphasizing the need for governed openness that is context-sensitive rather than openness as a universal template.

1.1 Research Design and Methodological Approach

This article adopts a conceptual theory-synthesis and theory-elaboration approach. Its purpose is not to test causal relationships empirically, but to develop a more analytically precise framework for understanding open development as a distinct development paradigm relevant to African contexts. To do so, the study integrates scholarship from development theory, endogenous growth theory, the economics of knowledge, ICT4D, and related work on data governance, networked learning, and participatory knowledge production.

The analysis proceeded in four steps. First, the study delimited the concept of open development from adjacent categories such as ICT4D, digital development, and technological innovation more broadly. Second, it reviewed foundational and contemporary literature to identify recurring claims about how openness may influence development processes and outcomes. Third, these claims were synthesized into a mechanism-based framework centered on access and usability, networked recombination and diffusion, and feedback-driven collective learning, together with the boundary conditions that shape their operation. Fourth, the article uses purposively selected analytical illustrations to examine theory–case alignment across different openness modalities and to clarify both enabling conditions and limitations. These cases are used as analytical illustrations rather than as representative evidence for causal attribution or continent-wide generalization.

This design is appropriate to the article's objectives because the study aims to clarify concepts, specify theoretical relationships, and propose a framework for future empirical investigation. At the same time, the approach has clear limits: the argument remains interpretive and synthetic, and the framework advanced here requires further empirical testing across varied national, sectoral, and institutional contexts.

1.2 Purpose of the Study

This study advances a theory-grounded and conceptually bounded account of open development as a distinct development paradigm relevant to African contexts. Rather than treating openness as a loose label for ICT-enabled interventions, the paper conceptualizes open development as a knowledge-centered approach in which institutionalized practices of openness—such as open access to information, open learning, open data, and collaborative knowledge production—shape how development problems are defined, how knowledge circulates, and how solutions are iteratively refined through networks (Bentley, 2014; Smith & Reilly, 2013). The analysis is anchored in endogenous growth theory and the economics of knowledge, which emphasize learning, innovation, and knowledge

diffusion as internal drivers of long-term development (Romer, 1990; Stiglitz, 1999).

The article pursues three interrelated objectives.

First, it elaborates a stronger theoretical foundation for open development by linking its core principles—openness, participation, and distributed knowledge production—to endogenous growth theory's emphasis on increasing returns to knowledge and learning (Romer, 1990) and to the economics of information's concern with how knowledge is produced, shared, and governed (Stiglitz, 1999). This responds to a persistent limitation in the literature in which open development is often discussed descriptively, as a set of initiatives, or normatively, as inherently desirable, without sufficient explanation of the mechanisms that connect openness to development processes (Bentley & Chib, 2016; Smith & Reilly, 2013).

Second, the paper conceptually discriminates open development from exogenous and neo-classical development approaches by specifying differences in (a) problem framing, (b) knowledge circulation, and (c) value realization. In open development, problems are more likely to be locally articulated and iteratively refined; knowledge circulates through networked diffusion and recombination rather than primarily through expert-led transfer; and value is realized not only through aggregate growth, but also through capability expansion, resilience, learning, and inclusive access to knowledge (Sen, 1999; Stiglitz, 2011; Smith & Reilly, 2013). This discrimination is intended to reduce concept stretching, where open development becomes synonymous with digitalization or innovation even when openness is not institutionalized as a durable practice (Heeks, 2010; Smith & Reilly, 2013).

Third, the study clarifies the developmental implications and boundary conditions of open development in African settings by examining how openness may enable inclusive innovation, transparency, and improved service delivery while also generating predictable risks such as uneven participation, elite capture, and exclusion where connectivity, literacy, or institutional protections are weak (Heeks, 2010; Smith & Reilly, 2013). In doing so, the paper positions open development not as a universal template but as a contingent paradigm whose effects depend on capabilities, governance arrangements, and socio-institutional context.

Taken together, these objectives provide a mechanism-oriented framework that scholars can use to generate more precise empirical propositions and that policymakers can use to design initiatives with clearer assumptions about how openness translates into development outcomes.

1.3 Significance of the Study

This study contributes to development theory and practice by strengthening the analytical foundations of open development at a time when openness, digitalization, and knowledge infrastructures increasingly shape development agendas. Although open development has gained visibility in policy discourse, it is still frequently treated as a bundle of tools—such as open data portals, crowdsourcing systems, and digital platforms—rather than as a coherent paradigm with identifiable mechanisms, institutional requirements, and failure modes (Bentley & Chib, 2016; Smith & Reilly, 2013). By grounding open development in endogenous growth theory and the economics of knowledge, the article provides a clearer theoretical logic for why openness might matter for development and under what conditions it is likely to do so (Romer, 1990; Stiglitz, 1999; Mansell, 2014).

Theoretically, the paper helps address the limits of development approaches that emphasize external inputs and aggregate growth measures while giving insufficient attention to learning dynamics, institutional capability, and the endogenous production and diffusion of problem-solving knowledge (Stiglitz et al., 2010; Stiglitz, 2011). By treating knowledge as a non-rival resource whose developmental effects depend on governance, capability, and social usability, the article aligns development analysis with scholarship on networked societies, learning economies, and capability-based development (Sen, 1999; Stiglitz, 1999; Stiglitz, 2011). This integrative framing also supports more interdisciplinary engagement across economics, ICT4D, development studies, and knowledge infrastructure research.

Empirically and analytically, the paper's significance lies in shifting attention from openness as a principle to openness as a set of institutionalized practices with observable implications. Much work on openness emphasizes transparency or access while leaving unclear how these elements translate into societal outcomes, particularly where institutional constraints and inequality shape who can participate and benefit (Heeks, 2010; Bentley & Chib, 2016). By foregrounding learning capacity, capability expansion, resilience, and inclusive access to knowledge as key outcome domains, the study supports evaluation approaches that move beyond GDP-centric measures and better reflect development as freedom and human well-being (Sen, 1999; Stiglitz, 2011).

For policy and practice, the article offers a more realistic basis for designing and assessing open development initiatives. As governments and development agencies increasingly promote openness, they require conceptual clarity regarding design requirements—such as governance arrangements, infrastructures of stewardship, safeguards against capture, and inclusion strategies—and regarding the boundary conditions that shape whether openness produces equitable benefits. The study therefore avoids treating openness as automatically emancipatory and instead frames it as something that must be governed to produce inclusive outcomes. This point is especially important in African contexts, where openness may intersect with uneven digital infrastructure, dependence on external platforms, weak institutional protections, and differentiated local capacities.

Finally, the study sets an agenda for future research by specifying a mechanism-based framework that can be tested comparatively across sectors and countries and by clarifying the need for indicators that capture learning, knowledge access, institutional capability, and social well-being alongside economic measures. In this way, the article provides a foundation for more rigorous empirical work on how development theory and evaluation must evolve in increasingly networked and knowledge-driven contexts.

2. Theorizing Open Development

This section develops a mechanism-oriented theorization of open development by integrating three strands of scholarship: (i) development as structural transformation, (ii) endogenous growth theory and the economics of knowledge, and (iii) work on networked learning and ICT-mediated participation. The aim is not to restate a normative claim that "openness is good," but to clarify why and under what conditions institutionalized openness can shape development processes and outcomes (Romer, 1990; Smith & Reilly, 2013; Stiglitz, 1999). In line with the article's conceptual theory-synthesis

approach, the discussion proceeds by specifying the developmental problem, clarifying the knowledge dynamics emphasized by endogenous growth theory, and then showing how open development extends these dynamics into a distinct and conditional development paradigm.

2.1 Development as Structural Transformation and Knowledge-Centered Change

Development has long been conceptualized as structural transformation—a multidimensional process involving shifts in productive structures, institutions, human capacities, and social relations rather than economic expansion alone (Bellù, 2011; Thomas, 2000). Earlier development thinking emphasized historical transitions, such as movement from agrarian to industrial systems, together with the institutional reorganization that accompanies such shifts (Deane, 1980; Gore, 2000). Over time, however, dominant neo-classical approaches increasingly narrowed development to aggregate growth, often proxied by GDP and related macro-indicators, thereby prioritizing capital accumulation and market efficiency over learning, institutional capability, and distributional dynamics (Arndt, 1987; Todaro & Smith, 2003).

This narrowing matters for open development because the mechanisms it highlights are not reducible to capital deepening. Neo-classical and exogenous growth accounts typically treat technological change as external to the model, imported through foreign investment, expertise, and technology transfer (Solow, 2000; Todaro & Smith, 2003). Yet persistent inequality, uneven outcomes, and institutional fragility in many low- and middle-income settings have revealed important limits to externally driven, expert-led approaches, especially where locally embedded knowledge and adaptive capacity shape whether interventions are adopted, modified, or resisted (Birdsall et al., 1995; Stiglitz et al., 2010). These limitations motivate alternative frameworks that place knowledge production, diffusion, and learning at the center of development dynamics.

A knowledge-centered understanding of structural transformation is therefore especially relevant to the present argument. Development depends not only on the transfer of resources, but also on whether individuals, communities, and institutions can generate, interpret, adapt, and circulate problem-solving knowledge. In this perspective, knowledge is not a secondary byproduct of development; it is one of its constitutive drivers. This shift is particularly important for African contexts, where the developmental effects of digital systems, open information, and participatory platforms are mediated by infrastructural inequality, institutional capacity, and the politics of access and control. Recent work on data governance and digital transformation in Africa underscores that information-based development depends not simply on availability, but on stewardship, standards, interoperability, and the social capacity to turn data into usable knowledge (African Union, 2022; World Bank, 2021).

2.2 Endogenous Growth Theory and the Centrality of Knowledge

Endogenous growth theory offers an analytical departure from exogenous models by treating technological change and knowledge accumulation as internally generated and socially organized rather than as residual “manna from heaven” (Romer, 1990; Jones, 2004). Its central insight is that knowledge has distinctive properties: it is non-rival, meaning that one actor’s use does not

diminish others' use, and often partially non-excludable, allowing spillovers and increasing returns when institutions enable learning and diffusion (Romer, 1992; Stiglitz, 1999). This shifts attention from scarcity-based allocation to the societal and institutional conditions that shape who learns, how knowledge circulates, and how innovation is sustained.

The implications for development are twofold. First, development becomes a cumulative process driven by learning, experimentation, and adaptation rather than merely by resource inflows or standardized policy prescriptions (Stiglitz & Greenwald, 2014). Second, the theory foregrounds institutions and networks that lower the costs of sharing and recombining knowledge, because these conditions shape whether spillovers translate into broad-based capability enhancement or remain concentrated among already advantaged actors (Stiglitz, 1999). For African contexts, this emphasis is especially salient: if knowledge and learning are central drivers of development, then strategies that rely primarily on external transfer may underperform where local capacities, legitimacy, and institutional fit are weak (Stiglitz et al., 2010).

Endogenous growth theory is thus highly useful for understanding why knowledge matters developmentally, but it is not sufficient on its own for theorizing open development. It explains why learning, innovation, and spillovers matter, but it does not fully specify how participation, governance, digital mediation, and knowledge-sharing rules structure those processes in practice. Nor does it adequately address the political and infrastructural inequalities that affect who can access, contribute to, and benefit from knowledge circulation. For that reason, moving from endogenous growth to open development requires a further conceptual step: specifying how openness reorganizes the production, circulation, and improvement of knowledge within development processes.

2.3 From Endogenous Growth to Open Development

Open development extends endogenous growth logic by specifying how knowledge dynamics operate in networked societies and by treating openness as an institutional principle that structures participation, diffusion, and problem-solving (Smith & Reilly, 2013). Whereas endogenous growth theory emphasizes knowledge as a driver of long-run growth, open development emphasizes the governance and circulation of knowledge: who can access it, contribute to it, reuse it, and collectively improve it through open, networked practices (Bentley, 2014; Smith & Reilly, 2013).

Two clarifications are essential for conceptual precision. First, Open development is not synonymous with ICT4D or digital development more broadly; rather, like peer production, it depends on organizational forms that decentralize problem definition and execution, draw on diverse motivations, and partially separate governance from exclusive property control (Benkler, 2016; Smith & Reilly, 2013). ICTs may facilitate open development, but technology adoption alone does not constitute openness. Open development requires institutionalized practices that enable sharing, reuse, transparency, and collaborative production of knowledge (Bentley, 2014; Smith & Reilly, 2013). Second, open development is not a claim that openness is universally beneficial. Rather, it is a claim that openness can alter mechanisms of development by reorganizing knowledge production and circulation, but always under identifiable boundary conditions.

Mechanistically, open development can be theorized as operating through three linked processes.

First, access and usability. Openness can increase the availability of information and learning resources, potentially lowering barriers to entry for actors previously excluded from knowledge and problem-solving spaces (Heeks, 2010; Thompson, 2008). However, access alone is insufficient. Information must also be interpretable, socially usable, and supported by durable infrastructures for storage, preservation, retrieval, sharing, and reuse. In this respect, recent research data management scholarship usefully reinforces the argument that openness depends not only on disclosure, but on architectures that make knowledge practically usable over time (Njagi & Njoroge, 2025).

Second, networked recombination and diffusion. Diverse actors can adapt, remix, and disseminate ideas across social and technical networks, thereby strengthening spillovers and iterative improvement (Romer, 1992; Smith & Reilly, 2013). The developmental value of openness here lies not merely in transfer, but in recombination: knowledge becomes more productive when it can be reworked across contexts, sectors, and institutional settings. This process is especially important where local actors must modify external ideas to fit local constraints rather than import them unchanged. This mechanism is particularly important under conditions of uncertainty and complexity, where distributed participation can mobilize tacit knowledge, diverse perspectives, and self-directed experimentation more effectively than systems that depend primarily on managerial direction or price signals (Benkler, 2016).

Third, collective learning and feedback. Participatory collaboration can generate feedback loops that identify problems, test responses, and refine solutions in ways more closely aligned with local constraints and aspirations (McFarlane, 2006; Smith & Reilly, 2013). This shifts development agency by moving part of problem identification and solution iteration toward users, communities, and intermediary actors, while still allowing learning across scales. Open development thus aligns with capability-oriented perspectives in which development is evaluated not only through output growth, but also through expanded opportunities, learning capacities, and social inclusion (Sen, 1999; Stiglitz, 2011).

These mechanisms help clarify what this article adds beyond descriptive accounts of “open” initiatives. Open development is not defined here by the mere presence of openness-related tools, but by the proposition that institutionalized openness can reshape development through identifiable knowledge mechanisms. At the same time, these mechanisms remain contingent. Their effects depend on infrastructure, literacy, mediation, and governance, and they may therefore generate uneven or exclusionary outcomes when those conditions are weak.

2.4 Openness, Networks, and Collective Learning

Networks are central to open development because they structure the pathways through which knowledge travels and becomes actionable. Social network perspectives emphasize that relationships among individuals, groups, and institutions shape information diffusion, trust, and coordination—conditions closely tied to innovation and collective action (Liu et al., 2017). In open development, networks function as infrastructures of learning: they enable distributed actors to pool experiential knowledge, connect local insight with external expertise, and coordinate incremental improvement over time (Nieves & Osorio, 2013; Siemens, 2006).

Importantly, learning in networked environments is not strictly hierarchical. Knowledge is produced through interaction among participants with different experiences, skills, and positionalities; this helps explain why open development often emphasizes peer learning, communities of practice, and iterative knowledge-building (Weinberger, 2011; Siemens, 2006). When these processes work, they can reduce the costs of adaptation in resource-constrained settings and improve the fit between solutions and local needs (Boyd et al., 2011).

However, the same networked openness that enables diffusion can also reproduce inequality. Uneven connectivity, disparities in digital literacy, unequal access to institutions, and power asymmetries within networks can determine who participates, whose knowledge counts, and who captures the gains (Castells, 2010; Bentley & Chib, 2016). These are not secondary problems but core boundary conditions of open development. This is particularly important in African contexts, where digital systems often operate amid uneven infrastructure, donor dependency, platform concentration, and fragile public institutions. Recent scholarship on digital governance and platform power in Africa has therefore emphasized that openness must be accompanied by safeguards, mediation, and context-sensitive institutional design if it is to support inclusive development rather than symbolic participation or new forms of dependency (African Union, 2022; World Bank, 2021).

2.5 Open Development as a Distinct Development Paradigm

Synthesizing these strands, open development can be theorized as a development paradigm in which knowledge openness, networked collaboration, and collective learning are treated as primary drivers of development processes. It builds on endogenous growth theory's emphasis on knowledge spillovers and increasing returns (Romer, 1990; Romer, 1992) while incorporating ICT4D insights regarding participation, institutional context, and the social shaping of technology (Heeks, 2010; Smith & Reilly, 2013). Its distinctiveness lies less in technology itself than in the way openness reorganizes development agency, knowledge production, and evaluation criteria (Bentley, 2014; Sen, 1999).

Crucially, this paradigm is conditional rather than universal. Openness is most likely to support equitable development where enabling conditions exist, such as inclusive access, sufficient literacy and skills, trusted intermediaries, accountable governance arrangements, and infrastructures that support knowledge stewardship and reuse (Bentley & Chib, 2016; Heeks, 2010; Njagi & Njoroge, 2025). Where these conditions are absent, open development may generate uneven benefits, amplify voice inequalities, or convert participation into symbolic inclusion without substantive power-sharing (Castells, 2010; Smith & Reilly, 2013). The political economy and governance of openness are therefore not external concerns; they are constitutive of whether open development expands capabilities or reproduces exclusion.

This theoretical specification provides the foundation for the next sections, which examine how the mechanisms and boundary conditions of open development translate into societal outcomes—such as capability expansion, resilience, and inclusion—and how associated risks—such as exclusion, capture, and governance deficits—can be anticipated and evaluated (Sen, 1999; Stiglitz, 2011). Together, these elements form the mechanism-based framework that the article later clarifies through analytical

illustrations rather than for continent-wide generalization. To consolidate the article's theoretical argument, Table 1 summarizes the mechanism-based framework of open development by linking each core mechanism to its enabling conditions, expected outcomes, risks, and governance implications.

Table 4. Mechanism-Based Framework of Open Development

Core mechanism	How the mechanism works	Enabling conditions	Expected development outcomes	Risks / boundary conditions	Governance and evaluation implications
Expanded access and usability of knowledge	Openness lowers barriers to information, learning resources, and problem-solving tools by making knowledge more visible, shareable, and reusable.	Affordable access; connectivity; language accessibility; digital and informational literacy; usable interfaces; metadata, storage, retrieval, and stewardship systems.	Improved access to knowledge; broader participation in problem-solving; capability expansion; reduced information asymmetries.	Information may be available but not usable; exclusion of low-connectivity or low-literacy groups; unequal benefit concentration.	Evaluate not only access, but usability, inclusiveness, and actual uptake; invest in stewardship, translation, accessibility, and low-bandwidth participation channels.
Networked recombination and diffusion	Actors adapt, remix, and circulate ideas across social and technical networks, generating spillovers, innovation, and context-sensitive learning.	Interoperability; open or reusable resources; bridging networks; organizational support; local absorptive capacity; trusted intermediaries.	Local adaptation of knowledge; innovation; wider diffusion of practices; stronger learning ecosystems; institutional and social coordination.	Recombination may be limited by weak capacity, platform dependency, enclosure, or unequal control over infrastructure.	Evaluate reuse, adaptation, and cross-sector diffusion; support open standards, portability, and local institutional capacity to reduce dependency and lock-in.
Feedback-driven collective learning	Participatory systems create channels through which users, communities, and institutions identify problems, contest existing practices, and refine interventions iteratively.	Responsive institutions; safe participation; trusted mediation; verification systems; political openness; incentives for institutional uptake.	Greater institutional responsiveness; improved fit between interventions and local needs; resilience; accountability; iterative improvement.	Participation without influence; symbolic openness; elite capture; misinformation; privacy or surveillance risks; weak institutional response.	Evaluate whether feedback leads to action, adjustment, and accountability; strengthen grievance systems, privacy safeguards, verification, and institutional response capacity.
Cross-cutting principle: Governed openness	Openness creates developmental value only when access, participation, and reuse are supported by accountable governance and ethical safeguards.	Inclusion strategies; privacy protections; interoperability; sustainability planning; local stewardship; adaptive monitoring.	More equitable and durable development gains; context-sensitive openness; reduced harm and exclusion.	Ungoverned openness may reproduce inequality, create misinformation risks, deepen dependency, or expose vulnerable groups to harm.	Use mechanism-aligned, mixed-method evaluation; differentiate responsibilities across governments, donors, civil society, and platform actors; recalibrate openness when

					risks emerge.

3. Open Development and Societal Outcomes

This section specifies how open development's knowledge dynamics translate into societal outcomes and why those outcomes are often uneven. Rather than treating outcomes as automatic "impacts" of technology adoption, the argument here is that open development operates through identifiable mechanisms—access and usability, recombination and diffusion, and feedback-driven collective learning—whose effects depend on institutional capacity, governance arrangements, and social capabilities (Romer, 1990; Stiglitz, 1999; Smith & Reilly, 2013). The section therefore shifts evaluation away from narrow project outputs and toward process-linked outcome domains: inclusion and institutional responsiveness, capability expansion, and human security and resilience (Sen, 1999; Heeks, 2010; Bentley & Chib, 2016). In doing so, it also foregrounds the structural constraints and boundary conditions that shape whether openness produces broad-based developmental value or uneven and exclusionary effects.

3.1 From Knowledge Dynamics to Developmental Outcomes

A central question for any theory of open development is how openness and networked knowledge practices generate outcomes that matter for development. Conventional development evaluation often privileges aggregate indicators, such as GDP growth, or project-level deliverables, such as platform launches, datasets released, or users reached. Yet such measures frequently under-capture the social and institutional processes through which development is actually produced, experienced, and sustained—especially where learning, adaptation, and institutional responsiveness determine whether interventions endure (Sen, 1999; Stiglitz et al., 2010). Open development therefore requires a different evaluative logic: outcomes should be understood as emergent properties of open and networked systems rather than as linear products of discrete technological interventions.

Mechanistically, three pathways are especially important. First, access and visibility can expand the informational resources available to households, communities, and institutions, thereby lowering search costs, coordination costs, and barriers to entry into problem-solving spaces (Heeks, 2010; Thompson, 2008). Second, recombination and diffusion allow knowledge to be adapted and reused across contexts, strengthening the spillovers emphasized by endogenous growth theory (Romer, 1992; Stiglitz, 1999). Third, collective learning and feedback can improve the fit between interventions and local realities by enabling iterative correction, institutional learning, and participatory refinement (McFarlane, 2006; Stiglitz & Greenwald, 2014). These mechanisms do not guarantee uniform benefits. Their effects are mediated by literacy, infrastructure, political openness, governance quality, and the distribution of organizational and technical capacities (Bentley & Chib, 2016; Castells, 2010).

This mechanism-based perspective matters because it prevents open development from being evaluated only in terms of presence or scale—for example, whether a platform exists or how many users it attracts. Instead, it asks whether openness actually changes how knowledge is accessed,

interpreted, reused, and translated into collective action or institutional response. Developmental value, in this view, is not exhausted by the availability of information; it depends on whether knowledge becomes socially usable and institutionally consequential.

3.2 Social Development: Inclusion, Participation, and Institutional Responsiveness

Open development is often justified in social-development terms because it appears to widen participation in public problem-solving and to strengthen accountability through transparency, monitoring, and collaborative knowledge production (Smith & Reilly, 2013). Where openness is institutionalized through accessible information, usable interfaces, participatory platforms, and transparent feedback channels, it can lower barriers to civic engagement and create additional opportunities for marginalized groups to articulate needs, contribute experiential knowledge, and scrutinize service delivery (Heeks, 2010; Benkler, 2006).

However, participation should be understood as a capacity-mediated mechanism, not as an automatic democratic good. Meaningful participation depends on who can access networks, interpret information, mobilize organizational support, and translate voice into influence (Bentley & Chib, 2016; Castells, 2010). Open systems may therefore generate what might be called a participation without redistribution problem: nominal access widens, but effective influence remains concentrated among actors with higher digital literacy, stronger organizations, greater political proximity, or better command of institutional language. In such settings, openness may increase visibility without improving responsiveness, or it may create new opportunities for capture by already advantaged groups.

For this reason, social-development outcomes in open development are contingent on mediation and institutional incentives. Openness is more likely to enhance inclusion and responsiveness where intermediaries help translate information into action, where participation is designed in ways that reduce exclusion, and where public institutions possess both the willingness and the capacity to respond to feedback. Recent African debates on data governance and digital public systems reinforce this point: transparency and access alone are insufficient where governance systems do not support accountability, interoperability, trust, and equitable participation (African Union, 2022; World Bank, 2021). Social-development gains therefore depend not simply on making systems more open, but on making participation more meaningful and institutionally consequential.

3.3 Human Development and Capability Expansion

Open development also aligns closely with human development approaches that define development as the expansion of substantive freedoms and capabilities rather than income growth alone (Sen, 1999; UNDP, 2017). By widening access to knowledge, learning resources, and communication networks, open development can strengthen individuals' and communities' capacities to acquire skills, make informed choices, and adapt livelihoods under changing conditions. From an endogenous growth perspective, these micro-level gains matter because they contribute to broader societal learning capacity and innovation potential (Romer, 1990; Stiglitz & Greenwald, 2014).

The capability effects of open development are most plausible when openness reduces informational scarcity and supports iterative learning—for example, through access to educational resources, health

information, agricultural knowledge, legal guidance, or market intelligence that can be adapted and reused locally (Heeks, 2010; Smith & Reilly, 2013). Yet capability expansion is not reducible to access. It depends on a wider ecology of enabling conditions, including literacy, language accessibility, time, social norms governing participation, and institutional supports that convert knowledge into actionable options (Bentley & Chib, 2016; Sen, 1999). In contexts where these complements are weak, open initiatives may create information abundance without expanding real freedoms.

This distinction is particularly important for African contexts, where infrastructural and institutional unevenness often shapes who can benefit from digital and open systems. Recent work on digital infrastructure and innovation in Africa suggests that information-based development is highly sensitive to complementary human-capital and institutional conditions, rather than being a straightforward product of technological availability alone (Osei, 2024). Open development may therefore contribute to capability expansion, but only when openness is embedded within wider investments in learning, mediation, and inclusive institutional design. Otherwise, shared resources may primarily benefit already-skilled or already-connected groups, amplifying rather than reducing inequality.

3.4 Human Security and Resilience

Beyond social and human development, open development has important implications for human security and resilience—understood as protecting fundamental freedoms and enabling individuals and communities to manage risks and shocks with dignity (CHS, 2003; UN, 2009). Open and networked information systems can support early warning, rapid dissemination of guidance, coordination among communities and service providers, and faster adaptation during crises such as epidemics, food insecurity, displacement, or environmental shocks. In such settings, one of the developmental advantages of openness is temporal: it can reduce delays in information flows and improve the speed of collective response (Heeks, 2010; Thompson, 2008).

At the same time, resilience gains should not be romanticized. Open systems can generate vulnerabilities alongside protections. Misinformation, privacy violations, political misuse of data, and weak safeguards for sensitive populations may undermine trust and expose already vulnerable groups to new risks (Bentley & Chib, 2016; UN, 2009). Dependence on digital infrastructures can also deepen insecurity where connectivity is unreliable or uneven, producing what may be termed resilience gaps between connected and unconnected populations. These concerns are especially salient where digital infrastructures are externally dependent or weakly governed, because openness without protection may widen exposure rather than strengthen security.

Human security outcomes therefore depend on whether openness is accompanied by trusted intermediaries, privacy protections, accountable governance, and infrastructures that remain usable during crisis conditions. This reinforces the article's broader argument: open development should be understood not simply as a mechanism of access, but as a governance problem involving the conditions under which shared information can be translated into safe and inclusive collective action.

3.5 Rethinking Development Outcomes Beyond Economic Metrics

A defining implication of open development is evaluative. It challenges growth-centric measures

by highlighting outcomes expressed through learning capacity, inclusion, responsiveness, and resilience —domains that are often under-measured by conventional development indicators (Sen, 1999; Stiglitz, 2011). This is not an argument against economic growth. Rather, it is an argument that growth is mediated by knowledge dynamics and institutional learning, and that these processes may be developmentally significant even when short-term income effects are modest or difficult to isolate (Stiglitz et al., 2010; Stiglitz & Greenwald, 2014).

Under this perspective, the core evaluative questions shift from "How much output was produced?" to "How was development generated, through what knowledge processes, and with what distributional consequences?" (Smith & Reilly, 2013; Sen, 1999). Evaluation should therefore attend to whether openness expands meaningful access to knowledge, strengthens local learning ecosystems, improves institutional responsiveness, and reduces vulnerability, while also tracking who remains excluded and why (Bentley & Chib, 2016; Heeks, 2010). This line of argument also resonates with research data management scholarship, which emphasizes that access alone is insufficient unless knowledge systems support durable retrieval, preservation, sharing, and reuse (Njagi & Njoroge, 2025).

A more appropriate evaluative framework for open development would therefore include both enabling conditions and outcome domains. Relevant indicators might include not only participation rates or resource availability, but also usability, inclusiveness, institutional uptake of feedback, local adaptation of shared knowledge, and the extent to which open systems reduce rather than reproduce vulnerability. Without such an evaluative logic, open development risks remaining a rhetorical agenda rather than a paradigm with testable claims and measurable mechanisms.

3.6 Uneven Outcomes, Structural Constraints, and Boundary Conditions

Open development does not inherently produce equitable outcomes. Because participation, learning, and reuse are all capacity-mediated, benefits often accrue disproportionately to actors with stronger connectivity, greater skills, more organizational resources, or closer proximity to institutions of power (Castells, 2010; Bentley & Chib, 2016). Structural constraints such as weak infrastructure, limited digital literacy, exclusionary language regimes, restrictive political environments, and low institutional responsiveness can all prevent open practices from translating into broad-based social benefit (Heeks, 2010; Stiglitz et al., 2010).

A mechanism-based framework therefore treats these conditions not as secondary implementation "challenges," but as boundary conditions internal to the theory of open development itself. Openness is most likely to contribute to inclusion, capability expansion, and resilience where enabling conditions exist: accessible infrastructure, investments in skills, governance arrangements that protect participation and privacy, trusted intermediaries, and institutions capable of learning from and responding to feedback (Bentley & Chib, 2016; Stiglitz & Greenwald, 2014). Where these conditions are absent, openness may generate symbolic participation without power redistribution, intensify voice inequalities, or expose communities to new risks.

This point is especially important in relation to African contexts. The article does not assume uniform continental effects. Rather, it treats African settings as heterogeneous environments in which the developmental implications of openness vary according to infrastructure, political institutions,

data governance arrangements, and local mediating capacities. This emphasis on heterogeneity is necessary if open development is to avoid reproducing the same context-blind universalism that it seeks to critique in earlier development models. Recognizing these contingencies positions open development not as a technocratic template, but as a conditional and governance-dependent paradigm whose outcomes depend on how openness is embedded in real institutional and social contexts.

4. Institutional Adoption, Governance, and the Political Economy of Open Development

If open development is theorized as a paradigm organized around institutionalized openness and networked knowledge production, its developmental implications cannot be assessed only at the level of grassroots practice. Durable outcomes depend on how openness is adopted, governed, and politically embedded within states, donors, civil society, and market actors. This section therefore shifts from micro-level mechanisms to the meso- and macro-level conditions that determine whether open development scales as capability-enhancing transformation or is absorbed into conventional, top-down development logics (Smith & Reilly, 2013; Bentley & Chib, 2016). The central claim is that open development is not merely a technical design choice but a political-institutional settlement over information, participation, and value creation (Castells, 2010; Benkler, 2006).

4.1 From Grassroots Innovation to Institutional Uptake

Open development is often associated with bottom-up innovation—community problem-solving, peer learning, and networked collaboration. Yet the sustainability and distributional effects of openness depend heavily on institutional uptake. As open initiatives mature, they intersect with state agencies, donors, and international organizations that shape priorities, funding modalities, and regulatory frameworks. This transition is pivotal: it can enable scaling and durability, but it can also reframe openness as a managerial instrument rather than a shift in development agency (Smith & Reilly, 2013; Heeks, 2010).

Institutional adoption frequently proceeds through open data programs, transparency reforms, and participatory platforms. Such initiatives may expand access to information and create new feedback channels between citizens and institutions. However, the developmental significance of institutional uptake hinges on whether openness changes the underlying rules of knowledge production and use—for example, whether data are released in usable forms, whether communities can interpret and contest official narratives, and whether feedback mechanisms have consequences for decision-making (Bentley & Chib, 2016; Smith & Reilly, 2013). Where openness is implemented primarily as a technical compliance exercise (e.g., data release without usability, consultation without influence), institutionalization may produce symbolic transparency without meaningful redistribution of voice or responsiveness (Heeks, 2010).

4.2 Governing Openness: Power, Participation, and Control

A core theoretical challenge for open development is governance: who governs open systems, by what rules, and in whose interests? Openness is often framed as democratizing, yet access and participation do not automatically translate into equal influence. Power asymmetries persist within open systems because networks are structured by unequal resources, literacy, organizational capacity, and institutional authority (Castells, 2010; Bentley & Chib, 2016). These asymmetries shape which knowledge is recognized as legitimate, whose problems become visible, and whose solutions scale.

Governance is expressed through practical design decisions: data standards, platform interfaces, moderation rules, licensing, interoperability, and the distribution of decision rights. In African contexts, where institutional capacity and regulatory environments vary widely, these governance choices can either widen participation or reproduce exclusion—often privileging urban, educated, and digitally connected groups while marginalizing rural populations or informal knowledge systems (Bentley & Chib, 2016; Castells, 2010). Accordingly, governance should be treated not as "implementation detail" but as the locus where openness becomes political.

Effective governance of open development requires balancing openness with safeguards that support equity and accountability. This includes (a) transparent decision-making about what is opened and how, (b) mechanisms for feedback, contestation, and redress, and (c) sustained investment in capability-building so underrepresented groups can participate meaningfully (Bentley & Chib, 2016; Heeks, 2010). Without such safeguards, open systems risk producing participation without power and transparency without responsiveness.

4.3 The Political Economy of Open Development

Open development operates within political and economic structures that shape the incentives for openness and the distribution of its benefits. Openness can threaten actors who gain from information asymmetries, closed procurement, or discretionary control over resources. As a result, open development may face resistance, selective adoption, or strategic compliance, where data are released in ways that preserve opacity (e.g., partial datasets, poor quality, non-interoperable formats) (Bentley & Chib, 2016; Heeks, 2010). These dynamics help explain why similar "open" reforms yield divergent outcomes across contexts.

At the same time, openness can generate new forms of value creation in data-intensive and knowledge-based sectors, raising questions about who captures that value. Open resources can be commercialized, platformized, or appropriated by actors with capital and technical capability, potentially undermining the inclusive promise of openness (Benkler, 2006; Bishop, 2009). The political economy question is therefore dual: (1) who bears the costs of producing and maintaining open resources, and (2) who captures the economic and political gains enabled by openness.

A political economy lens also clarifies that open development cannot be separated from broader governance regimes. Where civil liberties are constrained, where media and civic space are restricted, or where institutions lack incentives to respond, openness may be limited to technocratic "data release" without enabling accountability or collective action (Castells, 2010; Heeks, 2010). Conversely, where civic space is protected and institutions are capable of learning, open development is more likely to generate meaningful feedback loops and capability expansion (Stiglitz & Greenwald, 2014;

Smith & Reilly, 2013).

4.4 Enabling Conditions for Effective Open Development

Because open development outcomes are mechanism-dependent, effectiveness requires enabling conditions that extend beyond connectivity. Three conditions are particularly important.

First, human capabilities—digital literacy, critical interpretation, and collaborative skills—shape whether access becomes use and whether participation becomes influence (Heeks, 2010; Bentley & Chib, 2016). Second, institutional frameworks must support openness through clear policies, data governance and privacy protections, interoperability standards, and predictable financing for information infrastructures; otherwise, openness becomes episodic and fragile (Bentley & Chib, 2016). Third, social trust and norms of collaboration are critical for sustaining knowledge sharing and collective learning, particularly where historical exclusion or political contestation undermines willingness to participate (Castells, 2010; Smith & Reilly, 2013).

These conditions are unevenly distributed in African contexts, which helps explain the heterogeneity of open development outcomes. Where institutions support learning and responsiveness, openness can strengthen feedback loops between citizens and service providers. Where institutions are weak or exclusionary, openness may generate visibility without remedy or participation without consequence (Heeks, 2010; Bentley & Chib, 2016). The implication is that open development is not a "plug-in" reform; it is a capability- and governance-intensive process.

4.5 Between Transformation and Co-optation: Scaling Without Losing the Paradigm

Institutionalization creates a central paradox for open development. On one hand, engagement with formal institutions can scale successful practices, integrate them into policy processes, and stabilize financing and coordination. On the other hand, institutional adoption can dilute the paradigm by translating openness into a narrow technocratic reform—data portals, transparency checklists, and participation rituals—while leaving power relations and decision rights largely unchanged (Heeks, 2010; Bentley & Chib, 2016).

To preserve analytical clarity, open development should therefore be evaluated not on the procedural presence of "openness," but on whether openness reorganizes (a) development agency (who defines problems and solutions), (b) knowledge flows (who produces, accesses, and recombines knowledge), and (c) distributional outcomes (who benefits and who is excluded) (Smith & Reilly, 2013; Sen, 1999). This perspective distinguishes transformative openness—where feedback loops reshape institutional behavior and expand capabilities—from co-opted openness—where openness is used to legitimize existing hierarchies without meaningful redistribution of voice, learning capacity, or benefit (Castells, 2010; Bentley & Chib, 2016).

In sum, the political economy and governance of openness are not external to open development; they are constitutive of its developmental logic. Whether open development becomes a pathway for inclusive capability expansion or a repackaging of conventional development depends on how openness is governed, financed, and embedded in institutional incentives and power relations (Benkler, 2006; Heeks, 2010; Smith & Reilly, 2013).

5. Analytical Illustrations of Open Development

5.1 Rationale for an Analytical Illustration Approach

This section uses analytical illustrations to show how the proposed mechanisms of open development—institutionalized openness, networked diffusion and recombination, and feedback-driven collective learning—may be observed in practice. The purpose is not causal attribution, impact evaluation, or continent-wide generalization. Rather, the section pursues theory–case alignment: it examines whether and how selected initiatives reflect the distinctive logic of open development and where specific boundary conditions constrain or reshape outcomes (Smith & Reilly, 2013; Bentley & Chib, 2016; Heeks, 2010).

The cases are selected purposively for three reasons. First, they are strongly associated with African contexts and are widely recognized in development scholarship and practice. Second, they represent different modalities of openness, including open-source platforms, open knowledge commons, and open-access data and learning resources. Third, they help surface the governance, capability, and political-economy tensions discussed in the preceding sections. To sharpen conceptual boundaries, the section also includes one widely cited digital development case that is developmentally significant but only partially "open." This boundary case is important because it demonstrates why open development should not be conflated with ICT-enabled innovation in general (Heeks, 2010; Smith & Reilly, 2013).

The section therefore does not claim that these cases are representative of "Africa" as a whole. African contexts are institutionally, politically, and infrastructurally heterogeneous, and the illustrations are used here to clarify mechanisms rather than to infer uniform regional patterns. Their analytical value lies in showing how openness may enable developmental gains in some settings while remaining dependent on mediation, institutional uptake, and safeguards against exclusion in others.

5.2 Mobile Money and Network Effects as a Boundary Case: M-PESA

M-PESA is frequently cited as a transformative digital innovation in Kenya because it reduced transaction costs, expanded access to mobile financial services, and improved households' ability to transfer, store, and mobilize money. Empirical research has linked mobile money access to greater consumption smoothing and poverty reduction for some households, especially where remittance networks and local agent infrastructure are strong (Aker & Mbiti, 2010; Suri & Jack, 2016). In mechanism terms, M-PESA illustrates how dense socio-technical networks can increase everyday economic functionality and enhance the ability of households to manage risk through socially embedded financial flows.

However, M-PESA is best treated here as a boundary case, not as a paradigmatic example of open development. While it is highly networked and developmentally significant, it does not embody openness in the institutional sense used in this article. The platform's core software, governance rules, and data infrastructures are largely controlled within a corporate–regulatory framework, and the underlying data and decision rights are not openly accessible, reusable, or collectively governed.

In other words, M-PESA demonstrates that large-scale digital inclusion and significant capability outcomes do not automatically amount to open development (Heeks, 2010; Bentley & Chib, 2016).

This distinction is analytically important. Without it, the concept of open development risks stretching to include almost any successful digital intervention. M-PESA therefore clarifies a key argument of this paper: openness must be understood not only at the level of user access, but also in terms of how knowledge resources, infrastructures, and rules of participation are governed. A system may be inclusive in use and still remain non-open in its deeper organizational logic. By including M-PESA as a boundary case, the analysis sharpens the conceptual difference between digital development and open development and reinforces the claim that openness is an institutional condition rather than a synonym for scale, innovation, or technological reach.

5.3 Open-Source Crowdsourcing and Collective Intelligence: Ushahidi

Ushahidi, which originated in Kenya, aligns more closely with the logic of open development because it combines bottom-up data generation, public visibility, and an open-source ethos that permits adaptation and reuse across contexts (Norheim-Hagtun & Meier, 2010; Meier, 2012). In contrast to closed or proprietary digital systems, Ushahidi demonstrates how locally generated reports can be transformed into shared informational resources that reduce information asymmetries and support coordination among citizens, civil society actors, humanitarian agencies, and public institutions.

Mechanistically, Ushahidi illustrates all three core processes identified in this article. First, it lowers barriers to participation by enabling distributed users to submit reports from below. Second, it supports recombination by aggregating heterogeneous local inputs into a common visual and informational architecture. Third, it can generate feedback loops when institutions, media actors, or civil society organizations respond to the information generated by participants (Heeks, 2010; Smith & Reilly, 2013). In this sense, Ushahidi provides a closer approximation of open development because openness is embedded not only in access to the platform, but also in the production and circulation of knowledge itself.

At the same time, the case highlights important boundary conditions. Participation is shaped by differential access to mobile devices, connectivity, language, literacy, trust, and freedom from reprisal. Citizen-generated information does not automatically produce accountability or response. Its developmental value depends on whether institutions recognize, verify, and act upon it, and whether intermediaries can translate visibility into decision-making and public accountability (Bentley & Chib, 2016; Castells, 2010). Ushahidi therefore shows both the potential and the limits of open development: openness can widen participation and surface local knowledge, but developmental outcomes remain dependent on governance arrangements that convert shared information into institutional responsiveness.

5.4 Open Knowledge Commons in Practice: Humanitarian Mapping, Open Educational Resources, and Open Agricultural Data

A second cluster of cases illustrates open development through knowledge commons: shared resources governed by open licensing or open-access principles that permit reuse, adaptation, and

collective improvement.

Open humanitarian mapping (OpenStreetMap/HOT). Crisis mapping efforts coordinated through OpenStreetMap and humanitarian mapping communities show how open licensing and volunteer collaboration can generate public geospatial goods where official data are incomplete, restricted, or absent. During the West Africa Ebola outbreak, coordinated volunteer mapping helped address severe base-map gaps, enabling humanitarian actors to navigate and plan in previously under-mapped areas (Moeller & Furhmann, 2015). This case illustrates the mechanism of networked recombination: distributed contributors create reusable data infrastructures that can be updated and repurposed across emergencies and sectors. At the same time, the case also reveals asymmetries in whose spaces are mapped, whose labor is visible, and which needs become legible through the mapping process (Castells, 2010; Bentley & Chib, 2016).

Open educational resources (OER) and learning ecosystems. The African Storybook Initiative offers a useful example of how openness can expand learning resources through open licensing, remixable materials, and local language adaptation (Creative Commons, 2017). More broadly, OER initiatives reflect the principle that educational content can be shared, localized, and iteratively improved rather than distributed only through closed and high-cost channels (UNESCO, 2019). In open development terms, OER can contribute to capability expansion by lowering barriers to access and supporting distributed educational creativity. Yet these benefits remain dependent on teacher capacity, language accessibility, connectivity, curriculum alignment, and institutional support. The existence of open content alone does not ensure educational inclusion or learning gains (Sen, 1999; Heeks, 2010).

Open agricultural data commons (FAO WaPOR). Open development is also evident in open-access data infrastructures that enable actors at different scales to analyze environmental and agricultural conditions. FAO's WaPOR portal provides open access to remotely sensed water productivity data for Africa and the Near East, including downloadable layers and API-supported analysis (FAO, 2025). This case illustrates how open data can support learning, comparison, and decision-making across farmers' organizations, researchers, and public agencies. At the same time, it clearly demonstrates the capability requirement emphasized throughout this article: open data create developmental value only when actors possess the tools, skills, institutional support, and interpretive frameworks necessary to translate information into action (Stiglitz & Greenwald, 2014; Bentley & Chib, 2016).

Taken together, these commons-based illustrations show that open development is not limited to participation platforms alone. It also includes reusable knowledge infrastructures that lower the costs of access, adaptation, and collaborative improvement. Yet in every case, the developmental significance of openness depends on whether resources are socially usable, institutionally supported, and equitably accessible.

5.5 Cross-Case Insights: Mechanisms, Outcomes, and Constraints

Across these illustrations, three cross-case patterns reinforce the article's theoretical claims.

First, the most important outcomes often appear as process-linked capabilities rather than immediately visible income gains. The cases suggest that open development is especially likely to generate benefits

through expanded access to knowledge, improved coordination, stronger learning ecosystems, and greater resilience under uncertainty rather than through easily isolated short-term economic returns (Sen, 1999; Stiglitz, 2011). This supports the article's argument that development outcomes should not be assessed solely through growth-centric metrics.

Second, network effects amplify both opportunity and inequality. Open and networked systems can widen participation, spread information, and facilitate reuse, but they can also deepen disparities where skills, connectivity, and organizational resources are uneven. In other words, openness may broaden the field of participation while still reproducing voice hierarchies and asymmetries in who can actually shape decisions or benefit from shared knowledge (Castells, 2010; Bentley & Chib, 2016). This makes the distribution of capabilities central to how open development should be evaluated.

Third, institutional responsiveness and governance are decisive. Open platforms and knowledge commons generate durable social value when institutions or trusted intermediaries translate shared knowledge into decisions, services, and accountability, and when protections exist against exclusion, capture, or misuse (Heeks, 2010; Smith & Reilly, 2013). Where those mediating arrangements are weak, open systems may remain symbolically participatory while having limited effect on actual problem-solving or redistribution.

The boundary-case role of M-PESA is especially important in this comparative regard. It shows that developmental significance, scale, and network effects do not by themselves make a case one of open development. This reinforces the paper's insistence that openness must be specified as an institutionalized condition of sharing, reuse, participation, and collective improvement rather than as a loose synonym for digitalization or innovation.

5.6 Implications for Theory and Practice

These illustrations reinforce the article's central claim that open development operates through knowledge openness, networked diffusion and recombination, and collective learning, broadly consistent with endogenous growth perspectives that emphasize the developmental significance of knowledge under enabling institutional conditions (Romer, 1990; Stiglitz, 1999; Stiglitz & Greenwald, 2014). At the same time, the cases show that these mechanisms are not self-executing. Their developmental effects depend on governance design, institutional uptake, and investment in human and organizational capabilities.

For theory, the cases support a move away from descriptive inventories of "open initiatives" and toward mechanism-oriented propositions. More specifically, they suggest that openness is most likely to expand capabilities where:

(a) knowledge resources are genuinely reusable through open licensing or meaningful access arrangements;

(b) participation is supported by capability-building, language access, and inclusive intermediaries; and

(c) institutions can respond to feedback without repression, capture, or procedural exclusion (Bentley & Chib, 2016; Heeks, 2010). These propositions provide a more precise basis for future comparative and empirical research.

For practice, the cases caution against equating open portals, digital access, or platform scale with openness-driven development. Effective open development requires governed openness: governance arrangements that address equity, usability, privacy, stewardship, and sustained institutional learning (Smith & Reilly, 2013; Bentley & Chib, 2016). This implication can be differentiated by actor type. For governments, the key issue is whether public institutions can absorb feedback, ensure interoperability, and protect inclusive access. For donors and development agencies, the issue is whether they support long-term capability-building and maintenance rather than short-lived pilots alone. For civil society and intermediary organizations, the challenge is to translate openness into meaningful participation and accountability. For platform and technology actors, the issue is whether openness is embedded in governance and reuse conditions rather than only in user-facing access.

6. Limitations, Risks, and Ethical Challenges of Open Development

Open development offers a compelling knowledge-centered paradigm, but its developmental value is contingent rather than automatic. As the preceding sections and analytical illustrations have shown, the same mechanisms that make openness potentially valuable—expanded access, networked recombination, and feedback-driven collective learning—also create predictable vulnerabilities when they operate within unequal infrastructures, weak governance systems, and ethically sensitive information environments. A credible theory of open development must therefore specify not only how openness may expand capabilities, responsiveness, and resilience, but also the boundary conditions under which it may reproduce exclusion, dependency, misinformation, or harm. For this reason, this section reframes open development as governed openness: an approach that preserves participation and knowledge sharing while recognizing that openness must be actively designed, governed, and periodically adjusted if it is to remain developmentally and ethically defensible (Bentley & Chib, 2016; Heeks, 2010; Smith & Reilly, 2013).

6.1 Uneven Access and the Reproduction of Inequality

A primary limitation of open development is that openness is always mediated by structural inequality. Participation in open systems depends on connectivity, device access, affordability, literacy, language, gender norms, geography, disability, and time availability. As a result, open systems may widen opportunity while simultaneously amplifying the visibility, influence, and benefits of already advantaged actors (Bentley & Chib, 2016; Castells, 2010). In such cases, openness expands the field of participation without redistributing the underlying capacities required for meaningful participation.

This problem follows directly from the mechanism-based argument developed earlier in the article. Access and visibility matter only when people are able to convert them into socially usable knowledge and actionable participation. A governed-openness approach therefore treats participation capacity as a design variable rather than an assumption. In practical terms, this means that open development initiatives should not rely exclusively on high-bandwidth digital participation. Multi-channel archi-

tectures—such as SMS/USSD pathways, low-bandwidth interfaces, offline contribution with later upload, community radio mediation, and facilitation through trusted local organizations—can make open systems less dependent on continuous connectivity and more compatible with resource-constrained settings (Heeks, 2010).

Inclusion also requires explicit investment. Budgeted "inclusion packages," including last-mile access support, shared access points, device-lending schemes, accessibility features, and digital literacy support, can help prevent open development from simply mirroring pre-existing inequalities (Sen, 1999; Bentley & Chib, 2016). Just as importantly, equity-sensitive monitoring should track who participates and who benefits across key groups so that exclusion becomes visible early enough to trigger corrective action.

6.2 Power Asymmetries and the Governance of Open Systems

Openness does not eliminate power relations; it reorganizes them. Control over platforms, standards, technical architectures, and rules of participation may remain concentrated in governments, donors, firms, or technically privileged intermediaries even when initiatives are publicly described as open (Benkler, 2006; Bishop, 2009). Similarly, the politics of classification—what is counted, which categories are used, whose knowledge is recognized, and what forms of evidence are treated as legitimate—shapes the distribution of attention and resources within open systems (Bentley & Chib, 2016; Castells, 2010). These issues are particularly important in African contexts, where institutional capacity, donor influence, and platform dependency often shape how "openness" is implemented and whose priorities it serves.

A more credible model of open development therefore requires institutionalized governance arrangements rather than informal assumptions of fairness. In this regard, Benkler (2016) usefully argues that governance in peer-production systems must preserve freedom to operate for an open class of potential contributors, elicit prosocial and intrinsic motivations, and coordinate collective action without undermining the motivational basis of participation. Multi-stakeholder governance structures can help reduce capture where community representatives, civil society actors, public institutions, and technical stewards share oversight under transparent and reviewable rules (Smith & Reilly, 2013). Interoperability and portability standards are also important because they reduce enclosure, limit vendor lock-in, and preserve exit options when technical or governance arrangements become exclusionary (Benkler, 2006). Where feasible, locally legitimate institutions—such as municipalities, universities, cooperatives, libraries, or community-based organizations—can serve as data or knowledge stewards, anchoring openness in institutions that are more directly accountable to affected communities. Governance legitimacy also requires accessible grievance and redress mechanisms through which exclusion, misuse, or procedural bias can be contested and addressed.

6.3 Data Ethics, Privacy, and Security Risks

Open development often relies on the collection, storage, processing, or circulation of potentially sensitive information, including health, financial, biometric, educational, or location-based data. In contexts where legal protection is weak, civic space is constrained, or vulnerable populations face

stigmatization, such data may be used for surveillance, exclusion, discrimination, or political targeting (UN, 2009). Ethical failures do not merely create external "risks"; they can undermine trust, reduce participation, and damage the collective-learning processes on which open development depends (Heeks, 2010).

For that reason, open development should not be equated with full public release of all information. Governed openness implies tiered openness: some resources may be openly accessible, others conditionally shared, and some protected through controlled access arrangements. Privacy-by-design principles are essential here, including data minimization, anonymization or aggregation where appropriate, separation of identifiers, secure storage, access controls, and clear breach-response procedures. Research data management scholarship similarly emphasizes that openness depends on durable and well-governed architectures of storage, retrieval, preservation, sharing, and reuse rather than simple disclosure alone (Njagi & Njoroge, 2025).

Consent and communication must also be context-sensitive. Local-language materials, non-textual or oral explanations where literacy varies, and culturally legitimate consent procedures can strengthen ethical validity in settings where standardized consent forms may be insufficient or exclusionary. These safeguards do not contradict open development. Rather, they make openness socially sustainable by ensuring that shared information supports capability expansion without exposing vulnerable populations to avoidable harm.

6.4 Misinformation, Quality Control, and Epistemic Risks

Because open development frequently relies on user-generated content, decentralized reporting, or collaborative knowledge production, it faces epistemic risks that closed expert-led systems often manage differently. These include misinformation, manipulation, uneven quality, selective reporting, and strategic disinformation. While collective intelligence can generate valuable knowledge, it can also distort decisions, erode trust, or intensify social tensions when verification is weak—especially during crises or politically polarized moments (Weinberger, 2011). This is a central challenge for any theory that values openness without romanticizing it.

A governed-openness approach therefore requires epistemic governance. Verification systems should preserve participation while strengthening reliability. Layered models may combine peer confirmation, trusted local validators, professional review, and transparent correction procedures, thereby avoiding both naïve openness and rigid gatekeeping (Heeks, 2010). Provenance features—timestamps, source indicators, confidence tags, and visible revision histories—can also help users interpret information more carefully. Most importantly, quality control should feed back into learning rather than merely policing contributors. Transparent correction logs and contributor feedback help maintain participation while improving the epistemic quality of the system. During emergencies, however, stronger verification thresholds and constrained dissemination pathways may be ethically justified where misinformation could create immediate harm (UN, 2009).

6.5 Sustainability and Dependence on External Actors

Sustainability is a persistent limitation because many open development initiatives depend on

short-term donor funding, temporary partnerships, and external technical expertise. This can weaken continuity, erode institutional memory, and reproduce the dependency relations that open development is often expected to overcome (Heeks, 2010; Smith & Reilly, 2013). If open infrastructures are not maintained, updated, and institutionally embedded, openness becomes episodic rather than developmental, limiting cumulative learning and long-term capability effects.

A more durable approach requires planning for sustainability from the outset. Open systems should be embedded within ministries, municipalities, universities, libraries, cooperatives, or other locally legitimate institutions with clear mandates, staff responsibilities, and budget lines. Hybrid financing arrangements—combining public funding, service agreements, partnerships, membership models, or cross-subsidization—may reduce dependence on a single donor cycle. Technically, open-source cores and investment in local developer and maintenance ecosystems can improve maintainability while strengthening local control over the evolution of the system (Benkler, 2006; Stiglitz & Greenwald, 2014). In this respect, sustainability is not merely a managerial concern; it is part of whether open development genuinely supports endogenous capacity-building.

6.6 Ethical Tensions Between Openness and Control

Open development necessarily involves ethical tension. Unregulated openness may expose people to privacy harms, appropriation, exclusion, or disinformation, whereas excessive control may suppress participation, re-centralize authority, and undermine the very collaborative mechanisms that make open development distinctive (Sen, 1999). This tension is not peripheral; it is constitutive of the paradigm itself. The practical question is therefore not whether development should be "open" or "closed" in absolute terms, but what should be open, to whom, under what conditions, and with what protections.

This article proposes governed openness as a guiding principle for resolving that tension. Governed openness distinguishes among fully open, conditionally shared, and protected forms of knowledge according to context-sensitive risk assessment (Bentley & Chib, 2016; UN, 2009). Operationally, this can be supported through regular ethical impact assessments that review inclusion risks, privacy and surveillance risks, exclusionary effects, misinformation threats, and unintended downstream uses of information. Rights-based safeguards—non-discrimination commitments, independent oversight, grievance procedures, and privacy protections—help ensure that openness expands substantive freedoms rather than exposing vulnerable groups to new forms of risk or extraction (Sen, 1999; UN, 2009). Where appropriation risks are especially high, context-sensitive licensing and use restrictions may preserve openness while limiting foreseeable harmful exploitation (Benkler, 2006; Bishop, 2009).

6.7 Implications for Evaluating Open Development

The limitations and risks discussed above have direct implications for evaluation. Conventional evaluation frameworks often prioritize short-term outputs—datasets released, users reached, apps deployed, or downloads counted—without adequately capturing open development's more process-oriented outcomes, such as learning, institutional responsiveness, capability expansion, and resilience (Sen, 1999; Stiglitz, 2011). At the same time, celebratory narratives about openness can obscure

governance failures, unequal benefit distribution, and ethical harm.

A more credible evaluation framework should therefore be mixed-method, mechanism-based, and adaptive. Quantitative indicators—such as participation rates, reuse metrics, diversity of contributors, access distribution, or responsiveness times—should be paired with qualitative analysis of learning dynamics, institutional uptake of feedback, capability change, and patterns of exclusion (Stiglitz & Greenwald, 2014). Evaluation should track the mechanisms identified throughout this paper rather than treating openness itself as a proxy for success. This includes monitoring whether knowledge is actually reused, whether networks enable bridging across groups, whether feedback loops produce institutional adjustment, and whether safeguards for privacy, inclusion, and quality function in practice (Liu et al., 2017; Smith & Reilly, 2013).

To make the implications more operational, evaluation should also differentiate among actor types. For governments, evaluation should ask whether open systems improve accountability, interoperability, and responsiveness without deepening exclusion. For donors and development agencies, the key question is whether projects build durable local capacity and stewardship rather than temporary visibility. For civil society and intermediary organizations, evaluation should examine whether openness translates into meaningful participation and representation for marginalized groups. For platform and technical actors, the central issues include portability, transparency of governance rules, usability, and protection against enclosure or misuse. In all cases, periodic learning reviews should allow recalibration when exclusion patterns, misinformation risks, privacy concerns, or sustainability gaps become visible.

Recognizing limitations and embedding safeguards is not a retreat from open development. It is the ethical and methodological condition for making openness a responsible, context-sensitive, and developmentally meaningful paradigm.

7. Conclusion and Implications for Future Research and Policy

This article has developed a mechanism-based and conceptually bounded framework for understanding open development as a distinct development paradigm grounded in endogenous growth theory and the economics of knowledge. By integrating insights from development theory, ICT4D scholarship, and knowledge-based development, the paper moves beyond treating openness either as a descriptive label for a diverse set of initiatives—such as open data portals, crowdsourcing platforms, or open learning resources—or as a normative agenda assumed to be inherently beneficial. Instead, it argues that open development is most productively understood as a paradigm in which institutionalized openness reshapes how development problems are framed, how knowledge is produced and circulated, and how solutions are iteratively refined through networked learning and participatory feedback.

The article's central theoretical contribution lies in clarifying what open development adds beyond broader digital development frameworks. Not all ICT-enabled or digitally mediated innovations qualify as open development. The distinguishing feature is not simply the use of technology, scale of adoption, or developmental significance of an intervention, but whether openness is institutionalized through

meaningful conditions of access, reuse, participation, and collective improvement. By linking this formulation to endogenous growth theory and the economics of knowledge, the article shows why openness may matter developmentally: knowledge is not merely an input to be transferred, but a non-rival and socially productive resource whose value depends on whether it can be shared, recombined, contested, and adapted under enabling institutional conditions (Romer, 1990; Stiglitz, 1999). In this sense, the paper contributes not new empirical data, but a more analytically precise account of the mechanisms through which open development may operate and of the boundary conditions that shape whether those mechanisms produce broad-based developmental value.

The analysis also clarifies open development's distinctiveness relative to exogenous and neo-classical development models. Conventional approaches often privilege external expertise, capital inflows, and growth-centric indicators of success while treating knowledge and learning as secondary or residual factors (Solow, 2000; Todaro & Smith, 2003). In contrast, open development foregrounds local agency, knowledge recombination, networked learning, and feedback-driven institutional adaptation. It therefore directs evaluative attention toward outcomes such as capability expansion, institutional responsiveness, resilience, and inclusive access to knowledge and opportunities—domains that conventional development metrics may under-capture (Sen, 1999; Stiglitz, 2011). The argument is not that economic growth is irrelevant, but that growth alone is an insufficient lens for understanding development in increasingly networked and knowledge-intensive environments.

The analytical illustrations reinforce this theoretical claim while also clarifying its limits. They show that open knowledge commons, participatory platforms, and reusable information infrastructures can reduce information asymmetries, support distributed problem-solving, and strengthen learning ecosystems. At the same time, they also show that these outcomes are contingent rather than automatic. The developmental significance of openness depends on institutional uptake, mediation, governance design, and participation capacity. Openness may widen access yet fail to redistribute influence; it may generate visibility without remedy; and it may reproduce inequality or expose vulnerable groups to privacy harms, misinformation, or elite capture when safeguards are weak. For this reason, the article advances a central normative-analytic implication: the most credible form of open development is governed openness. Under this view, openness remains valuable as a means of expanding learning, coordination, and participation, but only when paired with inclusion strategies, accountable governance, privacy protections, verification procedures, sustainability planning, and adaptive evaluation.

7.1 Implications for Future Research

Several priorities follow from this framework.

First, more empirical research is needed to test the mechanisms and boundary conditions specified in this paper across sectors such as education, health, agriculture, local governance, and digital public service delivery. Comparative and mixed-method designs would be particularly useful in examining when openness strengthens access and usability, recombination and diffusion, and feedback-driven learning—and when it remains procedural, for example in the form of data release without meaningful reuse, participation without influence, or transparency without institutional response

(Heeks, 2010; Stiglitz & Greenwald, 2014). Such work is especially important in African contexts characterized by infrastructural unevenness, varied governance arrangements, and strong cross-country heterogeneity.

Second, future research should develop mechanism-aligned evaluation frameworks. Rather than using openness itself as a proxy for developmental impact, evaluation should measure the actual processes the theory claims to matter: usability of shared knowledge, diversity and inclusiveness of contribution, reuse and recombination of knowledge resources, network bridging across groups, and evidence that institutions learn from and respond to feedback over time (Liu et al., 2017; Stiglitz & Greenwald, 2014). These process indicators should be paired with broader capability-oriented outcome domains, such as learning capacity, resilience, and inclusion, consistent with human development perspectives (Sen, 1999; Stiglitz, 2011).

Third, the political economy and ethics of open development remain under-theorized relative to their policy importance. Future work should examine how standards, licensing, platform governance, data stewardship, and regulatory environments shape who benefits from openness and who bears its risks (Benkler, 2006; Bishop, 2009). In particular, more research is needed on data governance in African settings, including how institutions manage metadata, storage, preservation, retrieval, sharing, and reuse under conditions of unequal infrastructure and uneven state capacity (Njagi & Njoroge, 2025). Research on privacy harms, surveillance risks, and information misuse is also essential if governed openness is to be specified as an ethically feasible development approach rather than a purely aspirational one (UN, 2009).

7.2 Implications for Policy and Practice

For policymakers and practitioners, the central implication is that open development should not be treated as a transparency add-on or as a purely technical digitization strategy. It requires institutional and political design, not only technological deployment.

For national and local governments, the key priority is to ensure that open systems are linked to institutional responsiveness. This means investing not only in connectivity and platform access, but also in participation capacity, interoperability, public-sector uptake of feedback, privacy protection, and trusted local stewardship. Governments should treat openness as part of administrative learning and accountability reform rather than as a symbolic disclosure exercise.

For donors and development agencies, the most important implication is that short-term pilot funding is rarely sufficient. Open development initiatives require sustained support for local capacity-building, maintenance, translation, mediation, and governance. Donors should therefore fund not only innovation and visibility, but also stewardship arrangements, long-term learning systems, and mechanisms that allow local actors to adapt and govern open resources over time.

For civil society organizations, universities, libraries, and other intermediary institutions, the implication is that their role is not merely to disseminate information, but to translate openness into meaningful participation and socially usable knowledge. These actors often provide the mediation, trust, and contextual adaptation necessary for open resources to become relevant to local communities rather than remaining technically available but practically inaccessible.

For platform and technology actors, the central issue is governance. Open development is not achieved simply by extending user-facing access. It also depends on whether technical systems support reuse, portability, transparent rules, inclusive contribution, and accountability in how data and participation are governed. Where such conditions are absent, digital systems may be developmentally useful in some respects while still falling short of open development in the stronger sense advanced in this article.

Across all of these actor groups, policy design should institutionalize governed openness. This includes tiered access regimes, privacy-by-design safeguards, interoperability and portability requirements, inclusive participation channels, locally legitimate stewardship institutions, and adaptive monitoring systems capable of identifying exclusion, misinformation, governance failure, and sustainability gaps early enough to support recalibration. Without these complements, openness risks producing visibility without remedy and participation without influence.

In sum, open development offers a valuable framework for rethinking development in a networked and knowledge-driven world, but its promise does not lie in openness as an end in itself. Its promise lies in whether openness, when governed, enables people and institutions to expand learning, coordinate problem-solving, and shape development trajectories in ways that are locally grounded, socially inclusive, and ethically defensible (Sen, 1999; Smith & Reilly, 2013). Continued theoretical refinement, rigorous empirical testing, and sustained attention to governance, stewardship, and ethics are therefore the conditions under which open development can function as a responsible development paradigm rather than an idealized narrative.

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