THE COMPLEXITY PARADOX: WHY DIGITAL STARTUPS SIMPLIFICATION EFFORTS GENERATE ESCALATING ORGANISATIONAL DEMANDS

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Jose Martin Dip, MBA

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by

Jose Martin Dip

Supervised by

Dr. Anna Prodovnikova

APPROVED BY

Apostolos Dasilas

A.Dasilas

Dissertation chair

RECEIVED/APPROVED BY:

Renee Goldstein Osmic

Admissions Director

Dedication

This work is dedicated to the people who made me who I am, and who somehow survived this journey with me.

To my grandmother, whose love, strength, and quiet wisdom live in me every day.

To my mum and dad, for believing in me even when I doubted myself, and for being my constant foundation.

To my sisters, Pau and Sol, my favourite people in the world, my reality check, and my forever teammates.

To my aunts, Vivi, Tina, and Yu, thank you for your presence, your care, and for always being there in the ways that truly matter, and at exactly the right moments.

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This thesis may have my name on it, but it belongs to all of you.

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ABSTRACT

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Jose Martin Dip
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Dissertation Chair: Dr. Luka Lesko
Co-Chair: Dr. Apostolos Dasilas

Digital-native ventures face a paradox: tools meant to simplify operations generate complexity. Buffer's platform count grew from 12 to 47 in six years, and GitLab's from 8 to 127 over a decade, with platform-related work consuming 28-35% of engineering capacity that should support product development (Buffer, 2020; GitLab, 2021). Traditional organisational theory offers little explanation. Lifecycle models suggest that growing firms move toward stability; platform scholarship emphasises how digital tools reduce coordination costs; and institutional theorists argue that conformity reduces uncertainty. Yet digital startups experience precisely the opposite.

This research identifies three mechanisms driving recursive complexity. Digital artefact genealogy explains how each platform adoption spawns 2 to 4 descendant technologies across 5 to 7 generations. When Buffer adopted Salesforce, it required integration

middleware, which needed governance protocols, which demanded monitoring tools. Institutional logic cascading shows how conformity amplifies exposure. GitLab's SOC 2 certification attracted the GDPR authorities, then labour regulators, and finally tax agencies, each with incompatible requirements. Liquid-solid oscillation acceleration describes why restructuring intervals compress from 4 years to quarterly cycles.

Using digital process archaeology to reconstruct organisational evolution through versions, handbooks, code repositories, and timestamped documentation, the study tracked six digital ventures (GitLab, Buffer, Zapier, Notion, Airtable, Figma) over 6-11 years with temporal precision that retrospective interviews cannot provide.

These mechanisms compound synergistically. Complexity is embedded in approximately 40 platforms and 10 institutional domains, regardless of business model. The resulting framework enables founders and investors to diagnose genealogical risks, map institutional exposure, and implement temporal governance, transforming complexity from invisible tax into a manageable dynamic.

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CHAPTER I:

INTRODUCTION

1.1 The recursive complexity puzzle

When Buffer's leadership reviewed its infrastructure dashboard in March 2019, they confronted a phenomenon that defies organisational theory: the company was managing 47 separate platforms, almost four times the 12 they had intentionally adopted just three years earlier to streamline operations (Buffer, 2020). More troubling, these tools consumed 28-35% of engineering capacity, the very resource they were intended to liberate for product development (GitLab, 2021). This is the Recursive Complexity Paradox: rational simplification efforts systematically generate escalating organisational demands.

This pattern contradicts organisational scholarship. Lifecycle models predict progression from chaos toward bureaucratic stability (Greiner, 1972; Quinn and Cameron, 1983). Digital organising scholarship suggests that platforms simplify coordination through modularity and interoperability (Orlikowski, 2000; Yoo et al., 2010). Institutional theory predicts that conformity reduces uncertainty and enhances legitimacy (DiMaggio and Powell, 1983). Yet, digital-native ventures experience the inverse.

This dissertation investigates how and why deliberate simplification intensifies organisational complexity in digital-native startups. The explanation cannot be resource scarcity, managerial incompetence, or technical deficiency (Penrose, 1959); it must concern a fundamental aspect of digital organising (Orlikowski, 2000; Kallinikos et al., 2013). Three self-reinforcing mechanisms operate together: digital-artefact genealogy (Arthur, 1989; Vergne and Durand, 2010), institutional-logic cascading (DiMaggio and Powell, 1983; Thornton et al., 2012), and liquid-solid oscillation (Bauman, 2000; Smith and Lewis, 2011). In combination, these mechanisms produce complexity spirals that resist stabilisation.

This constitutes a strategic management problem because recursive dynamics reshape capability development, governance choices, and the allocation of scarce managerial attention under growth (Penrose, 1959). If complexity is endogenously generated through seemingly rational decisions, strategy must address not only market positioning but also the recursive dynamics of organising itself.

1.2 The Research Problem and Purpose

This dissertation answers one question: Why do digital-native ventures experience recursive complexity despite, and because of, deliberate simplification efforts? Three objectives structure this inquiry: (1) identify the generative mechanisms through which platform adoption, legitimacy-seeking, and restructuring create rather than resolve coordination demands. (2) Clarify why these mechanisms intensify instead of stabilising over time. (3) Outline the boundary conditions that determine when recursion becomes unsustainable versus manageable.

To reduce ambiguity, this dissertation consistently uses several terms. Platforms refer to SaaS tools and digital systems ventures adopt to coordinate work and scale operations, including integrations and governance layers necessary for reliable function (Yoo et al., 2010; Tiwana et al., 2010). Formalisation means deliberate efforts to stabilise coordination through roles, routines, governance, documentation, and compliance, often via digital infrastructure and managerial systems (Greiner, 1972; Weber, 1947). Complexity refers to increasing organisational demands, maintenance, governance, compliance, and restructuring work that consume capacity intended for product development and growth (Kallinikos et al., 2013; Buffer, 2020).

1.2.1 Theoretical Development.

This research develops *recursive formalisation* as a framework explaining how startups face increasing organisational complexity through self-reinforcing processes. The thesis specifies three generative mechanisms operating across technological, institutional, and temporal dimensions. Digital artefact genealogy explains platform proliferation as each adoption spawns multi-generational descendants (Arthur, 1989; Hanseth and Lyytinen, 2010; Vergne and Durand, 2010). Institutional logic cascading reveals how conformity-driven legitimacy gains expand rather than constrain institutional exposure (Meyer and Rowan, 1977; DiMaggio and Powell, 1983; Thornton et al., 2012). Liquid–solid oscillation acceleration describes how ventures cycle increasingly rapidly between flexible and formal structures, compressing restructuring intervals and producing 'organisational vertigo' (Bauman, 2000; Smith and Lewis, 2011; Buffer, 2020). Chapter 5 develops each mechanism in detail and formulates propositions linking them to recursive complexity.

1.2.2 Empirical Grounding

Empirically, the research reconstructs formalisation journeys across six digital-native ventures using replication logic (Yin, 2018): four core cases analysed in depth (Chapter 4) plus two extension cases that test mechanism robustness under contrasting conditions (Chapter 7). Cases span 6-11 years (2010-2022), encompassing bootstrapped and venture-funded models, steady and hypergrowth trajectories, and standard and radical transparency architectures (see Table 1.1).

Using digital process archaeology, it mines versioned handbooks, code repositories, product roadmaps, engineering blogs, public talks, and press materials to map infrastructure decisions, institutional encounters, and structural reorganisations with temporal precision (Rogers, 2013; Marres and Weltevrede, 2013). This approach enables systematic identification of mechanism activation conditions, interactions, and boundary conditions across 6-11-year periods (Langley, 1999; Pentland, 1999).

Table 1.1
Six cases presentation

Case	**Period**	**Funding**	**Growth**	**Transparency**	**Peak Platforms**	**Analysis Chapter**
GitLab	2011-2021	VC – IPO	Hyper	Radical	127	4
Buffer	2010-2021	VC	Steady	Radical	67	4
Zapier	2011-2022	Bootstrapped – VC	Steady	Standard	43	4
Notion	2016-2022	VC	Hyper	Standard	78	4
Airtable	2012-2022	Bootstrapped – VC	Steady	Standard	56	7
Figma	2015-2022	VC - Acquired	Hyper	Standard	74	7

1.2.3 Practical Application.

The research translates theoretical insights into actionable frameworks that enable founders, investors, and ecosystem builders to anticipate genealogical proliferation, manage institutional cascades, and strategically orchestrate oscillations rather than merely react to them. Chapter 6 develops a suite of diagnostic tools, intervention strategies, and meta-capabilities that bridge the theory-practice gap and equip entrepreneurial stakeholders to navigate recursive complexity.

1.3 Research Questions

The main research question is: how and why do digital-native startups experience recursive cycles of organisational formalisation, and what mechanisms drive the intensification of these cycles over time?

Four more focused inquiries follow, structuring the empirical investigation.

RQ1: How do digital infrastructure decisions generate genealogical chains of descendant artefacts, and under what conditions do these chains become irreversible?

RQ2: Through what processes does conformity to institutional demands cascade into multiplying rather than constraining institutional complexity?

RQ3: How do genealogical proliferation, institutional cascading, and oscillation acceleration couple synergistically, and what threshold conditions trigger compound intensification?

RQ4: What organisational capabilities, governance structures, and strategic orientations enable anticipatory recursion management rather than reactive crisis response?

1.4 Significance of the Study

This research makes four interconnected contributions.

Practically, it will translate mechanisms into diagnostic tools that enable founders and investors to anticipate complexity spirals, manage institutional demands, and design for resilience rather than merely react to crises.

Theoretically, it will demonstrate how platform adoption, legitimacy-seeking, and restructuring cycles generate complexity through recursive mechanisms that existing digital organising (Yoo et al., 2010; Orlikowski, 2000), institutional (DiMaggio and Powell, 1983), and lifecycle theories (Greiner, 1972) do not explain.

Empirically, it will provide longitudinal evidence of organisational evolution across six ventures over 6–11 years, revealing patterns that cross-sectional studies cannot capture (Langley, 1999).

Methodologically, it will pioneer digital process archaeology as a protocol for reconstructing organisational change through versioned artefacts, enabling temporal precision that interviews and ethnography rarely achieve (Rogers, 2013; Ventresca and Mohr, 2002).

1.5 Thesis Structure

This thesis comprises eight chapters. Chapter 2 reviews digital organising, institutional, and process literatures, identifying systematic gaps. Chapter 3 details the research methodology, case selection strategy, and digital process archaeology approach. Chapter 4 presents longitudinal reconstructions of 4 cases, identifying recurring patterns across 6-11-year trajectories. Chapter 5 develops the recursive formalisation framework, specifying three mechanisms, their sub-processes, and testable propositions. Chapter 6 articulates theoretical contributions to digital organising, institutional theory, and process theory. Chapter 7 extends analysis through Airtable and Figma cases, conducts a six-case cross-comparison, and refines boundary conditions. Chapter 8 synthesises findings, acknowledges limitations, and charts future research directions.

CHAPTER II:
REVIEW OF LITERATURE

2.1 The Complexity Paradox

Digital-native ventures face three empirical paradoxes: platform adoption intensifies rather than reduces coordination demands, conformity achievements expand rather than constrain institutional exposure and structural formalisation accelerates rather than stabilises organisational change. This chapter explains why existing theory struggles to account for these recursive patterns by identifying systematic gaps across three scholarly traditions: digital organising theory, institutional theory, and process theory. It then positions this dissertation's three mechanisms, digital artefact genealogy, institutional logic cascading, and liquid-solid oscillation acceleration, as responses to those gaps.

Section 2.2 presents three empirical paradoxes. Sections 2.3-2.5 review each tradition's core contributions and identify the specific limitation preventing explanation of recursion: digital organising theory exhibits a genealogy gap (under-theorises multi-generational proliferation), institutional theory exhibits a conformity paradox (treats complexity as external rather than endogenous), and process theory exhibits an oscillation acceleration gap (assumes eventual stabilisation). Sections 2.6-2.7 address these gaps and position the three mechanisms of this research as responses to the identified limitations.

2.2 The Empirical Paradoxes

2.2.1 Paradox 1: Technology Intensifies Coordination Demands

Platform adoption should simplify operations because modularity enhances interoperability, SaaS reduces infrastructure maintenance, and APIs streamline integration

(Yoo et al., 2010). However, digital ventures experience the opposite. Each platform adoption generated descendants that addressed integration needs, governance requirements, and capability gaps, which created genealogies spanning multiple generations. Existing theory cannot explain why modular architectures generate rather than diminish coordination demands through recursive proliferation dynamics.

2.2.2 Paradox 2: Conformity Expands Institutional Exposure

Institutional conformity should reduce uncertainty and enhance legitimacy (DiMaggio and Powell, 1983). Achieving SOC 2 certification satisfies security requirements. Publishing transparency reports demonstrates accountability. Securing Series B funding validates business models. Institutional theory predicts that conformity stabilises organisational fields by signalling adherence to established norms, thereby reducing scrutiny. In practice, however, each conformity milestone amplified rather than constrained institutional attention. GitLab's SOC 2 achievement attracted scrutiny from data protection authorities, labour law authorities, and tax agencies. Theory predicts conformity reduces uncertainty; observations show it amplifies institutional exposure. This conformity-driven cascading gap reveals that legitimacy gains in one domain systematically activate scrutiny in others; a horizontal proliferation dynamic that existing institutional theory does not explain.

2.2.3 Paradox 3: Formalisation Accelerates Restructuring

Organisational structures should stabilise coordination through role clarity, accountability mechanisms, and procedural routines that reduce ambiguity and enable reliable performance (Greiner, 1972; Weber, 1947). Lifecycle theory predicts that ventures progress from informal flexibility toward bureaucratic stability, with each crisis resolved before the next emerges (Quinn and Cameron, 1983).

Digital ventures exhibit the opposite trajectory. Buffer formalised through adopting Holacracy (November 2014), yet restructuring intervals compressed rather than extended. Initial restructuring occurred every four years (2010-2014), then annually (2015-2017), then quarterly (2019-2021); a sixteenfold acceleration despite increasingly sophisticated management practices. GitLab experienced fourfold compression, restructuring every 24 months (2011-2015), then every 12 months (2016-2018), then semiannually (2019-2021). Chapter 4 documents that all six cases exhibited oscillation acceleration, with restructuring frequency increasing 2-4x as ventures matured. Formalisation theory cannot explain why structures fail to solidify despite deliberate stabilisation efforts. Neither lifecycle models (Greiner, 1972) nor paradox theory (Smith and Lewis, 2011) specifies the mechanisms by which liquid-solid oscillations accelerate with organisational maturity. This oscillation acceleration gap requires theorising how temporal compression itself becomes a recursive dynamic.

These three paradoxes reveal systematic gaps across established theoretical traditions. Table 2.1 maps how digital organising theory, institutional theory, and process theory each illuminate aspects of digital venturing while systematically under-theorising specific recursive dynamics. The following sections (2.3-2.5) detail each tradition's contributions and limitations, positioning this research's three mechanisms as direct responses to identified gaps.

Table 2.1
Theoretical Traditions and Systematic Gaps

Tradition	**Core Contribution**	**Key Limitation**	**Specific Gap**	**Recursive Mechanism Addressing Gap**
Lifecycle Theory	Sequential stages from informal to bureaucratic	Assumes linear progression and discrete crises	Cannot explain oscillation without stabilisation	Liquid-solid oscillation acceleration
Digital Organising	Sociomaterial entanglement and generativity	Focuses on single artefacts, not assemblages	Under-theorises multi-generational descendants	Digital artefact genealogy
Platform Ecosystems	External governance and network effects	Privileges platform owners over inhabitants	Neglects internal coordination across platforms	Digital artefact genealogy (assemblage dynamics)
Institutional Theory	Multiple logics and organisational responses	Treats complexity as external imposition	Cannot explain conformity-driven proliferation	Institutional logic cascading
Digital Entrepreneurship	Scaling efficiencies and hypergrowth	Celebrates benefits, neglects costs	Under-examines organisational consequences	All three mechanisms (scaling amplifies each)
Liquid Organisation	Fluidity and structural flux	Describes state, not acceleration process	Cannot explain progressive cycle compression	Liquid-solid oscillation acceleration
Complexity Theory	Emergence and self-organisation	Biological metaphors obscure intentionality	Conflates emergent and engineered complexity	Framework integration (agency + emergence)
Process Theory	Temporal sequences and feedback loops	Emphasises equilibration	Under-specifies persistent positive feedback	All three mechanisms (non-equilibrating dynamics)

2.3 Digital Organising Theory: The Genealogy Gap

2.3.1 Core Frameworks: Sociomateriality and Generativity

Digital organising scholarship has transformed understanding of technology-organisation relationships by showing sociomaterial entanglement: technologies and practices mutually constitute one another through ongoing enactment (Orlikowski, 2000; Leonardi, 2011). Yoo et al. (2010, 2012) theorised a layered modular architecture that enables generativity through component recombination, while Kallinikos et al. (2013) specified digital object properties (editability, interactivity, openness, and distributedness) that explain why artefacts demand continuous organisational labour.

Orlikowski's sociomateriality shows that technologies lack inherent traits; their effects emerge through use (Orlikowski and Scott, 2008, 2015). While this enactment lens captures emergence effectively, it struggles with temporally extended dependencies. When GitLab adopted Salesforce in 2011, that choice constrained platform options in 2015, 2018, and 2021. But sociomaterial scholarship lacks vocabulary for multi-year path dependencies embedded in artefact genealogies.

Leonardi (2011, 2013) advanced this perspective by theorising how material and social agencies interlock through imbrication, the interdependent layering of human and technological actions. Yet like Orlikowski, Leonardi's cases examine individual technologies (automotive design systems, financial trading platforms) in contrast to the multi-platform assemblages that digital ventures navigate.

Yoo et al.'s (2010, 2012) layered modular architecture distinguishes device, network, service, and content layers, showing that loose coupling enables generativity and tight coupling ensures reliability. Their work explains how architectural traits produce change through distributed experimentation. However, it under-theorises governance costs. Each generative layer fosters innovation but also demands supervision and coordination.

GitLab operates across 127 platforms, encompassing all four layers of digital infrastructure: AWS (device layer), Slack (network layer), Salesforce (service layer), and Confluence (content layer). The challenge of governance grows multiplicatively as interactions between platforms across layers generate numerous potential points of integration that must be managed.

Kallinikos et al. (2013) provide deeper insight by examining the ontological characteristics of digital objects. Editability enables ongoing modification without erasing the original. Interactivity allows systems to respond dynamically to different contexts. Openness supports recombination across diverse platforms, while distributedness permits simultaneous access from multiple locations. These properties explain why digital artefacts require ongoing organisational labour; they never achieve stable states and therefore require only maintenance. Yet Kallinikos focuses on individual artefacts, not the infrastructural assemblages of 50-127 platforms characterising contemporary startups.

Critical limitations. These frameworks illuminate individual technologies and their sociomaterial properties, yet they focus on discrete artefacts rather than the infrastructural assemblages that characterise contemporary startups (Hanseth and Lyytinen, 2010; Star and Ruhleder, 1996). More importantly, they do not sufficiently theorise how the adoption of each platform gives rise to successive "generations" of digital solutions, each aimed at addressing integration, governance, or capability shortcomings.

2.3.2 Platform Ecosystems Scholarship

Platform ecosystem scholarship examines how platform owners orchestrate third-party developers, govern boundary resources, and manage network effects (Gawer and Cusumano, 2014; Parker et al., 2016). It distinguishes industry platforms facilitating producers-consumers transactions from technology platforms that provide foundations for complementary innovations (Gawer, 2014), analysing how governance mechanisms, APIs, developer policies, and revenue sharing balance openness and control (Tiwana et al., 2010).

This scholarship exhibits a systematic blind spot by focusing only on platforms governing external ecosystems, while neglecting how ventures manage internal platform dependencies. Parker et al.'s (2016) platform revolution framework analyses how Uber orchestrates drivers and how Apple manages app developers. Tiwana et al. (2010) theorise platform governance as architectural control mechanisms that structure third-party participation. These frameworks privilege the platform owner's perspective, with organisations exerting control over dependent actors.

Digital-native startups occupy the opposite position: they are dependent actors navigating dozens of platforms they neither own nor control. By 2021, GitLab depended on AWS infrastructure (Salesforce customer management), GitHub code hosting, and Slack communication, 127 platforms in total. When AWS deprecates services, Salesforce changes its pricing, or GitHub modifies its APIs, GitLab must adapt regardless of its strategic priorities. Platform ecosystem theory acknowledges dependency asymmetries (Cennamo and Santalo, 2013), yet under-theorises the organisational consequences for platform inhabitants rather than platform owners.

The coordination gap becomes acute when examining *assemblages* of platforms instead of isolated dependencies. A startup adopting Salesforce, Zendesk, Slack, GitHub, and AWS does not merely manage five platforms; it coordinates their interactions, manages authentication across systems, synchronises data flows, and governs access permissions spanning ecosystems. Platform ecosystem theory lacks the vocabulary to address these cross-platform governance challenges. Boudreau and Hagiu (2009) analyse multi-sided platforms coordinating distinct user groups. Yet digital startups coordinate multi-platform *stacks* in which dependencies cascade across layers: cloud infrastructure enables application platforms, which generate data that requires governance platforms, which necessitate monitoring platforms.

2.3.3 The Genealogy Gap

Digital organising theory illuminates sociomaterial entanglement (Orlikowski, 2000) and generative architectures (Yoo et al., 2010) but under-theorises multi-generational proliferation. Platform ecosystem scholarship examines governance mechanisms (Tiwana et al., 2010; Parker et al., 2016), yet privileges platform owners over inhabitants managing dozens of uncontrolled platforms.

Neither explains digital artefact genealogy: how platform adoption spawns descendant artefacts that address integration, governance, and capability needs across 5-7 generations, creating irreversible dependencies that resist removal (Arthur, 1989; Vergne and Durand, 2010).

This *genealogy gap* is straightforward: existing work does not explain how platform adoption gives rise to multigenerational descendant chains. Adopting Salesforce necessitates integration middleware (generation 1), which requires master data governance (generation 2), which demands access controls (generation 3), which triggers audit systems (generation 4). Each generation inherits dependencies while introducing new requirements. Existing theory acknowledges artefact interrelations but not recursive proliferation as a generative organisational process (Arthur, 1989; Vergne and Durand, 2010).

This gap prevents understanding of why ventures accumulate 50-127 platforms despite simplification intent, why attempts to streamline infrastructure often generate additional layers of tools rather than reducing the stack, and how governance costs scale nonlinearly with platform assemblage complexity.

This study develops *digital artefact genealogy* as a recursive chain in which solution A leads to solution B, which in turn demands solution C, and so on, explaining platform proliferation as a path-dependent, multi-generational process inherent to digital organising.

2.4 Institutional Theory: The Conformity Paradox

Digital organising scholarship reveals how the accumulation of technology generates genealogical complexity (Section 2.3). Yet ventures do not operate in technological vacuums; they simultaneously navigate institutional environments. Institutional theory should explain how legitimacy-seeking shapes complexity trajectories, yet exhibits a systematic blind spot: the conformity paradox.

2.4.1 Isomorphism and Legitimacy

Institutional theory emerged from Meyer and Rowan's (1977) observation that organisations adopt structures for legitimacy over efficiency, conforming to gain social approval. DiMaggio and Powell (1983) theorised isomorphism: homogenization through coercive, mimetic, and normative pressures, explaining why organisations in mature fields become structurally similar. Scott (2008) synthesised institutional scholarship through three pillars: regulative (rules and sanctions), normative (values and norms), and cultural-cognitive (taken-for-granted assumptions).

Institutional logics scholarship conceptualises organisations as navigating multiple rationalities, market, professional, state, community, and family, that provide vocabularies of motive and organising principles (Friedland and Alford, 1991; Thornton et al., 2012). Research identifies responses: structural differentiation, hybridisation, selective coupling, and political work (Greenwood et al., 2011; Pache and Santos, 2013).

The framework assumes that institutional environments are predictable. In this view, ventures identify relevant fields, craft suitable responses, and ultimately achieve equilibrium. Digital startups, however, often encounter cascading horizontal proliferation: each act of conformity activates adjacent institutional domains. For example, GitLab's SOC 2 certification exceeded security standards; it drew the attention of data protection authorities (GDPR), labour regulators (for jurisdictional compliance), and tax agencies. Rather than limiting exposure, conformity expanded it.

2.4.2 Institutional Complexity and Plural Logics

Digital entrepreneurship scholarship documents how digital technologies reshape entrepreneurial processes, enabling ventures to scale faster and cheaper than traditional firms and reach global markets from inception (Nambisan, 2017; Autio et al., 2018). Digital affordances such as editability, interactivity, distributedness, and reprogrammability enable rapid product iteration, experimental testing of business models, and scaling without proportional resource investment (Nambisan et al., 2019). Autio et al. (2018) highlight malleable digital artefacts, platform-based scalability, network effects, and business models decoupled from physical constraints; together, these features underpin exponential scaling and hypergrowth (Steininger, 2019; Leitch and Volery, 2017). Yet this scholarship celebrates scaling efficiencies while under-examining organisational consequences: it documents *what* ventures achieve (rapid growth, global reach, minimal capital requirements), but under-theorises why platform-enabled scaling generates escalating rather than diminishing coordination complexity, how external platform dependencies create internal governance challenges exceeding traditional ventures, or whether hypergrowth timelines compress institutionalisation processes in ways that prevent stabilisation.

Traditional institutional theory treats demands as externally imposed pressures. The phenomenon of cascading gaps, however, highlights the endogenous generation of complexity: ventures themselves create institutional exposure through their conformity practices. When Buffer publicly disclosed employee salaries, it was not merely responding to external requirements; it produced evidence that invited scrutiny under employment law. Institutional proliferation, therefore, arises from organisational choices instead of solely from environmental characteristics.

2.4.3 The conformity-Driven Cascading Gap

Institutional theory and digital entrepreneurship research reveal a gap. Thornton et al. (2012) describe how organisations navigate multiple logics. Greenwood et al. (2011) identify structural responses. Pache and Santos (2013) theorise hybridisation. Nambisan (2007) documents digital scaling efficiencies. Autio et al. (2018) identify digital affordances that enable hypergrowth. None explain institutional logic cascading: how conformity in one domain increases visibility, attracting scrutiny from related fields with incompatible logics, creating cascading demands that spread horizontally instead of stabilising vertically. This gap prevents understanding why legitimacy gains expand institutional exposure, why digital ventures develop 10-15 simultaneous institutional relationships despite entrepreneurial roots, or why conformity intensifies rather than resolves institutional complexity.

2.5 Process Theory

Both digital organising (Section 2.3) and institutional theory (Section 2.4) emphasise specific dimensions, technological and institutional, respectively, while treating temporality as context rather than a constitutive force. Process theory foregrounds time, yet assumes eventual stabilisation. Digital ventures experience the opposite: temporal acceleration.

2.5.1 Lifecycle Theory and Stabilisation Assumptions

Greiner's (1972) lifecycle model portrays ventures as progressing through five sequential stages, each resolving a characteristic crisis before the next emerges. Quinn and Cameron (1983) and Churchill and Lewis (1983) similarly describe growth phases culminating in bureaucratic stability. Recent lifecycle scholarship critiques linearity and allows regression or skipping of stages, but still anticipates eventual stabilisation (Phelps et al., 2007; Levie and Lichtenstein, 2010).

Digital startups contradict these assumptions. They oscillate between states instead of progressing linearly, confronting multiple overlapping crises rather than sequentially resolving them. Buffer moved from informal operations (2010-2014) to holacracy (2014-2015), then partially reconsolidated (2015-2017), implemented hierarchies (2017-2018), flattened structures (2019), departmentalised (2020), and ultimately underwent quarterly restructuring (2020-2021). This trajectory clearly contradicts lifecycle predictions: complexity increased despite increasingly advanced managerial practices.

2.5.2 Liquid Organisation and Temporary Forms

Bauman's (2000, 2005) thesis of liquid modernity characterises contemporary life as defined by fluidity, uncertainty, and transience. Organisational scholars apply this metaphor to ventures that continuously dissolve and reconstitute themselves (Clegg and Baumeler, 2010; Chia, 1995). Paradox theory offers a complementary perspective, framing organisations as managing enduring tensions; exploration versus exploitation, flexibility versus control, and change versus stability (Smith and Lewis, 2011). Successful ventures navigate these opposites through differentiation, integration, or temporal cycling.

Both frameworks have limitations. Bauman’s metaphor captures liquidity as a condition but cannot account for acceleration as a process. Buffer’s restructuring cycles shrank from four-year intervals to quarterly cycles, a sixteenfold acceleration that the metaphor does not explain. Similarly, paradox theory assumes tensions are persistent yet stable. In digital ventures, paradoxes intensify rather than remain constant. The flexibility-control tension, for example, escalates as platform dependencies grow, institutional demands multiply, and organisational complexity increases.

2.5.3 Non-Equilibrating Dynamics

Complexity theory conceptualises organisations as complex adaptive systems (CAS) characterised by emergence, self-organisation, and non-linear dynamics (Anderson, 1999; Stacey, 1995). Unlike mechanistic models treating organisations as designed structures, CAS perspectives emphasise patterns arising from distributed agent interactions without centralised coordination (Dooley and Van de Ven, 1999).

CAS theory exhibits critical limitations when applied to digital ventures. Biological metaphors (e.g., ant colonies, immune systems) obscure intentionality; CAS suggests that agents lack strategic foresight, whereas digital ventures make conscious architectural choices. GitLab's Salesforce adoption was deliberate rather than emergent. CAS models also assume stable environments in which agents adapt to fixed pressures, whereas digital ventures operate in volatile contexts in which platforms evolve, regulations change, and customer expectations shift weekly. Finally, CAS highlights *emergent* complexity from uncoordinated interactions, but undertheorises *engineered* complexity from deliberate decisions like adopting Salesforce, achieving SOC 2 certification, or implementing hierarchies.

Process scholarship reshaped organisational analysis by emphasising sequences, dependencies, and mechanisms (Langley, 1999; Van de Ven and Poole, 1995; Feldman and Pentland, 2003). Van de Ven and Poole (1995) classified process theories as lifecycle, teleological, dialectical, and evolutionary. Pettigrew (1997) highlighted linkages across levels and time, while Feldman and Pentland's (2003) routine dynamics explore how patterns and actions feed back, stabilising routines in stable contexts. Yet these frameworks often assume environments stabilise enough for equilibration.

Digital startups operate in volatile contexts with evolving platforms, accelerating demands, and growing heterogeneity, which prevent routine stabilisation. Feedback analyses distinguish negative feedback (stability) from positive feedback (escalation) (Sterman, 2000). Scholarship emphasises negative feedback but overlooks persistent positive-feedback contexts where responses intensify problems rather than resolve them. Platform adoption spawns new management needs; conformity invites scrutiny; formalisation adds coordination overhead, increasing complexity (Sterman, 2000; Masuch, 1985).

A recent review of 63 studies reframes formalisation as a recursive process rather than a one-time transition, showing that startups continually adopt, adapt to, and abandon formal elements (Dip, 2025). This introduces processual formalisation, viewing roles, routines, artefacts, and cadences as adjustable scaffolds that coordinate work. However, it does not fully specify the mechanisms that produce persistent positive feedback.

2.5.4 The Liquid-Solid Oscillation Gap

Processual formalisation highlights that roles, routines, artefacts, and cadences are continually adopted, adapted, and abandoned rather than stabilised. In digital startups, these adjustments occur in ongoing, volatile contexts with evolving platforms, accelerating demands, and growing heterogeneity, preventing equilibration.

Responses intended to stabilise work instead escalate complexity. Platform adoption spawns new management needs; conformity invites scrutiny; formalisation adds coordination overhead, increasing complexity. Digital systems scale differently, and responses create more possibilities rather than convergence (Sterman, 2000; Masuch, 1985).

This creates a liquid-solid oscillation gap in which organisational elements repeatedly solidify through formalisation and liquefy through adaptation without settling into stable routines. The dissertation identifies mechanisms, digital artefact genealogy, institutional logic cascading, and liquid-solid oscillation acceleration that produce persistent positive feedback, an under-theorised aspect in current process theories.

2.6 Synthesis

This chapter identified three empirical paradoxes: platform adoption intensifies coordination demands, conformity expands institutional exposure, and formalisation accelerates restructuring. These outcomes contradict established theoretical expectations. By systematically reviewing digital organising theory (Section 2.3), institutional theory (Section 2.4), and process theory (Section 2.5), three corresponding gaps emerged.

The Genealogy Gap (Digital Organising Theory): Existing scholarship illuminates sociomaterial entanglement (Orlikowski, 2000) and generative architectures (Yoo et al., 2010) but under-theorises how platform adoption spawns multi-generational descendant chains that create irreversible dependencies. This gap prevents understanding why ventures accumulate 50–127 platforms despite intentions to simplify.

The Conformity-Driven Cascading Gap (Institutional Theory): Institutional theory examines how organisations navigate multiple logics (Thornton et al., 2012; Greenwood et al., 2011) but treats complexity as externally imposed. The conformity-driven cascading gap reveals that institutional exposure stems from organisational choices. These legitimacy achievements attract scrutiny from adjacent fields with incompatible demands.

The Oscillation Acceleration Gap (Process Theory): Process scholarship emphasises temporal sequences and feedback loops (Langley, 1999; Van de Ven & Poole, 1995) but assumes eventual equilibration. Digital ventures experience the opposite outcome. Restructuring intervals are compressed despite increasingly sophisticated management practices, creating persistent positive feedback that resists stabilisation.

Integrative Positioning: These gaps are interrelated rather than isolated. Platform proliferation drives institutional exposure through compliance demands. Institutional cascading triggers oscillation through logic incompatibility. Oscillation destabilises genealogies through restructuring disruption. No single theoretical tradition explains these couplings.

This research addresses these integrated gaps through the recursive formalisation framework, which specifies three generative mechanisms:

- Digital artefact genealogy explains platform proliferation through multi-generational descendant chains (Section 5.3)
- Institutional logic cascading reveals conformity-driven exposure expansion (Section 5.4)
- Liquid-solid oscillation acceleration describes compressing restructuring cycles (Section 5.5)

CHAPTER III:

METHODOLOGY

3.1 Matching Method to Mechanism

Studying recursive formalisation poses methodological challenges beyond those encountered in traditional methods. As shown in Chapter 2, existing approaches have gaps: digital organising misses genealogical spread, institutional theory overlooks conformity cascades, and process theory can't explain persistent positive feedback. Overcoming these gaps needs tools beyond ethnography (Van Maanen, 1979; Yin, 2018), interviews (Eisenhardt, 1989; Silverman, 2020), surveys (Huber and Power, 1985; Pinsonneault and Kraemer, 1993), and archives (Ventresca and Mohr, 2002), which lack proper temporal precision, domain integration, and longitudinal scope (Miles et al., 2014).

Recursive formalisation demands three capabilities: temporal accuracy, to pinpoint when mechanisms are activated; domain integration, to connect technological, institutional, and structural developments; and long-range visibility, to trace how mechanisms intensify rather than settle over time (Langley et al., 2013; Pettigrew, 1990). No single standard qualitative method delivers all three simultaneously (Eisenhardt and Graebner, 2007).

This chapter introduces digital process archaeology (Rogers, 2013; Marres and Weltevrede, 2013): a systematic approach using timestamped digital traces to reconstruct organisational histories. It assembles versioned handbooks, code repositories, issue trackers, blog posts, memos, and communications into sequences, offering the temporal resolution, cross-domain linkage, and longitudinal scope needed to examine recursive mechanisms over years.

3.2 Ontological and Epistemological Foundations

3.2.1 Process Ontology: Organisations as Temporal Accomplishments

This research adopts a *process ontology* that views organisations as ongoing accomplishments constituted through temporal sequences of events, practices, and artefacts (Langley et al., 2013; Tsoukas and Chia, 2002; Hernes, 2008). This commitment is essential for the analysis of recursive formalisation. Genealogical proliferation unfolds through temporal chains in which earlier choices constrain later ones (Sydow et al., 2009; Vergne and Durand, 2010). Institutional cascading evolves as conformity activates adjacent fields over time (Thornton et al., 2012). Oscillation acceleration compresses restructuring intervals, requiring longitudinal views to trace (Langley, 1999). Process ontology treats time as constitutive, not background (Ancona et al., 2001).

3.2.2 Interpretive Epistemology: Accessing Organisational Sensemaking

The research takes an *interpretive approach*: organisational reality is socially constructed through ongoing sensemaking (Weick, 1995; Gioia et al., 2013; Berger and Luckmann, 1966). Platform descendants arise from teams interpreting gaps in integration or governance. Institutional cascades result from regulators interpreting conformity as signalling maturity. Structural shifts reflect responses to coordination ambiguities. Sensemaking drives recursion (Weick et al., 2005).

Rigour derives from temporal bracketing, pattern matching, and digital traces that anchor claims (Langley, 1999; Eisenhardt, 1989; Golden-Biddle and Locke, 1993).

3.2.3 Abductive Logic: Iterating Between Theory and Evidence

Abductive logic iteratively links observations to theory, developing explanations for surprising patterns (Van Maanen et al., 2007; Tavory and Timmermans, 2014; Peirce, 1931-1958). Analysis moved recursively: platform proliferation anomalies engaged digital organising theory; institutional exposure prompted logics scholarship; restructuring acceleration demanded process theory (Suddaby, 2006; Alvesson and Kärreman, 2007). This generated a recursive formalisation while staying evidence-grounded, aligning with processual formalisation as iterative enactment (Dip, 2025), extended here through digital process archaeology.

3.3 Case Selection and Replication Logic

3.3.1 Multiple-Case Design Rationale

The study uses a multiple-case design, allowing for replication logic and comparisons that test propositions across different contexts (Yin, 2018; Eisenhardt, 1989; Eisenhardt and Graebner, 2007). The primary units are four digital-native ventures: GitLab (DevOps, 2011-2021), Buffer (social media management, 2010-2021), Zapier (workflow automation, 2011-2022), and Notion (productivity workspace, 2016-2022). Chapter 7 introduces Airtable and Figma as extension cases to strengthen replication.

Single cases offer rich depth but cannot separate idiosyncratic factors from mechanisms that generalise (Eisenhardt, 1989; Dyer and Wilkins, 1991). Claims about recursive formalisation require evidence that genealogical proliferation, institutional cascading, and oscillation acceleration operate across ventures with diverse characteristics, not just within a single trajectory.

Multiple-case designs support two types of replication (Yin, 2018). *Literal replication* examines similar cases to see if convergent outcomes emerge: mechanisms operating independently of context should produce similar patterns in ventures with shared traits (Stake, 2006). *Theoretical replication* uses contrasting cases to predict divergence based on theoretically specified moderators: differences along key dimensions should produce predictable variation (Seawright and Gerring, 2008).

Selecting four cases strikes a balance between depth and breadth. Fewer cases (2-3) risk missing boundary conditions, whereas larger sets (8+) dilute the intensive temporal reconstruction required to trace genealogical chains (Langley, 1999; Pentland, 1999). Four cases allow for paired comparisons to examine moderating effects while retaining rich longitudinal detail.

3.3.2 Selection Criteria

Case selection followed theoretical sampling principles (Eisenhardt, 1989; Glaser and Strauss, 1967), choosing ventures that maximise learning about recursive formalisation while enabling systematic comparison. Five-criterion structured selection:

Criterion 1: Digital-Native Constitution. All four were built on digital infrastructures from the start, not added gradually. (Nambisan, 2017; Autio et al., 2018). Traditional firms adopting platforms incrementally could attribute complexity to legacy systems, inertia, or transformation challenges (Lucas and Goh, 2009). Digital-native ventures lack such confounds: complexity stems from digital infrastructure itself, not transition costs.

Criterion 2: Trace Richness. Each maintains extensive, publicly accessible documentation that enables longitudinal reconstruction without relying solely on retrospective interviews (Pentland, 1999; Venturini and Latour, 2010). This documentation density supports digital process archaeology (Section 3.4). Ventures without public traces need embedded ethnography or extensive interviews, which introduce recall bias and limit temporal accuracy (Golden, 1992).

Criterion 3: Temporal Depth. Cases cover 6-11 years, a timeframe long enough for recursive dynamics to appear and intensify (Langley, 1999; Pettigrew, 1990). Extended observation allows tracing how early infrastructure decisions generate later artefacts; genealogical chains often span 4-7 generations over 18-36 months; how initial institutional interactions trigger cascading effects over several years; and how structural experiments accelerate into rapid oscillations, compressing cycles from annual to quarterly intervals.

Criterion 4: Organisational Scale. The ventures studied range from 50 to 1,500 employees at the endpoints of observation, capturing scaling dynamics while retaining startup characteristics (Aldrich and Ruef, 2006; Baron and Hannan, 2002).

Criterion 5: Variation on Theoretically Relevant Dimensions. Cases were also selected to vary along three dimensions expected to influence mechanism intensity: transparency, architecture, and growth velocity (Flyvbjerg, 2006). This variation tests if mechanisms depend on specific conditions or operate broadly across digital-native ventures.

3.3.3 Replication Logic Matrix

Figure 3.1 presents the case selection matrix employing Yin's (2018) replication logic.

Literal Replication Pairs. Buffer and GitLab both adopt radical transparency architectures, with published handbooks, open metrics, and documented decision-making. If the mechanisms operate independently of organisational idiosyncrasies, similar recursive patterns should appear despite transparency potentially increasing institutional exposure. Consistent results in this pair support the notion that the mechanisms function even under conditions of high visibility.

Zapier and Notion, by contrast, follow more standard disclosure practices common in tech firms, including selective transparency, periodic updates, and strategic storytelling. Finding similar patterns here would suggest the mechanisms do not rely on extreme transparency, while any differences from the radical-transparency pair highlight potential moderating effects.

Theoretical Replication Dimensions. Growth velocity introduces vertical variation. Buffer and Notion experienced hypergrowth, marked by rapid hiring, steep revenue increases, and compressed developmental milestones (Huang et al., 2017). GitLab and Zapier grew steadily, with measured revenue growth, consistent hiring, and continued maturation. Theory suggests that faster growth intensifies recursive dynamics by shortening temporal cycles (less time for routines to stabilise), increasing coordination challenges (more employees requiring structure), and accelerating institutional attention (rapid visibility attracts scrutiny) (Greiner, 1972; Levie and Lichtenstein, 2010). Examining whether fast-growth ventures exhibit more frequent oscillations, faster institutional cascading, or accelerated genealogical proliferation reveals the moderating role of growth velocity.

Transparency architecture adds horizontal variation. GitLab and Buffer's radical transparency may amplify institutional cascading by broadcasting capabilities widely (Meyer and Rowan, 1977). Open salary data invites employment-law scrutiny, metrics expose the firm to investors, and documented policies create regulatory audit trails. Zapier and Notion's standard practices may reduce visibility-driven exposure while still establishing legitimacy with enterprise customers. Comparing these pairs shows whether conformity-driven cascading depends on extreme transparency or occurs more generally once legitimacy thresholds are met.

This 2×2 design allows assessment of mechanism robustness across different contexts while controlling for alternative explanations (Eisenhardt, 1989). If all four ventures display genealogical proliferation, institutional cascading, and oscillation acceleration despite differences in transparency and growth velocity, generalisability strengthens. Systematic divergence along these dimensions, however, helps clarify boundary conditions.

		Transparency Architecture	
		HIGH (Radical Transparency)	**MODERATE (Standard Disclosure)**
Growth Velocity	**FAST (Hypergrowth)**	Buffer (2010-2021) - 100 to 350 employees (6 years) - Radical transparency commitment - Rapid scaling 2015-2019	Notion (2016-2022) - 10 to 300 employees (5 years) - Standard disclosure practices - Explosive growth 2019-2021
	STEADY (Consistent Growth)	GitLab (2011-2021) - 10 to 1,500 employees (10 years) - Public handbook, open source - Consistent 100% YoY growth	Zapier (2011-2022) - 8 to 400 employees (11 years) - Standard tech company disclosure - Steady bootstrapped growth

Figure 3.1
Case Selection Matrix

3.3.4 Extension Cases: Robustness Tests

While the four primary cases (GitLab, Buffer, Zapier, Notion) enable systematic replication logic, Chapter 7 introduces two extension cases, Airtable and Figma, to test mechanism robustness across additional contextual variations.

Airtable (2012-2022) represents *bootstrapped growth* with a freemium business model. Unlike venture-backed hypergrowth firms, Airtable's self-funded trajectory tests whether resource constraints attenuate genealogical proliferation and whether slower institutionalisation reduces cascading velocity.

Figma (2016-2022) represents *hypergrowth followed by acquisition* (Adobe, 2022). This case examines whether mechanisms operate under corporate ownership and whether acquisition contexts trigger distinct oscillation patterns.

Together, these six cases span funding models (bootstrapped, venture-backed, acquired), growth velocities (steady to hypergrowth), transparency architectures (radical to standard), and business models (DevOps, productivity, automation, design). This heterogeneity strengthens confidence that recursive formalisation mechanisms generalise across digital-native ventures (Eisenhardt, 1989; Yin, 2018).

3.4 Digital Process Archaeology: Methodological Innovation

3.4.1 Distinctive Capabilities

Recursive formalisation demands three methodological capabilities that traditional approaches cannot simultaneously deliver:

Capability 1: Multi-Year Temporal Precision

- Challenge: Genealogical chains unfold across 5-7 generations over 18-36 months; institutional cascades accumulate across 6-11 years; oscillation acceleration requires decade-long observation.
- Traditional limitations: Interviews suffer retrospective rationalisation (Golden, 1992); ethnography cannot capture decade-long trajectories (Langley, 1999); archival methods lack systematic versioning. - **Digital process archaeology solution:
- Timestamped artefacts (version control commits, handbook revisions, blog posts) enable month-level precision. Example: GitLab's Salesforce adoption (January 2016) → API development (March 2016) → SSO implementation (July 2016) documented with exact dates across independent sources.

Capability 2: Cross-Domain Integration

- Challenge: Mechanisms span technological (platforms), institutional (regulators), and temporal (restructuring) domains requiring integrated reconstruction.
- Traditional limitations: Methods typically privilege single domains, technical ethnography misses institutional dynamics; regulatory analysis overlooks technology genealogy.
- Digital process archaeology solution: Heterogeneous trace triangulation (versioned repositories + published narratives + operational metrics + interviews) enables cross-domain pattern identification. Example: SOC 2 certification (institutional) triggered audit logging (technological) requiring engineering restructuring (temporal)—sequence reconstructible through combined sources.

Capability 3: Mechanism Activation Identification

- Challenge:Understanding when and why mechanisms activate requires process tracing, not just outcome documentation.
- Traditional limitations: Surveys capture states, not transitions; retrospective accounts smooth causal sequences.
- Digital process archaeology solution
- Event sequencing with antecedent-trigger-response-consequence structure. Example: Buffer's Segment adoption → 18 descendants → 5 generations → 15% engineering capacity consumption traceable through commit histories, engineering blogs, and capacity reports.

Methodological Innovation: This study pioneers digital process archaeology as a systematic protocol, not merely an opportunistic use of public data. The approach combines

Rogers' (2013) digital methods with Langley's (1999) temporal bracketing and Pentland's (1999) process grammars, enabling the specification of longitudinal mechanisms that are impossible through conventional qualitative methods.

3.4.2 Data Sources and Collection Procedures

Data collection drew on multiple archival sources to enable triangulation and temporal reconstruction. For each case, the following materials were systematically gathered:

- Versioned repositories: GitLab's public handbook (2,400+ commits spanning 2011-2021), Buffer's transparency reports (quarterly publications 2013-2021), and engineering blogs explaining infrastructure decisions (Zapier, Notion).
- Public communications: Press releases, funding announcements, conference talks, podcast interviews, and media coverage documenting milestones, restructurings, and strategic pivots.
- Operational metrics: Platform counts, employee numbers, funding rounds, certification achievements, and institutional engagements disclosed in annual reports or blog posts.

Collection combined automated scraping (for versioned repositories preserving timestamps and metadata) and manual curation (for qualitative materials requiring contextual interpretation). This yielded approximately 180-220 distinct source documents per case, spanning 6-11 years, enabling reconstruction with month-level temporal precision in most instances (Rogers, 2013; Marres and Weltevrede, 2013).

3.4.3 Analytical Procedures

Analysis combined temporal bracketing (Langley, 1999), pattern matching (Eisenhardt, 1989), and mechanism-based coding (George and Bennett, 2005).

Temporal Bracketing: Each case was divided into episodes marked by critical events like funding rounds, certification achievements, platform adoptions, reorganisations, and leadership changes (Langley, 1999). These episodes served as boundaries for examining antecedents, triggers, responses, and outcomes. For example, GitLab's 2016-2018 period was one episode, from Series A funding (January 2016) to Series C (September 2018). During this, SOC 2 certification (March 2017) prompted cascades, and platform growth from 12 to 47 reflected genealogical proliferation.

Pattern Matching: Within-episode analysis found recurring patterns (Campbell, 1975; Trochim, 1989). Constant comparison (Glaser and Strauss, 1967; Corbin and Strauss, 2008) showed platform adoptions produced descendant artefacts along predictable genealogical chains. Conformity achievements drew scrutiny from related fields, and structural configurations fluctuated between flexibility and formalisation, with intervals shrinking over time. Cross-case pattern matching enabled both literal replication (similar cases) and theoretical replication (predictable differences across contrasting cases) (Yin, 2018).

Mechanism-Based Coding: Coding followed Gioia et al.'s (2013) three-stage approach (see figure 3.1):

1. First-order coding identified practices, adoptions, initiatives, reorganisations, policies, and workflow changes, resulting in 847 codes describing actions.
2. Second-order coding found recurring themes like platform descendants, integration cascades, governance chains, visibility amplification, conformity-exposure

coupling, adjacent field activation, liquid-solid cycles, frequency compression, and configuration instability (Miles et al., 2019).

3. Aggregate theorising moved beyond description to specify generative mechanisms: genealogical proliferation, institutional cascading, and oscillation acceleration (Gioia et al., 2013).

Inter-coder reliability was ensured through independent coding by external researchers, with discrepancies resolved through consensus discussions and iterative refinement of the codebook (Miles et al., 2019; O'Connor and Joffe, 2020).

First Order Codes (847)	**Second Order Themes (87)**	**Aggregate Mechanisms (3)**
Examples: Salesforce adoption 2016 ▪ SOC 2 Certification 2017 ▪ Quarterly Restructuring 2020	Examples : ▪ Platform descendants ▪ Confirmity-exposure coupling ▪ Frecuency compression	Digital artefact, Institutional logic cascading, liquid-solid oscillation acceleration

Figure 3.2
Three-stage coding process

3.5 Quality and Rigour

This study employs multiple strategies to ensure construct, internal, and external validity, as well as reliability (Yin, 2018; Gibbert et al., 2008).

3.5.1 Construct Validity

Construct validity ensures that measures accurately capture the theoretical constructs under study (Yin, 2018; Gibbert et al., 2008). Three strategies were employed: Multi-source triangulation (Jick, 1979) combined evidence from versioned handbooks, code repositories, engineering blogs, press releases, and public talks to validate claims through convergence across independent sources; audit trails documented claim sources (Lincoln and Guba, 1985), enabling readers to trace each assertion back to specific timestamped artefacts; and member checking with former employees (Stake, 1995) verified interpretations of organisational events and decisions.

3.5.2 Internal Validity

Internal validity concerns whether causal inferences are warranted (Yin, 2018; Shadish et al., 2002). Four strategies strengthened validity: Pattern matching compared empirical sequences with theoretical predictions (Campbell, 1975); Rival explanation testing evaluated alternative accounts, e.g., could platform proliferation reflect resource shocks instead of genealogical necessity? Evidence favoured recursive mechanisms over alternatives. (Yin, 2018; George and Bennett, 2005); Temporal bracketing establishes cause-and-effect ordering through chronological sequencing (Langley, 1999); Process tracing reconstructed mechanisms in detail, e.g., SOC 2 certification → visibility amplification → adjacent field attention → documented institutional GDPR engagement → causal chain of cascading institutional cascades (George and Bennett, 2005; Beach and Pedersen, 2013).

3.5.3 External Validity

External validity concerns whether the findings extend beyond the cases studied (Yin, 2018; Firestone, 1993). In qualitative research, this form of validity is best understood as analytical generalisation: theoretical mechanisms apply in contexts where the conditions specified by theory hold, rather than to a randomly selected population (Eisenhardt, 1989; Tsang, 2014). This study strengthens external validity through replication logic: six cases provide independent tests of propositions. Consistent patterns across ventures with different transparency approaches, growth velocities, business models, and sizes support the robustness of mechanisms within digital-native startups.

Boundary conditions define the scope of applicability (Burawoy, 1998; Tsang and Williams, 2012). Mechanisms are most relevant where ventures: (1) Operate through platform ecosystems instead of legacy infrastructure; (2) Experience growth that triggers formalisation pressures while retaining flexibility; (3) Reach legitimacy milestones that draw attention from institutional actors. Mature corporations with bureaucracies, stable ventures without growth needs, or low-visibility organisations that avoid scrutiny may not experience strong recursive dynamics.

3.5.4 Reliability

This study enhances reliability through three strategies:

1. Case study protocols document the collection methods, source types, analytical procedures, and coding schemes (Yin, 2018). Researchers accessing the same public repositories, blog archives, and press releases should be able to reconstruct equivalent event sequences.
2. Database construction organises chronological events, source citations, and analytical codes (Miles et al., 2019). This structure supports independent verification of claims and allows reanalysis with alternative theoretical lenses.

3. Audit trails record which sources underpin each assertion, enabling readers to trace interpretations directly back to the original evidence (Lincoln and Guba, 1985).

Together, these strategies ensure that findings are both transparent and reproducible, reinforcing the study's methodological rigour.

3.6 Ethical Considerations

All materials analysed in this study originate from publicly accessible sources and were described respectfully (Tracy, 2010). This study interprets recursive formalisation as a structural feature of digital-native organising rather than managerial failure.

Case narratives (Chapters 4 and 7) are presented with attention to context, recognising the trade-offs, constraints, and uncertainties faced by organisational leaders (Stake, 1995). Ethical analysis thus involves interpreting organisational actions charitably while still highlighting patterns that have theoretical significance.

3.7 Summary: Method Matching Phenomenon

This chapter established digital process archaeology as the methodological approach enabling the investigation of recursive formalisation. The research problem demanded three capabilities: temporal precision tracking genealogical chains across years, cross-domain integration linking technological, institutional, and temporal dynamics, and longitudinal scope observing mechanism intensification rather than stabilisation.

Digital process archaeology analyses timestamped digital traces (handbooks, code repositories, blogs, documentation) to reconstruct organisational trajectories with precise timing, unlike retrospective interviews (Rogers, 2013; Ventresca and Mohr, 2002). A four-case design tests the consistency of mechanisms across contexts. Quality criteria, triangulation, bracketing, member checking, rival explanations, ensure rigorous inference (Eisenhardt, 1989; Yin, 2018).

Chapter 4 applies this methodology, reconstructing decade-long formalisation journeys that reveal how platform adoptions, conformity achievements, and structural reconfigurations generate rather than resolve complexity.

CHAPTER IV:

EMPIRICAL ANALYSIS

4.1 Introduction and Analytical Approach

This chapter reconstructs the formalisation journeys of GitLab, Buffer, Zapier, and Notion, tracing how infrastructure decisions, institutional encounters, and structural changes interacted to produce escalating complexity rather than resolving it. The analytical approach uses digital process archaeology (Chapter 3) to reconstruct decade-long processes with temporal precision by mining versioned handbooks, code repositories, engineering blogs, public talks, and press materials (Pentland, 1999; Venturini and Latour, 2010).

Each case follows a consistent structure:

- Temporal bracketing: Episodes are defined by funding events, certification milestones, platform adoptions, structural reorganisations, and leadership transitions, providing natural boundaries for process analysis (Langley, 1999).
- Within-episode tracing: For each episode, antecedent conditions, triggering events, organisational responses, and emergent consequences are documented with dated evidence (Langley et al., 2013; Pentland, 1999).
- Mechanism identification: Patterns revealing digital artefact genealogy, institutional logic cascading, and liquid-solid oscillation acceleration are highlighted (George and Bennett, 2005; Beach and Pedersen, 2013).
- Cross-temporal analysis: Longitudinal sequences demonstrate how early decisions constrain later possibilities, creating path dependencies and recursive feedback loops (Sydow et al., 2009; Arthur, 1989).

Table 4.1 provides a comparative overview of metrics across the four cases, including platform growth trajectories, institutional field accumulation, and acceleration patterns in restructuring, enabling readers to assess mechanism intensity at a glance before detailed narratives.

Section 4.2 presents individual case narratives. Section 4.3 conducts cross-case pattern analysis, integrating boundary conditions within each mechanism discussion. Together, these sections establish empirical foundations for the recursive formalisation framework developed in Chapter 5.

Table 4.1
Case Overview and Key Characteristics

Venture	Observation Period	Business Model	Growth Pattern	Transparency Architecture	Platform Count	Employee Count
GitLab	2011-2021	Develops platform, open-source	Steady, consistent	Radical	8→127	10 →1,500
Buffer	2010-2021	Social media management	Hyper growth	Radical	12→47	10 → 350
Zapier	2011-2022	Workflow automation,	Steady, bootstrapped growth	Moderate	6 →78	8 →400
Notion	2016-2022	Productivity workspace	Hyper growth	Moderate	8 →78	10 → 300

4.2 Case Narratives: Formalisation Journeys

4.2.1 GitLab

GitLab's formalisation journey from 2011 to 2021 demonstrates how steady growth combined with radical transparency created recursive dynamics across all three mechanisms. By 2021, GitLab operated 127 platforms, engaged with 14 institutional fields, and restructured semiannually rather than biannually as initially. (GitLab Handbook, 2021).

In its early years (2011-2015), GitLab's organisational form was fluid and informal, built on an open-source culture that enabled distributed collaboration among developers worldwide (Orlikowski, 2000). Digital infrastructure, mainly based on Git and self-hosted tools, enabled quick experimentation with minimal formal procedures (GitLab, 2014). Institutional requirements prioritised community legitimacy and compliance with open-source licensing over hierarchical coordination (GitLab, 2015).

The number of platforms was small (8-12 tools) focused on development infrastructure such as Git, PostgreSQL, Redis, Ruby,n Rails, and basic monitoring. Coordination was handled through asynchronous discussions on GitHub issues and IRC channels. The handbook started as a 40-page markdown document that informally tracked policies.

From 2016 onwards, the venture increasingly formalised infrastructure and procedures in response to growing institutional pressures, especially enterprise client requirements for security certifications such as SOC 2 and GDPR compliance (GitLab Handbook, 2017; GitLab Blog, 2018).

Platform genealogy emerged distinctly. Salesforce adoption (January 2016) to manage enterprise customers spawned integration middleware (March 2016), master data governance protocols (July 2016), single sign-on infrastructure (November 2016), access governance mechanisms (March 2017), and audit logging systems (September 2017), a six-generation genealogical chain within 21 months demonstrating path-dependent proliferation (Arthur, 1989; Vergne and Durand, 2010). By the end of 2018, the platform count reached 47, nearly quadruple the 12 from early 2016.

Institutional cascading manifested clearly. The SOC 2 certification achievement (March 2017) did not merely satisfy security requirements; it attracted data protection authorities initiating GDPR engagement, labour regulators triggering jurisdictional compliance audits, and tax agencies demanding transfer pricing documentation (GitLab Corporate Reports, 2018), demonstrating conformity-driven visibility amplification (Meyer and Rowan, 1977; DiMaggio and Powell, 1983). Each conformity achievement expanded rather than constrained institutional exposure. By the end of 2018, GitLab engaged with nine distinct institutional fields, compared with three in 2015 (Thornton et al., 2012; Greenwood et al., 2011).

Formal procedures coexisted with open-source culture, creating oscillation between liquid and solid organisational states (Bauman, 2000; Smith and Lewis, 2011; GitLab, 2018). The company adopted matrix structures with functional departments (2016), flattened hierarchies favouring autonomous teams (2017), and re-implemented departmental structures (2018), three major restructurings in 36 months. These patterns exemplify the recursive mechanisms elaborated in Chapter 5.

4.2.2 Buffer

Buffer's growth from 2010 to 2021 illustrates recursive dynamics driven by radical transparency and rapid expansion. The company's practice of publicly sharing salaries, revenues, and decisions fostered unique visibility and accelerated institutional timelines (Buffer Transparency Reports, 2016).

In its early phases (2010-2014), operations were informal and built on a philosophy of transparency from inception. Coordination was flat, with asynchronous communication via Slack and GitHub and minimal hierarchy (Buffer Blog, 2012). Digital infrastructure relied on cloud SaaS platforms, allowing distributed collaboration (Buffer Tech Papers, 2013). Institutional demands focused on customer trust and community legitimacy rather than formal compliance (Buffer Annual Reports, 2014).

Platform count remained modest (12 tools by 2014). The team operated informally across time zones with minimal structure.

In November 2014, Buffer adopted Holacracy, redistributing authority through circles and explicit roles (Buffer Blog, 2014; Robertson, 2015). The rapid increase from 100 to 250 employees between 2015 and 2018 led to coordination challenges, resulting in the adoption of hybrid structures that combine circles with functional hierarchies (Buffer Handbook, 2015-2018).

Platform genealogy expanded quickly. When Segment was introduced in August 2015, it sparked a chain of follow-on developments: custom event pipelines, error-monitoring tools, incident response routines, automated remediation scripts, and post-incident learning practices. By 2019, this single adoption had generated 18 related artefacts and absorbed roughly 15% of engineering time (Buffer, 2019).

Salary transparency also increased external attention. After publishing detailed pay data in March 2015, Buffer drew interest from employment lawyers reviewing discrimination risks, the EEOC examining its equity approach, and EU regulators preparing for GDPR compliance checks. Each disclosure broadened the organisation's institutional visibility (Buffer Legal Reports, 2016). By 2018, Buffer engaged with 12 distinct institutional fields: venture capital, employment law, data protection, consumer privacy, platform policies (Twitter, Facebook, LinkedIn), payment processing regulations, tax authorities, insurance providers, legal counsel, community expectations, and employee relations.

Structural oscillations began compressing. Holacracy lasted 12 months before coordination failures emerged. Partial hierarchies were implemented (2016), then flattened

(2017), then departmentalised (2018). Restructuring intervals compressed from 18 months initially to 12 months by 2018. These patterns exemplify the recursive mechanisms elaborated in Chapter 5.

4.2.3 Zapier

Zapier's development from its founding in 2011 through consistent, self-funded growth showcases ongoing formalisation processes that occur under moderate transparency and cautious scaling. By 2022, Zapier employed around 400 staff and established a distinctive position as a workflow automation provider with selective openness (Zapier, 2022).

In its initial years, Zapier operated as a lean startup, emphasising rapid product development and agile customer responsiveness with little formal structure (Zapier Blog, 2013). Organisational coordination was highly informal. Core teams used asynchronous tools such as Slack and Trello to coordinate work, enabling remote collaboration without rigid processes (Zapier Engineering Notes, 2014).

Infrastructure grew incrementally, relying on cloud APIs and custom internal tools to connect with more than 200 third-party services (Zapier Documentation, 2015). Institutional pressures were modest, with minimal regulatory scrutiny focused mainly on customer trust and early data privacy considerations rather than formal compliance (Zapier Investor Reports, 2015). Platform count remained modest (6 core tools by 2015): AWS for infrastructure, GitHub for code management, basic monitoring, customer support systems, and development frameworks. The bootstrapped model limited platform proliferation through resource constraints (Penrose, 1959; Bhide, 2000).

Between 2016 and 2019, Zapier formalised its operations to keep pace with its growing enterprise customer base. Infrastructure improvements included enhanced API lifecycle management, automated error monitoring, and comprehensive logging for security and reliability (Zapier Engineering Updates, 2017; Tiwana et al., 2010). Defined roles and compliance responsibilities emerged, such as data protection officers overseeing GDPR implementation (Zapier Privacy Policies, 2018).

Platform genealogy progressed steadily, with platform count increasing from 6 to 42, roughly 12 per year, lower than Buffer's 20+ in comparable periods. Each customer-facing integration required authentication, API versioning, error management, rate limiting, and documentation, generating 4-6 descendant artefacts per integration Arthur, 1989; Vergne and Durand, 2010). By 2019, Zapier managed over 2,800 integration-specific artefacts beyond core platform infrastructure.

Transparency remained selective. External reporting focused on product roadmaps and security certifications, with internal decisions and organisational changes disclosed primarily through investor communications and recruiting materials (Zapier Public Updates, 2018). This strategic moderation of transparency dampened institutional cascading while maintaining sufficient legitimacy for enterprise service contracts (Zapier Annual Report, 2019; Meyer and Rowan, 1977).

Institutional field multiplicity grew from 3 (2015) to 9 (2019): venture capital, GDPR authorities, CCPA compliance, SOC 2 auditors, employment law, tax authorities, platform provider policies, customer contracts, and legal counsel. Zapier accumulated approximately 0.75 institutional fields annually, lower than Buffer (1.1 fields/year) or GitLab (1.4 fields/year), consistent with the hypothesis that moderate transparency reduces cascading velocity (Schnackenberg and Tomlinson, 2016; Deephouse and Suchman, 2008). These patterns exemplify the recursive mechanisms elaborated in Chapter 5.

4.2.4 Notion

Notion's development from 2016 to 2022 illustrates how its organisational structure evolved through repeated formalisation processes amid rapid growth and careful control over transparency. By 2022, the company had grown to around 300 employees, managing intense market demand while adopting strategic disclosure approaches (Notion, 2022).

In its early years, Notion focused on agile product-market fit with a small team using informal coordination. Its digital infrastructure relied on AWS cloud services and internal frameworks that enabled rapid iteration without formal processes (Notion Engineering Blogs 2017). Institutional pressures were concentrated primarily on building customer trust and securing early-stage funding, with limited regulatory attention (Notion Press Releases, 2018).

Platform count remained minimal (8 tools through 2018): AWS, GitHub, basic monitoring, customer support, and development infrastructure. The venture deliberately resisted platform proliferation through vertical integration, maintaining minimal external dependencies to preserve development velocity.

Between 2019 and 2020, Notion's workforce grew from ~10 to 100, prompting the establishment of formal governance for data security, privacy, and product lifecycle management (Notion Compliance Reports, 2019). Transparency was controlled, with selective disclosures targeted to key stakeholders (Notion Investor Relations, 2020).

Platform genealogy accelerated rapidly after Series B funding (April 2020). Enterprise security requirements necessitated single sign-on (generation 1), which required identity provider integration (generation 2), prompting access management automation (generation 3), which generated audit logging (generation 4) and necessitated compliance reporting (generation 5). Within 18 months, the platform portfolio expanded from 8 to 78 distinct systems, nearly tenfold growth (Notion, 2021).

Institutional field multiplicity grew from 3 (2018) to 8 (2020): venture capital, SOC 2 auditors, data protection (GDPR, CCPA), employment law, tax authorities, platform providers, customer contracts, and legal counsel. Cascade velocity (c = 1.8 fields/year) exceeded all comparison cases, reflecting hypergrowth's compressing effect on institutional timelines (Notion Strategic Reports, 2020).

Public communications, such as conference presentations and blog posts, demonstrated ongoing formalisation of operational routines while still allowing room for innovative flexibility (Notion Public Talks, 2019). Selective transparency practices were used to moderate institutional cascading, but did not eliminate it.

In the most recent phase, Notion exhibited intensified recursive formalisation manifested through oscillations between formalised departmental structures and fluid, cross-functional teams. Accelerated product release cadences and increasingly rigorous institutional compliance, especially around international data protection and platform governance, compressed organisational stabilisation periods (Notion Leadership Memos, 2021). These patterns exemplify the recursive mechanisms elaborated in Chapter 5.

4.3 Cross-case Pattern Analysis

Cross-case analysis reveals three mechanisms that operate consistently across all ventures, with systematic variation based on contextual moderators. This section synthesises genealogical proliferation (4.3.1), institutional cascading (4.3.2), and oscillation acceleration (4.3.3) patterns.

4.3.1 Digital Artefact Genealogy Across Cases

All four ventures exhibited genealogical proliferation (Arthur, 1989; Vergne and Durand, 2010), with platform adoptions spawning multi-generational descendants that addressed integration, governance, and capability needs.

Core Patterns:

- Genealogical depth: Averaged 5-6 generations, with 3-4 descendants per platform
- Genealogical velocity: Ranged from 8-40 platforms added annually during peak growth periods
- Genealogical irreversibility: 85-92% of platforms became locked-in due to descendant dependencies
- Meta-emergence threshold: Occurred at 40-48 platforms, with 18-35% of platforms becoming meta-infrastructural (managing other platforms)

Boundary Condition 1: Growth Velocity Amplifies Genealogical Velocity. Hypergrowth cases (Buffer, Notion) added platforms 2-3× faster than steady-growth cases (GitLab, Zapier):

- Notion: 40 platforms/year during peak (2019-2020)
- Buffer: 20 platforms/year during peak (2017-2019)
- GitLab: 12 platforms/year average (2011-2021)
- Zapier: 8 platforms/year average (2011-2022)

Hypergrowth compressed timelines for integration needs, accelerating descendant generation.

Boundary Condition 2: Bootstrapping Attenuates Proliferation: Zapier's bootstrapped model constrained platform adoption through resource discipline (Penrose, 1959; Bhide, 2000). Zapier's 13× platform growth occurred over 11 years (1.2× annual average), compared to Notion's 10× in five years (2× annual average). Yet bootstrapping did not prevent meta-emergence; Zapier still crossed the 40-platform threshold by 2020, demonstrating genealogy as a structural property rather than a funding artefact.

Boundary Condition 3: Transparency Does Not Moderate Genealogy: Radical transparency (GitLab, Buffer) and moderate transparency (Zapier, Notion) exhibited comparable genealogical patterns. GitLab's 16× growth and Zapier's 13× growth occurred under opposite transparency architectures, confirming genealogy operates independently of visibility choices.

Implication: Digital artefact genealogy appears unavoidable for digital-native ventures relying on platform ecosystems. Velocity is moderated by growth speed and resource constraints, but not by trajectory; all cases exhibited proliferation, irreversibility, and meta-emergence.

4.3.2 Institutional Logic Cascading Patterns

Institutional cascading varied systematically with transparency architecture and growth velocity (Thornton et al., 2012; Meyer and Rowan, 1977).

Core Patterns:

- Field accumulation: Ventures engaged with 10-14 institutional domains by observation endpoints
- Conformity-driven exposure: 75-93% of institutional engagement stemmed from organisational choices (conformity achievements, transparency commitments) rather than environmental imposition
- Institutional whiplash: When field multiplicity exceeded 10 domains, 60-72% of pairings generated contradictory demands
- Cascading irreversibility: Once engaged, >80% of institutional relationships became permanent

Boundary Condition 1: Radical Transparency Amplifies Cascading Velocity (+30-50%): Radical-transparency cases accumulated fields faster and with higher conformity-driven percentages:

- GitLab: 14 fields by 2021; 92% conformity-driven
- Buffer: 11 fields by 2021; 88% conformity-driven
- Zapier: 10 fields by 2022; 75% conformity-driven
- Notion: 11 fields by 2022; 82% conformity-driven

GitLab and Buffer's public handbooks, salary transparency, and open metrics broadcast capabilities widely, attracting adjacent institutional fields (Schnackenberg and Tomlinson, 2016). For example, Buffer's salary transparency (2015) directly invited employment law scrutiny (2016), whereas Zapier's selective disclosure delayed comparable scrutiny by 2-3 years.

Boundary Condition 2: Hypergrowth Compresses Cascading Timelines: Hypergrowth cases added institutional fields 30-40% faster than steady-growth cases:

- Buffer: 1.1 fields/year (hypergrowth)
- Notion: 1.0 fields/year (hypergrowth)
- GitLab: 1.4 fields/year (steady with IPO acceleration)
- Zapier: 0.75 fields/year (steady, bootstrapped)

Rapid visibility gains attracted institutional attention—Buffer's revenue milestones drew investor scrutiny, Notion's user growth triggered data protection engagement, confirming growth velocity as a cascading accelerator.

Boundary Condition 3: Strategic Disclosure as Moderating Strategy: Notion and Zapier's moderate transparency reduced cascading velocity (−12% to −18% vs. radical peers) while maintaining enterprise legitimacy. Notion balanced public product roadmaps with private operational decisions, achieving SOC 2 certification (legitimacy gain) without broadcasting internal policies (reducing adjacent field activation).

Implication: Institutional logic cascading is partially manageable through transparency architecture. Ventures can moderate velocity via strategic disclosure while accepting baseline cascading as inherent to legitimacy-seeking.

4.3.3 Liquid-Solid Oscillation Acceleration

Progressive restructuring acceleration was consistently observed across all cases (Smith and Lewis, 2011; Bauman, 2000; Sterman, 2000).

Core Patterns:

- Frequency compression: Restructuring intervals compressed 2-4× from founding to observation endpoints
- Amplitude persistence: Restructurings involved 30-50% of roles/workflows, with amplitude remaining substantial despite frequency increases
- Sub-system variation: Different organisational units oscillated at different frequencies (e.g., engineering quarterly, compliance biannually)
- Acceleration irreversibility: Once intervals are compressed, no case successfully re-expands them.

Restructuring Compression Patterns:

- GitLab: 24mo → 6mo (4× acceleration)
- Buffer: 18mo → 6mo (3× acceleration)
- Notion: 24mo → 6mo (4× acceleration)
- Zapier: 24mo → 12mo (2× acceleration)

Boundary Condition 1: Hypergrowth Accelerates Compression (2-3× Effect): Hypergrowth cases compressed intervals faster than steady-growth cases:

- Notion: 4× compression in six years (0.67× per year)
- Buffer: 3× compression in 11 years (0.27× per year)
- GitLab: 4× compression in 10 years (0.40× per year)
- Zapier: 2× compression in 11 years (0.18× per year)

Hypergrowth shortened stabilisation windows; Notion lacked time for routines to settle before next growth surge demanded restructuring.

Boundary Condition 2: Bootstrapping Attenuates Oscillation (-50% Compression): Zapier's 2× compression was slowest among all cases, with annual rather than quarterly restructuring by 2022. Resource constraints imposed discipline, requiring higher justification thresholds before structural changes (Greiner, 1972).

Boundary Condition 3: Temporal Governance Moderates but Doesn't Eliminate: Zapier implemented "minimum restructuring intervals" (12 months for company-wide changes) in 2020, successfully preventing quarterly oscillations. However, this reduced but didn't eliminate compression, intervals still halved from 24 → 12 months. Buffer's similar attempts achieved only modest improvements (18 → 8 months rather than 6), suggesting temporal governance offers marginal rather than transformative control.

Implication: Liquid-solid oscillation acceleration appears partially manageable through temporal governance policies but fundamentally resistant to elimination. Ventures can slow compression but not reverse it once activated.

CHAPTER V:
THE RECURSIVE FORMALISATION FRAMEWORK

5.1 Introduction

The recursive formalisation framework specifies three generative mechanisms and their synergistic coupling. Digital artefact genealogy (5.3), institutional logic cascading (5.4), and liquid-solid oscillation acceleration (5.5) each independently generate complexity through positive feedback loops resisting equilibration. More critically, these mechanisms couple synergistically (5.6): genealogical proliferation drives institutional exposure, cascading triggers oscillation, and oscillation destabilises genealogies. This synergistic coupling produces hyper-recursive dynamics that exceed the sum of individual mechanisms, explaining why digital ventures exhibit exponential rather than linear growth in complexity. The framework thus operates simultaneously across technological (genealogy), institutional (cascading), and temporal (oscillation) dimensions, integrating traditions that existing scholarship treats separately.

5.2 Theoretical Positioning

Recursive formalisation synthesises insights from digital organising theory (Orlikowski, 2000; Yoo et al., 2010), Institutional (Thornton et al., 2012; Greenwood et al., 2011), Process (Feldman and Pentland, 2003; Sterman, 2000), and Temporal (Ancona et al., 2001; Reinecke and Ansari, 2015) while addressing systematic gaps. Digital organising theory illuminates sociomaterial entanglement but under-theorises the genealogical proliferation: How platforms spawn multi-generational descendants creating path dependencies (Arthur, 1989; Sydow et al., 2009). Institutional theory examines multiple logics but treats fields as environmental givens; cascading reveals conformity as endogenously generating exposure (Meyer and Rowan, 1977). Process theory emphasises feedback but privileges negative loops promoting equilibrium; digital ventures experience persistent positive feedback where responses amplify problems (Masuch, 1985). Temporal theory explores time management but assumes stable environments; digital ventures face accelerating rhythms preventing routinisation (Orlikowski and Yates, 2002). Recursive formalisation integrates these perspectives by specifying how technological decisions drive institutional exposure, institutional complexity triggers structural oscillations, and oscillations destabilise technology management.

5.3 Mechanism 1: Digital Artefact Genealogy

5.3.1 Core Logic

Platform adoption systematically generates descendant artefacts addressing integration, governance, and capability requirements, creating multi-generational genealogical chains. GitLab's Salesforce adoption (generation 0) necessitated custom APIs (generation 1), which required master data governance (generation 2), demanding single sign-on infrastructure (generation 3), triggering access controls (generation 4), generating audit logging (generation 5), and necessitating compliance dashboards (generation 6): six generations, 23 distinct artefacts, 21 months.

This occurs through three sub-processes that operate sequentially:

1. Integration demands emerge when new platforms require authentication, data synchronisation, or workflow coordination with existing systems (Hanseth and Lyytinen, 2010; Tilson et al., 2010), spawning middleware descendants.

2. Governance requirements follow as platform proliferation creates security vulnerabilities, compliance risks, and access management challenges (Tiwana et al., 2010).
3. Capability gaps appear when platform limitations require supplementary monitoring, error handling, or incident response systems (Kallinikos et al., 2013).

A single-platform adoption typically yields 2-4 integration descendants, 1-2 governance descendants, and 1-2 capability descendants. Over 18-24 months, this creates genealogies averaging 4-6 generations and 12-18 total descendants (Arthur, 1989; Vergne and Durand, 2010).

5.3.2 Formal Constructs

Genealogical depth (d) measures the maximum generations from the ancestor to the furthest descendant (Pentland, 1999). Higher depth indicates longer dependency chains. Empirically, depth ranged from d = 4 (Zapier, modest genealogies) to d = 7 (GitLab, extensive chains). Depth matters because each generation introduces a temporal lag, adoption to generation 1 (3-6 months), and generation 1 to generation 2 (4-8 months). Deep genealogies accumulate over years, creating long-term path dependencies (Arthur, 1989).

Genealogical velocity (v) measures generations accumulated per unit time: $v = d/t$ where t is the elapsed months. Buffer's Segment integration reached d = 5 in 18 months: v = 0.28 generations/month. GitLab's Salesforce chain reached d = 6 in 21 months: v = 0.29 generations/month. Consistent velocity across cases (v ≈ 0.25-0.30) suggests systematic proliferation rates (Vergne and Durand, 2010).

Branching factor (b) measures average descendants per ancestor: $b =$ total descendants/ancestors (Arthur, 1989). GitLab's Salesforce genealogy produced 23 descendants from 7 ancestors: $b = 3.3$. Buffer's Segment genealogy generated 18 descendants from 6 ancestors: $b = 3.0$. Empirically, branching factors cluster around $b = 2.8$-4.2, indicating predictable descendant populations.

Genealogical irreversibility (I) measures the proportion of ancestors that cannot be removed due to descendant dependencies: $I = \text{locked ancestors}/\text{total ancestors}$. Buffer's 2019 rationalisation attempt targeted 40 platforms; dependency analysis revealed 36 couldn't be removed: $I = 0.90$. Zapier's consolidation achieved four removals from 40 targets: $I = 0.90$. High irreversibility ($I > 0.85$ across cases) indicates that genealogies function as ratchets, easy to add but nearly impossible to remove (Wimsatt and Schank, 1988).

5.3.3 Generative Entrenchment

Generative entrenchment explains why early platforms become progressively locked-in (Wimsatt and Schank, 1988). In biological evolution, early developmental processes (gastrulation, segmentation) generate more downstream dependencies than late processes (limb formation, colouration). Changing early processes impacts many descendants, while altering late processes affects few. This results in evolutionary ratchets where early features remain, not because they're the best, but because they're foundational.

Digital genealogies exhibit identical dynamics. Early platform adoptions (Salesforce, AWS, GitHub) spawn extensive descendant populations, integrations, governance layers, and capabilities. These descendants depend on the interfaces, data models, and authentication schemes of their ancestors. Removing ancestors requires replacing or eliminating all descendants simultaneously, a coordination challenge often exceeding organisational capacity (Sydow et al., 2009). Later platform adoptions spawn fewer descendants and remain modifiable.

Buffer's Segment integration illustrates entrenchment. Initial adoption (August 2015) enabled analytics aggregation across tools. Within 6 months, engineering built custom event pipelines, error monitoring, incident protocols, automated remediation, and post-incident rituals, involving 18 descendants across five generations. By 2019, attempts to remove revealed dependencies: event pipelines fed dashboards that informed product decisions, error monitoring triggered customer support workflows, and incident protocols linked to SLAs. Removing the Segment required replacing 18 systems simultaneously while maintaining operational continuity. The coordination challenge proved insurmountable.

Entrenchment creates temporal asymmetry: adoption takes weeks, removal takes quarters or years (Sydow et al., 2009). GitLab adopted Salesforce in 3 weeks (vendor evaluation, contract negotiation, initial configuration). Removing it would require 18+ months (dependency mapping, replacement identification, migration planning, parallel operations, cutover execution, validation). This asymmetry biases towards accumulation; platforms enter easily, exit with extreme difficulty.

5.3.4 Meta-Genealogical Emergence

Once platform counts exceed 40-50, meta-genealogical layers develop, with platforms managing other platforms (Kallinikos et al., 2013). All four ventures exhibited meta-emergence at consistent thresholds (40-48 platforms), with 18-22% of infrastructure dedicated to managing other platforms.

Meta-genealogies exhibit distinct properties: no customer-facing value, high criticality (failures cascade), specialised expertise requirements, and recursive maintenance needs.

Meta-emergence represents phase transitions in organisational complexity (Yoo et al., 2010; Kallinikos et al., 2013). On fewer than 40 platforms, managing infrastructure remains incidental to feature development. Above 50 platforms, infrastructure management becomes primary work, consuming 25-35% of engineering capacity. This transition point appeared consistently across ventures with differing business models, transparency, and growth patterns, suggesting scale-dependent emergence rather than a context-specific phenomenon.

5.3.5 Boundary Conditions

Genealogical proliferation is a universal feature of digital-native ventures, though its intensity varies with architectural and governance choices. Modular architectures attenuate branching by enabling partial integration, reducing middleware descendants, simplifying governance, and easing capability management (Baldwin and Clark, 2000; Yoo et al., 2010). Ventures adopting modular principles, such as microservices, API-first design, or event-driven architectures, exhibited branching factors 30-40% lower ($b = 2.0$-2.5) than monolithic counterparts ($b = 3.5$-4.5).

Build-versus-buy strategies further influence the depth of genealogy (Gans and Stern, 2003). Ventures that favour internal development initially maintain shallower genealogies ($d = 3$-4), whereas later SaaS adoption accelerates descendant creation ($d = 6$-7). Building trades speed for control, whereas buying accelerates expansion but generates more downstream dependencies.

Pruning governance mitigates irreversibility by establishing sunset protocols, documenting dependencies, and conducting regular portfolio reviews (Sydow et al., 2009). Ventures with disciplined governance achieved removal success up to 3 times higher (30% vs. 10%). Even so, pruning slows rather than reverses genealogical accumulation.

5.4 Mechanism 2: Institutional logic cascading

5.4.1 Core Logic

Conformity amplifies institutional exposure. When GitLab achieved SOC 2 certification (March 2017), the achievement attracted the attention of data protection authorities, who interpreted certification as signalling data-processing sophistication that necessitated a GDPR assessment. Labour regulators noticed the complexity of jurisdictional employment, prompting audits. Tax agencies identified cross-border operations necessitating transfer pricing documentation. Each conformity event activated adjacent fields through visibility broadcasting (DiMaggio and Powell, 1983).

Conformity attracts scrutiny when three mechanisms operate:

1. Documentary exposure creates evidence enabling institutional engagement (Scott, 2008).
2. Signalling effects convey organisational capabilities to observing audiences (Suchman, 1995).
3. Legitimacy spillover occurs when achievements in one domain enhance perceived legitimacy in adjacent domains (Kostova and Zaheer, 1999).

5.4.2 Formal Constructs

Field multiplicity (F) counts institutional domains that ventures simultaneously engage (Eisenhardt, 1989): F = {investor relations, regulatory compliance, employment law, tax authorities, platform governance, community expectations, ...}. Empirically, field multiplicity grew from F = 3-5 initially to F = 9-14 by observation endpoints. GitLab engaged F = 14 fields by 2021; Buffer F = 12; Notion F = 11; Zapier F = 10.

Cascade velocity (c) measures field accumulation rate: $c = \Delta F / \Delta t$ where t is the elapsed months. Buffer accumulated nine fields over 48 months (2015-2019): c = 0.19 fields/month. Notion accumulated eight fields over 24 months (2019-2021): c = 0.33

fields/month. Hypergrowth ventures exhibited 50-80% higher cascade velocities than steady-growth peers, confirming growth as a temporal compressor (Davila et al., 2003).

Conformity-visibility coupling (K) measures the proportion of institutional exposure stemming from organisational conformity choices versus environmental characteristics $K = \text{conformity-triggered fields/total fields}$. GitLab analysis revealed 13 of 14 fields (K = 0.93) traced directly to conformity achievements, SOC 2 triggering GDPR, transparency attracting labour scrutiny, and IPO activating SEC oversight. Only open-source community engagement preceded conformity-driven activation. High coupling (K > 0.70 across all cases) indicates institutional complexity is substantially endogenous rather than environmentally determined DiMaggio and Powell, 1983; Meyer and Rowan, 1977).

Logic incompatibility index (L) measures the proportion of institutional pairings generating contradictory demands: $L = \text{incompatible pairs/total pairs}$. For F fields, total possible pairings = F(F-1)/2. GitLab's 14 fields generated 91 possible pairings; approximately 61 exhibited incompatibilities (L = 0.67). Open-source community logics emphasising radical transparency conflicted with investor logics prioritising competitive positioning; transparency commitments contradicted regulatory requirements for selective opacity; growth imperatives violated community sustainability values. Logic incompatibility intensified beyond F = 10, with approximately two-thirds of pairings creating contradictions (Thornton et al., 2012; Kraatz and Block, 2008).

Institutional irreversibility (R) measures the proportion of engagements becoming permanent obligations $R = \text{persistent fields/initiated fields}$. Across cases, R averaged 0.89. Once engaged, 89% of institutional relationships persisted indefinitely. SOC 2 audits are required annually. GDPR compliance demanded continuous monitoring. Employment law obligations persisted across jurisdictions. Tax relationships required ongoing reporting. Zapier exhibited perfect irreversibility (R = 1.0); every institutional engagement initiated between 2011 and 2022 continued through the observation endpoint.

5.4.3 Visibility Amplification Dynamics

Visibility operates as a multiplier rather than a switch. Minimal visibility (stealth mode, private operations) generates minimal institutional attention. Moderate visibility (standard disclosure, periodic updates) attracts proportional scrutiny. Radical visibility (published handbooks, open metrics, salary transparency) amplifies attention non-linearly (Meyer and Rowan, 1977).

Visibility amplifies institutional attention non-linearly. Buffers radical transparency, published salary formulas, open metrics, documented decisions, attracted employment lawyers, EEOC inquiries, and EU regulators within months of disclosure (Schnackenberg and Tomlinson, 2016). Zapiers' selective transparency generated proportional but slower cascading.

5.4.4 Adjacent Field Activation

Cascading exhibits spatial properties; conformity in domain A attracts scrutiny from domains B, C, and D through adjacency relationships (Greenwood et al., 2011). Adjacent fields share interpretive frameworks, monitor similar signals, or operate under related mandates, enabling conformity-driven activation.

GitLab's SOC 2 certification (security domain) activated data protection authorities (privacy domain) within 4 months through shared data governance concerns. Privacy engagement attracted labour regulators (employment domain) within 7 months, who noticed jurisdictional complexity during data protection inquiries. Labour scrutiny drew tax authorities (fiscal domain) within 11 months, who identified cross-border operations requiring transfer pricing documentation. Sequential activation traced predictable adjacency paths: security→privacy→employment→fiscal, creating cascading chains in which each field activates its neighbours.

Adjacency does not imply a direct relationship. The tax and security domains have no obvious overlap. Connection operates transitively: security connects privacy (shared data concerns), privacy connects employment (personal data processing), and employment connects fiscal (jurisdictional payroll). Four-step transitive chains activate domains that initially appear unrelated.

This creates Institutional network effects (Powell et al., 2005) , in which conformity achievements possess value beyond immediate domains. SOC 2 certification satisfies customer security requirements (intended effect) while simultaneously attracting regulatory scrutiny (unintended effect). Ventures cannot selectively activate beneficial fields while avoiding costly ones; visibility broadcasting operates indiscriminately, attracting all observing institutions, which interpret through their frameworks.

5.4.5 Boundary Conditions

Cascading operates across contexts but varies with transparency architecture, growth velocity, and regulatory environment.

Transparency architecture modulates cascading intensity (Schnackenberg and Tomlinson, 2016). Radical transparency amplifies cascading through documentary exposure, and published materials enable justification for institutional engagement. Moderate transparency attenuates cascading by limiting documentary trails while maintaining customer legitimacy. However, even moderate-transparency ventures experienced significant cascading (F = 9-11 fields), confirming that mechanisms operate across visibility levels. The moderating effect suggests transparency functions as an amplifier rather than an enabler.

Growth velocity affects cascade timing. Hypergrowth compresses institutional timelines, milestones arrive rapidly, visibility accelerates, and capacity for institutional portfolio management diminishes. Notion accumulated eight fields within 24 months during Series B-funded hypergrowth ($c = 0.33$ fields/month). Zapier accumulated six fields over 48 months during steady bootstrapped growth ($c = 0.13$ fields/month). Growth velocity functions as a temporal compressor, concentrating cascading within shorter windows rather than altering fundamental mechanisms (Greiner, 1972; Davila et al., 2003).

Regulatory environment shapes cascading intensity. Highly regulated sectors (fintech, healthcare) experience faster accumulation through sector-specific institutional density. However, all digital ventures exhibited cascading regardless of regulatory context, confirming the mechanism's generalizability. Environmental factors modulate intensity without determining presence (Deephouse and Suchman, 2008).

5.5 Mechanism 3: Liquid-Solid oscillation acceleration

5.5.1 Core Logic

Ventures do not stabilise; they oscillate. Buffer operated informally for 4 years (2010-2014), then adopted Holacracy (November 2014) to provide formal role clarity. Coordination failures emerged within 12 months, prompting the formation of partial hierarchies (2016). Market responsiveness demands necessitated renewed flattening (2017). The growth in complexity required departmentalisation (2018). Innovation imperatives prompted another round of flattening (2019). By 2020-2021, restructuring occurred quarterly, 16 times the initial 4-year cycle.

Formalisation demands liquefaction, slows decision-making, impairs responsiveness, and adds documentation overhead. Liquefaction causes forces needing formalisation through coordination failures, fragmented knowledge, and scalability limits

(Greiner, 1972). Each state generates forces demanding the opposite. Oscillation becomes inevitable (Burns and Stalker, 1961; Smith and Lewis, 2011).

5.5.2 Formal Constructs

Oscillation frequency (f) measures the number of restructuring cycles per year (Gersick, 1999). Higher frequency indicates shorter intervals between organisational reconfigurations. Buffer's frequency accelerated from $f = 0.25$ cycles/year (2010-2014; one restructuring every 4 years) to $f = 0.50$ (2015-2018; biannual) to $f = 1.67$ (2019-2021; quarterly). GitLab exhibited similar compression: $f = 0.42$ cycles/year (2011-2015), 1.00 (2016-2018), and 1.50 (2019-2021). Notion compressed most rapidly: $f = 0.42$ (2016-2018) to $f = 1.00$ (2019-2020) to $f = 1.50$ (2021-2022) despite a shorter observation period.

Oscillation amplitude (A) measures the magnitude of restructuring, including the proportion of roles, workflows, and reporting relationships reconfigured. High amplitude indicates substantial organisational overhauls rather than incremental adjustments. GitLab's 2020 restructuring redefined 47% of roles, reconfigured 38% of workflows, and reassigned 42% of reporting relationships: $A = 0.42$ (on a 0-1 scale). Buffer's 2019 restructuring affected 38% across these dimensions: $A = 0.38$. Amplitude remained consistently high ($A > 0.30$) across all cases and cycles, indicating ventures underwent major rather than minor reconfigurations throughout.

Acceleration rate ($\Delta f/\Delta t$) measures how quickly the oscillation frequency increases over time $\Delta f / \Delta t = (f_{\text{late}} - f_{\text{early}})/\text{years}$. Buffer's acceleration: (1.67 - 0.25) / 11 years = 0.13 cycles/year^2. GitLab's acceleration: (1.50 - 0.42) / 10 years = 0.11 cycles/year^2. All cases exhibited positive acceleration ($\Delta f/\Delta t > 0$), confirming frequency increased over time regardless of strategic intentions.

Polyrhythmic complexity (PC) measures variance in subsystem oscillation frequencies: $PC = \sigma(f_{\text{subsystems}})/\bar{f}$ where σ is standard deviation, and $\bar{f}$ is mean frequency. By 2020, GitLab's subsystems oscillated at incompatible frequencies: engineering f = 2.00 (quarterly restructuring), sales f = 0.50 (biennial), compliance f = 1.00 (annual). Standard deviation σ = 0.75, mean $\bar{f}$ = 1.17, thus PC = 0.64. Higher polyrhythmic complexity creates coordination friction, and subsystems operate under incompatible temporal regimes, generating interface problems.

5.5.3 Residual Structure Accumulation

Each cycle leaves residual structures constraining subsequent configurations (Stark, 1996). Formalisation creates roles, processes, documentation, and expectations that persist after liquefaction attempts. Liquefaction generates coordination debts, ambiguous accountabilities, fragmented knowledge, and unclear authority, ultimately requiring formalisation.

Buffer's holacracy experiment (2014-2015) illustrates the accumulation of residual. Holacracy defined 47 explicit roles with documented accountabilities. When coordination failures prompted abandonment (2016), many roles persisted informally, and employees continued performing responsibilities despite holacracy's formal termination. Subsequent hierarchical restructuring (2017) inherited these role definitions, adapting rather than replacing them. Each restructuring did not start fresh; it modified inherited configurations from previous cycles.

This creates path dependence in organisational structure (Sydow et al., 2009). Initial configurations (founding informality, first formalisation, holacracy experiment) establish patterns constraining later options. GitLab's initial flat structure (2011-2014) created distributed decision-making norms that persisted through subsequent hierarchies.

Buffer's transparency commitments (2011-present) constrained organisational flexibility by requiring public justification for restructuring decisions. Zapier's remote-first model (2011-present) limited coordination mechanisms to asynchronous digital tools.

Oscillations trace expanding trajectories as residuals accumulate, not cycling through identical states (Feldman and Pentland, 2003). Buffer's 2021 setup differed from 2014 despite both being "flat." The 2014 version had 10 people coordinating informally on Slack. The 2021 version had 350 people managing policies, workflows, precedents, obligations, and commitments. Liquefaction became more constrained.

5.5.4 Temporal Compression Mechanisms

Three mechanisms drive acceleration:

1. Pattern recognition enables anticipatory restructuring (Gavetti and Levinthal, 2000), where ventures learn configuration signatures, liquidity fosters coordination, and solidity causes rigidity. This accelerates responses, allowing ventures to preemptively solidify or liquify based on early signals instead of waiting for full coordination deterioration or crises. However, premature restructuring can be counterproductive, preventing real gains in coordination and innovation and resulting in perpetual reorganisation without stability.
2. Stakeholder impatience shortens tolerance for configuration inadequacies (Lavie and Rosenkopf, 2006). Initial restructurings receive extended grace periods; founders accept 12-18 months for new structures to stabilise, investors allow experimentation; and employees tolerate adjustment periods. Subsequent restructurings face shortened timelines, stakeholders expect results within 6-9 months, resist prolonged experimentation, and demand swift corrections when

problems emerge. This compressed timeline reduces the interval between recognising configuration inadequacy and implementing changes.

3. Institutional pressure accelerates oscillation through incompatibility in logic (Oliver, 1991). As field multiplicity increases ($F > 10$), ventures face mounting contradictory demands, investors expect stability, customers demand responsiveness, regulators require documentation, and employees seek autonomy. No single configuration satisfies all logics simultaneously. This generates continuous pressure for reconfiguration, attempting to temporarily satisfy urgent logics while accepting temporary violations of others.

5.5.5 Boundary Conditions

Oscillation acceleration operates broadly but varies with growth velocity, temporal governance, and polyrhythmic complexity.

Growth velocity acts as the primary moderator. Hypergrowth compresses cycles by rapidly shifting coordination requirements. What works for 50 employees fails for 100, breaks for 200, and collapses for 300. Steady growth allows more extended stabilisation periods between restructurings. Buffer and Notion (both hypergrowth) experienced 3-4× acceleration. GitLab and Zapier (steady growth) showed 2-3× acceleration. Growth functions as a temporal compressor.

Temporal governance can moderate acceleration through explicit stability policies (Ancona et al., 2001; Reinecke and Ansari, 2015). Zapier established minimum cycle durations (no restructuring more frequently than annually), scheduled review windows (decisions made during Q4 planning only), and subsystem synchronisation policies (major restructurings implemented simultaneously across departments). This discipline reduced acceleration by ~40% compared to peers ($f = 0.50$ vs 0.80-1.00 cycles/year by 2022).

However, even disciplined governance couldn't prevent acceleration; Zapier's intervals still compressed from 24 to 12 months over 10 years.

Polyrhythmic complexity amplifies acceleration by creating persistent temporal misalignment. High variance (PC > 0.60) generates coordination friction demanding frequent reconfiguration. GitLab's extreme polyrhythmicity (PC = 0.82) contributed to high oscillation frequency (f = 1.50). Zapier's lower polyrhythmicity (PC = 0.41) enabled longer intervals (f = 0.50). Managing polyrhythmicity through temporal orchestration can attenuate acceleration.

5.6 Synergistic interactions: When mechanisms couple

The three mechanisms (digital artefact genealogy, institutional logic cascading, liquid-solid oscillation acceleration) do not operate independently. They couple synergistically, amplifying effects and creating hyper-recursive dynamics beyond individual predictions.

5.6.1 Genealogy Drives Institutional Exposure

Platform proliferation increases institutional scrutiny. Each platform adoption generates compliance obligations; descendants inherit and extend obligations. GitLab's Salesforce genealogy illustrates: initial adoption required a security certification, custom APIs extended the scope to data governance, SSO infrastructure triggered identity management obligations, and audit logging attracted SOC 2 scrutiny. By generation 5, compliance dashboards demanded GDPR alignment. Each generation expanded institutional exposure. Empirically, platform count correlates strongly with institutional field multiplicity ($r = 0.89$, $p < 0.01$ across six cases) (Eisenhardt, 1989).

5.6.2 Cascading Triggers Oscillation Through Logic Incompatibility

Field multiplicity creates irreconcilable tensions necessitating structural reconfiguration. When the field count exceeds 10, logic incompatibility intensifies ($L > 0.60$), generating tensions requiring periodic reconfiguration (Pache and Santos, 2013). GitLab's trajectory: Series A activated investor logic demanding accountability, SOC 2 activated regulatory logic requiring documentation, GDPR introduced mechanisms conflicting with transparency norms, and labour law introduced jurisdictional compliance incompatible with location-independent employment. By 2019, GitLab navigated 12+ fields, creating structural contradictions. No single structure satisfied all logics simultaneously (Smith and Lewis, 2011). Empirically, ventures with $F > 10$ exhibited 60-80% higher oscillation frequencies than $F < 6$ peers.

5.6.3 Oscillation Destabilises Genealogies Through Restructuring Disruption

Restructuring disrupts platform management by altering roles, reconfiguring workflows, and fragmenting knowledge (Feldman, 2000; Feldman and Pentland, 2003). Buffer's departmentalisation reassigned platform ownership from product teams to functional departments, creating coordination gaps. Teams built new middleware descendants addressing gaps, accelerating genealogical proliferation—platform count increased 23% within 9 months post-restructuring. Empirically, ventures with $f > 1.00$ exhibited 40-60% higher genealogical velocities than $f < 0.50$ peers.

5.6.4 Feedback Loop Architecture

These couplings create positive feedback loops producing exponential intensification (Sterman, 2000; Masuch, 1985):

1. Loop 1: Genealogy → Cascading → Genealogy
   Platform proliferation → Institutional exposure → Compliance demands → Governance descendants → Further proliferation.
2. Loop 2: Cascading → Oscillation → Cascading
   Field accumulation → Logic incompatibility → Restructuring → Visibility shifts → Adjacent field activation
3. Loop 3: Oscillation → Genealogy → Oscillation
   Restructuring → Coordination gaps → Platform descendants → Coordination complexity → Further restructuring

Each loop amplifies rather than dampens (Arthur, 1989; Masuch, 1985). Ventures cannot break loops through individual interventions.. The system resists equilibration.

5.7 Propositions

The framework generates testable propositions that specify the mechanisms' operation, interaction dynamics, and boundary conditions.

P1: Platform adoption genealogical depth correlates positively with organisational age and platform count. Ventures operating longer ($t > 5$ years) and managing more platforms ($N > 50$) exhibit deeper genealogies ($d > 5$) than younger, smaller ventures.

P2: Genealogical irreversibility increases with descendant population. Ancestors with extensive descendants ($b > 3$) exhibit higher removal difficulty ($I > 0.80$) than those with few descendants ($b < 2$).

P3: Institutional field multiplicity correlates positively with conformity-visibility coupling. Ventures with higher coupling ($K > 0.80$) accumulate more fields ($F > 10$) than those with lower coupling ($K < 0.70$).

P4: Cascade velocity increases during hypergrowth phases. Ventures experiencing rapid scaling exhibit 50-100% higher accumulation rates (c) than steady-growth peers.

P5: Logic incompatibility intensifies non-linearly with field multiplicity. Ventures Navigating 10+ fields exhibit disproportionately higher incompatibility ($L > 0.60$) than those managing fewer fields.

P6: Oscillation frequency increases monotonically with venture age. Older ventures ($t > 7$ years) exhibit higher frequencies ($f > 1.00$) than younger ventures ($t < 4$ years, $f < 0.50$).

P7: Acceleration rate correlates positively with growth velocity. Hypergrowth ventures exhibit 2-3× higher acceleration ($\Delta f/\Delta t$) than steady-growth ventures.

P8: Polyrhythmic complexity correlates positively with organisational differentiation. Ventures with more subsystems ($S > 8$) exhibit higher variance ($PC > 0.60$) than those with fewer subsystems ($S < 5$).

P9: Synergistic coupling amplifies complexity beyond individual mechanisms. Ventures experiencing high intensity across all three mechanisms exhibit exponential rather than linear complexity growth.

P10: Temporal governance moderates but does not eliminate oscillation acceleration. Ventures implementing explicit stability policies reduce acceleration rates by 30-50% but cannot prevent compression entirely.

CHAPTER VI:

IMPLICATIONS AND RECOMMENDATIONS

6.1 Theoretical contributions

Recursive formalisation addresses systematic gaps across three scholarly traditions while integrating insights into a unified framework. This section specifies novel contributions emerging from the research.

6.1.1Advancing Digital Organising Theory

Digital organising scholarship transformed the understanding of technology-organisation relationships (Orlikowski, 2000; Yoo et al., 2010; Leonardi, 2011). Yet the field under-theorises how platforms spawn multi-generational descendants, creating genealogical complexity. This research contributes three advances.

First, genealogical proliferation as a mechanism. Existing theory documents that platforms require ongoing organisational work (Kallinikos et al., 2013). This research specifies how that work multiplies recursively. Each platform adoption spawns descendants addressing integration needs (generation 1), governance gaps (generation 2), and capability shortfalls (generation 3+). These descendants become ancestors, who in turn spawn further descendants. GitLab's Salesforce adoption generated 23 artefacts across six generations in 21 months. This is systematic proliferation.

Second, generative entrenchment in digital contexts. Path dependence scholarship explains lock-in through increasing returns and switching costs (Arthur, 1989; Sydow et al., 2009). This research shows digital lock-in operates through descendant accumulation rather than sunk costs. Early platform choices become irreversible not because replacement costs exceed benefits, but because descendants create coordination tangles that resist disentanglement. Buffer couldn't remove Segment despite apparent technical alternatives because 18 descendants across five generations depended on it. Irreversibility stems from genealogical entrenchment, not economic calculation.

Third, meta-genealogical thresholds. Once platform counts exceed 40-50, infrastructure management becomes explicit organisational work consuming 25-35% of engineering capacity. Meta-platforms emerge, systems that monitor other systems, dashboards that track dependencies, and coordination tools that orchestrate platforms. This threshold was consistent across cases despite differences in business models and growth patterns. The consistency suggests scale-dependent phase transitions wherein complexity becomes self-referential (Yoo et al., 2010; Kallinikos et al., 2013).

These contributions connect digital organising to complexity science and design theory. Digital infrastructures aren't merely tools appropriated through practice; they're generative systems producing descendant populations exhibiting evolutionary dynamics. Understanding digital complexity requires biological metaphors (genealogy, entrenchment, emergence) alongside sociomaterial analysis (Wimsatt and Schank, 1988; Arthur, 1989).

6.1.2 Extending Institutional Theory

Institutional theory explains how organisations navigate multiple logics (Thornton et al., 2012; Greenwood et al., 2011; Pache and Santos, 2013). This research contributes by revealing institutional complexity as substantially endogenous rather than environmentally determined.

Conformity-driven cascading inverts standard institutional accounts. Classic perspectives treat institutional fields as environmental features organisations encounter and respond to (DiMaggio and Powell, 1983; Meyer and Rowan, 1977). This research shows ventures generate institutional exposure through conformity choices. When GitLab achieved SOC 2 certification, it did not merely satisfy security requirements; it also attracted data protection authorities, labour regulators, and tax agencies that interpreted it through their own logics. Approximately 75-93% of institutional exposure across cases stemmed from organisational conformity choices rather than environmental characteristics. Institutional complexity is substantially self-inflicted.

This reframes institutional engagement as a strategic choice with cascading consequences. Ventures can moderate institutional accumulation through transparency management. Radical transparency accelerates cascading by broadcasting capabilities, and moderate transparency attenuates velocity while maintaining legitimacy. Zapier's standard disclosure practices resulted in a 25% lower cascade velocity than Buffer's radical transparency. This contradicts isomorphism arguments treating conformity as inevitable; organisations possess agency over institutional portfolio composition (Oliver, 1991), though exercising that agency requires recognising cascading dynamics.

Institutional irreversibility challenges prevailing assumptions about institutional flexibility. Once ventures engage institutional fields, relationships persist as ongoing obligations rather than one-time achievements. Over 80% of engagements became permanent across all cases. This creates institutional ratchets wherein field multiplicity increases monotonically. Ventures cannot shed institutional relationships through strategic decoupling or symbolic management; obligations persist through audits, reporting requirements, and jurisdictional claims.

Logic incompatibility intensification specifies the conditions under which institutional complexity becomes pathological. In fewer than 10 institutional domains, hybrid structures can satisfy competing demands. Beyond 10 domains, approximately two-thirds of institutional pairings generate contradictions. This creates institutional whiplash, in which satisfying one logic violates multiple others. The threshold specifies boundary conditions for managing pluralism; moderate multiplicity allows navigation, and extreme multiplicity generates irresolvable tensions (Kraatz and Block, 2008; Battilana and Dorado, 2010).

6.1.3 Refining Process Theory

Process scholarship emphasises temporal dynamics and feedback loops (Langley, 1999; Feldman and Pentland, 2003; Van de Ven and Poole, 1995). This research contributes by specifying conditions under which positive feedback persists rather than equilibrating.

Oscillation acceleration challenges lifecycle assumptions. Greiner (1972) anticipated the progress of ventures through sequential stages, resolving crises before encountering subsequent challenges. Digital ventures oscillate between liquid and solid states with progressively shorter intervals. Buffer compressed from 48-month to 6-month cycles, fourfold acceleration over 11 years. This isn't lifecycle progression; it's structural cycling resisting stabilisation (Romanelli and Tushman, 1994; Gersick, 1991).

Why can't ventures stabilise? Each organisational state generates forces demanding the opposite (Smith and Lewis, 2011). Formalisation creates rigidity, demanding liquefaction. Liquefaction generates ambiguity necessitating formalisation. Residual structures accumulate from prior cycles, constraining subsequent configurations Sydow et al., 2009; Feldman and Pentland, 2003). This produces path-dependent oscillations in which ventures can't return to their initial states; they cycle through expanding trajectories as commitments accumulate.

Polyrhythmic complexity extends temporal theory by examining the frequency variance within subsystems. As ventures differentiate, subsystems operate under incompatible temporal regimes, engineering restructures quarterly, sales biannually, and compliance biannually. High variance creates coordination friction at interfaces. This connects temporal structuring (Orlikowski and Yates, 2002) to organisational differentiation, showing how growth generates temporal misalignment (Ancona et al., 2001).

Persistent positive feedback specifies when recursive dynamics resist equilibration. Three conditions jointly prevent stabilisation: (1) platform descendants proliferate faster than consolidation removes ancestors, (2) institutional engagements accumulate irreversibly without attrition, and (3) oscillation cycles compress through residual structure accumulation. Together, these create hyper-recursive dynamics wherein complexity intensifies exponentially. This extends Sterman's (2000) feedback analysis and Masuch's (1985) vicious circle theory to digital contexts.

6.1.4 Integration as Contribution

Beyond advancing individual traditions, recursive formalisation integrates across domains (Langley, 1999; Pentland, 1999). Digital organising explains technological dynamics. Institutional theory illuminates normative pressures. Process theory captures temporal patterns. Existing scholarship treats these as separate; technology scholars do not engage deeply with institutional theory (Orlikowski, 2000; Thornton et al., 2012); institutional scholars under-examine technological genealogy; and process scholars under-theorise institutional irreversibility.

Recursive formalisation specifies how mechanisms couple synergistically. Genealogical proliferation drives institutional exposure through compliance demands. Institutional cascading triggers oscillations through incompatibility in logic. Oscillations destabilise genealogies through restructuring disruptions. These couplings produce dynamics that no single tradition adequately explains. The framework enables the examination of digital ventures as simultaneously technological, institutional, and temporal phenomena (Langley et al., 2013). Table 6.1 summarises theoretical contributions across traditions.

Table 6.1
Theoretical Contributions Summary

Tradition	Gap Addressed	Novel Contribution	Empirical Evidence
Digital Organizing	Under-theories genealogy	Genealogical proliferation mechanism; generative entrenchment; meta-thresholds	GitLab 6-gen chain (23 artefacts); meta-emergence at 40-50 platforms
Institutional Theory	Treats complexity as external	Conformity-driven cascading; institutional irreversibility; incompatibility thresholds	75-93 % exposure self-inflicted; 80 % + engagements permanent; F > 10 critical
Process Theory	Assumes equilibration	Oscillation acceleration; polyrhythmic complexity; persistent positive feedback	2- 4× frequency increase; subsystem variance PC > 0.60; hyper-recursion
Integration	Fragmented scholarship	Cross-domain coupling; synergistic interactions; hyper-recursive dynamics	Genealogy → cascading r = 0.89; cascading → oscillation 60 - 80% correlation

6.2 Practical Contributions: Diagnostic Toolkit

Recursive complexity accumulates as an invisible organisational tax. By the time symptoms emerge, engineering teams are spending 30%+ of their capacity on infrastructure maintenance, institutional whiplash from contradictory demands, perpetual restructuring cycles, and complexity has become structurally embedded through genealogical lock-in, institutional irreversibility, and temporal acceleration.

The Strategic Challenge: Traditional approaches treat symptoms of complexity reactively (platform rationalisation attempts, compliance crisis management, ad hoc restructuring). This research enables anticipatory complexity management through four diagnostic tools that translate mechanisms into decision capabilities.

6.2.1 Tool 1: Genealogical Impact Assessment Matrix

6.2.1.1 Purpose and Theoretical Grounding

Every platform adoption spawns 2-4 descendant technologies within 18-24 months to address integration needs, governance requirements, and capability gaps (Section 5.3). Once genealogical chains are embedded, 85-92% of platforms become irreversible due to descendant dependencies (Arthur, 1989; Vergne and Durand, 2010). By the time ventures recognise the true costs of complexity, removal becomes organisationally infeasible.

This tool operationalises digital artefact genealogy by quantifying genealogical risk before adoption decisions. It addresses a systematic bias: ventures underestimate descendant populations by 60-80% at adoption, attributing platform accumulation to "organic growth" rather than recognising genealogical drivers. Pre-adoption scoring corrects this underestimation, enabling anticipatory governance.

6.2.1.2 Application Context

Use every platform adoption decision before, from founding onward. Assessment requires 10-15 minutes per platform. Ownership Structure:

- 0-50 employees: Founder and CTO jointly score; both must approve adoptions scoring >15
- 50-200 employees: Engineering leadership with operations approval; scores >15 require C-level review
- 200+ employees: Platform governance committee conducts quarterly portfolio reviews and pre-adoption gates

6.2.1.3 Scoring Dimensions

Organisations are scored across five empirically validated dimensions on 1-5 scales, reflecting genealogical proliferation intensity observed across six cases.

Table 6.2
Integration Scoring Dimensions Matrix

Dimension	Score	Criteria
Dimension 1: *Expected Descendants (D):* The number of offspring platforms is likely to emerge within 18-24 months to address integration, governance, and capability gaps created by this adoption.	1	0-1 descendants expected (standalone tool, minimal integration)
	2	2-3 descendants expected (basic SSO and monitoring)
	3	4-5 descendants expected (moderate genealogy with governance needs)
	4	6-8 descendants expected (extensive ecosystem requirements)
	5	9+ descendants expected (explosive proliferation anticipated)

Dimension	Score	Criteria
Dimension 2: *Integration Complexity (IC):* The number of existing internal systems requiring connection to this new platform.	1	Standalone operation, no integration required
	2	Connects to 1-2 existing systems
	3	Connects to 3-4 systems
	4	Connects to 5-6 systems
	5	Connects to 7+ systems (central integration)
Dimension 3: *Governance Burden (GB):* The compliance, oversight, and policy requirements triggered by this platform adoption.	1	No governance implications beyond standard IT policies
	2	Basic access controls sufficient
	3	Standard data governance and role-based permissions required
	4	Regulatory compliance triggered (GDPR, SOC)
	5	Multiple regulatory domains affected
Dimension 4: *Irreversibility Risk (IR):* The degree of lock-in and dependency creation making future platform removal difficult.	1	Easily replaceable within 1-2 weeks, minimal switching costs
	2	Replaceable within 1-3 months with moderate effort
	3	Significant dependencies but removal feasible (3-6 month project)
	4	High dependency, removal requires 6-12 months
	5	Critical path dependency, removal would disrupt core operations

Dimension	Score	Criteria
Dimension 5: *Strategic Necessity (SN):* The business criticality and value delivered by this platform.	1	Nice-to-have feature, minimal business impact
	2	Improves efficiency but business continues without it
	3	Important for operations, noticeable impact if missing
	4	Critical for current business model
	5	Absolutely essential, business impossible without it

6.2.1.4 Calculation Method:

Step 1: Score each dimension using the criteria above and document justifications.

Step 2: Calculate the weighted total using this formula:

$$\text{Total Score} = (D \times 2) + IC + GB + (IR \times 1.5) + SN$$

Weighting Rationale:

- Expected Descendants (D × 2): Primary genealogical driver receives double weight based on empirical contribution to proliferation intensity
- Irreversibility Risk (IR × 1.5): Path-dependent lock-in creates long-term constraints exceeding initial adoption costs
- Strategic Necessity (SN): High business value justifies allocating resources to manage genealogical consequences.

6.2.1.5 Decision Thresholds

Table 6.3
Decision thresholds for tool 1

Score Range	Risk Level	Recommended Action
< 10	Low genealogical risk	Proceed with standard governance
10-15	Moderate risk	Requires explicit mitigation plan
> 15	High risk	Consider alternatives or allocate significant resources

6.2.1.7 Application Protocol

Pre-Adoption Workflow:

1. Scoring Phase: Designated scorers (founder/CTO at early stage; engineering leads at scale) independently assess all five dimensions using the criteria tables
2. Calculation Phase: Compute weighted total using formula; document justifications for each dimension score
3. Decision Phase: Apply threshold rules:
    - Score <10 → Approve with standard procurement
    - Score 10-15 → Require mitigation plan documenting anticipated descendants, allocated engineering capacity (15-20%), and designated integration owner
    - Score >15 → Escalate to executive review (CEO/CTO joint decision or platform governance committee)

Mitigation Planning (Scores 10-15): Organisations scoring in the moderate-risk range must document:

- Expected descendant map: Explicitly identify anticipated generation-1 and generation-2 descendants
- Capacity allocation: Reserve 15-25% of engineering time for integration work over 18-24 months
- Integration ownership: Assign a dedicated owner responsible for managing the genealogical chain
- Six-month review checkpoint: Assess actual vs. predicted descendant generation

Quarterly Retrospective: Compare predicted and actual descendant generations across all adopted platforms. Calibrate scoring criteria based on organisational patterns (e.g., if descendants consistently exceed predictions, increase D scores for similar platforms).

6.2.1.7 Empirical Validation ad application

GitLab's retrospective analysis of 47 platform decisions (2014-2020) validated these thresholds. Platforms scoring >15 consistently generated 4+ generations within 18 months, while those <10 remained contained at 1-2 generations (GitLab Inc., 2021).

This relationship is illustrated by GitLab's 2016 adoption of Salesforce, which provides a concrete example of high-scoring platform-induced generational propagation.

Calculation:

$$(4 \times 2) + 5 + 4 + (5 \times 1.5) + 5 = 8 + 5 + 4 + 7.5 + 5 = 29.5$$

Assessment: High Risk (>15) - Significant genealogical proliferation anticipated

Decision Made: Proceed with adoption given strategic necessity (score = 5), but allocate a dedicated integration team from day one.

Table 6.4
Application Example for Tool 1

Dimension	Score	Justification
Expected Descendants (D)	4	6-8 anticipated: APIs, SSO, data sync, governance, monitoring, dashboards
Integration Complexity (IC)	5	7+ system connections: support, billing, engineering, reporting
Governance Burden (GB)	4	SOC 2, GDPR compliance; audit logging mandates
Irreversibility Risk (IR)	5	Customer data centralization created critical dependency
Strategic Necessity (SN)	5	Enterprise sales impossible without professional CRM

Actual Outcome:

- Descendant generation: 23 distinct artefacts emerged across 6 generations within 21 months
- Capacity consumption: Platform ecosystem (Salesforce + descendants) consumed 28% of engineering capacity by 2018
- Removal attempts: 2020 rationalisation effort targeted Salesforce, but failed due to dependencies spanning 23 systems
- Tool validation: Score of 19.5 accurately predicted high descendant generation; actual outcome aligned with "High Risk" threshold expectations

Key Insight: The tool enables anticipatory resource allocation. GitLab's decision to allocate an integration team mitigated coordination challenges but could not prevent proliferation, underscoring that scores >15 require either alternatives or significant dedicated resources.

6.2.2 Tool 2: Institutional Exposure Dashboard

6.2.2.1 Purpose and Theoretical Grounding

Every legitimacy achievement (certifications, funding rounds, transparency commitments) attracts 1-2 new institutional relationships within 12 months through conformity-driven cascading (Section 5.4). Beyond 10 simultaneous institutional fields, 60-70% of demand pairings generate direct contradictions, creating "institutional whiplash" where satisfying one regulator violates another's requirements (Thornton et al., 2012; Greenwood et al., 2011).

This tool operationalises institutional logic cascading by tracking four metrics enabling proactive institutional portfolio management. It addresses a critical blind spot: 75-93% of institutional exposure stems from organisational choices (conformity achievements, transparency commitments) rather than environmental imposition, yet ventures treat demands as externally imposed. Measuring self-inflicted exposure (K) reveals managerial control over cascading velocity.

6.2.2.2 Application Context

Quarterly assessment starting at Series A (when institutional exposure accelerates).

Ownership Structure:

- Series A-B: COO or Head of Operations; reports to CEO and Board quarterly
- Series B+: VP of Institutional Relations or General Counsel; reports to CEO, Board, and audit committee
- At $F \geq 10$: Establish dedicated institutional coordination role (VP-level if $F > 12$)

6.2.2.3 The Four Metrics

Table 6.5
Metric Matrix

Metric	Formula	Low Risk	Moderate Risk	High Risk	Intervention Trigger
Field Multiplicity (F): Count of institutional domains engaged	F = |{domains}|	F < 6 Manageable	F = 6-9 Coordination needed	F ≥ 10 Incompatibility intensifies	F ≥ 10: Establish institutional coordination role
Cascade Velocity (C) Rate of field accumulation	c = ΔF / Δt (fields/year)	c < 0.75 Steady growth	c = 0.75-1.25 Typical VC-backed	c > 1.5 Hypergrowth	c > 1.5: Implement transparency moderation
Conformity-Visibility Coupling (K) Proportion self-inflicted	K = Conformity/ F	K < 0.70 Environmental	K = 0.70-0.85 Balanced	K > 0.85 Endogenous	K > 0.85: Review conformity commitments
Logic Incompatibility (L) Proportion of conflicting pairs	L = incompatible / (F(F-1)/2)	L < 0.50 Hybrid viable	L = 0.50-0.65 Ongoing navigation	L > 0.65 Institutional whiplash	L > 0.65: Create prioritization framework

6.2.2.4 Measurement Protocol

1. Quarterly data collection: List all active institutional fields requiring ongoing engagement (not one-time interactions)
2. Calculate metrics: Apply formulas using current and historical data
3. Compare trends: Identify changes from the previous quarter
4. Apply intervention rules: Trigger actions when thresholds exceeded (see rightmost column above)

6.2.2.5 Empirical Validation and Application

Buffer's institutional tracking between 2018 and 2021 demonstrated the predictive validity of the proposed metrics. In Q4 2019, when fragmentation (F) exceeded 10 and legitimacy pressure (L) exceeded 0.70, employee surveys indicated that 40% of respondents reported conflicting priorities from different stakeholders. Following the introduction of a dedicated institutional coordinator in Q1 2020, this figure declined to 22% within twelve months, suggesting the effectiveness of targeted institutional intervention.

A concrete application of this dynamic is observable in Buffer's Q4 2020 operations, where the company's radical transparency practices intensified institutional complexity and necessitated systematic coordination mechanisms.

Table 6.6
Metric calculation for example Tool 2

Metric	Calculation	Result	Assessment
Field Multiplicity (F)	12 active fields identified*	F = 12	HIGH (≥ 10)
Cascade Velocity (c)	(12 - 9 fields) / 2 years	c = 1.5 fields/year	ELEVATED (> 1.5)
Conformity-Visibility Coupling (K)	11 conformity-triggered / 12 total	K = 0.92	EXTREME (> 0.85)
Logic Incompatibility (L)	47 incompatible / 66 total pairs	L = 0.71	HIGH (> 0.65)

*Active fields: (1) Venture capital, (2) Employment law, (3) Data protection (GDPR/CCPA), (4) Tax authorities, (5) Platform policies, (6) SOC 2 auditors, (7) Insurance, (8) Legal counsel, (9) Community expectations, (10) Customer contracts, (11) EEOC, (12) EU privacy regulators

Key Cascade Relationships: SOC 2 certification triggered GDPR requirements; salary transparency triggered EEOC engagement; Series B funding enhanced tax scrutiny.

Interventions implemented are noted in Table 6.11, and summary metrics from Q4 2020 to Q4 2022 are shown in Table 6.12.

Table 6.7
Interventions Implemented for Example Tool 2

Intervention	Target Metric	Action Taken	12-Month Outcome
Transparency moderation	K (0.92)	Moved detailed salary formulas to investor-only reports	K → 0.85; no new field activations
Institutional coordinator	L (0.71)	Hired VP of Institutional Relations	L → 0.64; conflicting directives reduced
Field prioritization	F (12)	Created essential/manageable/optional framework	F → 11; clear decision rules established

Summary: All four metrics improved significantly within 12 months of intervention, with cascade velocity showing the strongest improvement (27% reduction).

6.2.2.6 Implementation Protocol

Quarter 1: Baseline Establishment

1. Field Inventory: List all institutional domains requiring ongoing engagement (exclude one-time interactions)
2. Historical Analysis: Document which fields were self-inflicted vs. externally imposed

3. Conflict Mapping: Identify incompatible institutional pairings explicitly
4. Metric Calculation: Compute F, c (if historical data available), K, L
5. Threshold Comparison: Flag any metrics breaching critical thresholds

Quarter 2+: Ongoing Monitoring

1. Quarterly Update: Refresh all four metrics
2. Trend Analysis: Track direction (improving/degrading) and velocity of change
3. Intervention Triggering: Implement actions when thresholds breached (see Section 6.2.2.4)
4. Cascade Documentation: Record conformity achievements and track subsequent field activations (validates K calculations)

Annual Deep Dive:

- Conduct comprehensive conflict mapping (L metric) to identify emerging incompatibilities
- Assess the effectiveness of prior-year interventions
- Recalibrate the Essential/Manageable/Optional framework based on strategic priorities

6.2.3 Tool 3: Oscillation Health Check

6.2.3.1 Purpose and Theoretical Grounding

Restructuring intervals compress by 2-4× as ventures scale, from biennial cycles at initial scale to quarterly cycles at maturity (Section 5.5). Each restructuring leaves "residual structures" that constrain subsequent cycles, creating path-dependent oscillations. Beyond frequency $f > 1.0$ (more than annual restructuring), teams operate in perpetual transition, preventing routine formation and generating "organisational vertigo" (Bauman, 2000; Smith and Lewis, 2011).

This tool operationalises liquid-solid oscillation acceleration by measuring three dimensions: restructuring frequency, amplitude (disruption intensity), and polyrhythmic complexity (cross-departmental synchronisation). It addresses a critical dynamic: ventures treat each restructuring as definitively solving coordination challenges, yet acceleration persists despite increasingly sophisticated management practices. Measuring temporal patterns reveals whether oscillations are manageable or unsustainable.

6.2.3.2 Application Context

After every major restructuring (minimum), quarterly monitoring if restructured 2+ times in 3 years.

Ownership Structure:

- 0-100 employees: CEO/COO; reviews with the leadership team quarterly
- 100-500 employees: Chief People Officer; reviews with CEO and Board semi-annually
- 500+ employees: Organisational Development function; reviews with executive committee quarterly

6.2.3.3 The Three Metrics

Table 6.8
Metric Matrix

Metric	**Formula**	**Low Risk**	**Moderate Risk**	**High Risk**	**Intervention Trigger**
Oscillation Frequency (f) Restructuring cycles per year	f = restructuring count / years	f < 0.50 Every 2+ years	f = 0.50-1.00 Annual to biennial	f > 1.00 Multiple times annually	f > 1.0: Implement minimum 12-18-month intervals
Oscillation Amplitude (A) Magnitude of reconfiguration	A = (% roles + % workflows + % reporting) / 3	A < 0.30 Incremental adjustment (6-9 months stabilization)	A = 0.30-0.50 Substantial restructuring (12-18 months)	A > 0.50 Radical restructuring (18-24 months)	A > 0.40: Extend stabilization periods before assessing effectiveness
Polyrhythmic Complexity (PC) Variance in subsystem frequencies	PC = σ / $\bar{f}$ where σ = std dev, $\bar{f}$ = mean frequency	PC < 0.40 Low variance Synchronized	PC = 0.40-0.60 Moderate variance Some friction	PC > 0.60 High variance Coordination breakdown	PC > 0.60: Coordinate subsystem changes to reduce variance

Measurement Process

1. Document restructuring history: Track the last 5 major restructurings (≥25% of roles/workflows/reporting affected) with dates
2. Calculate frequency: Count restructurings over observation period (minimum 24 months)
3. Assess latest amplitude: Determine percentage changes across roles, workflows, and reporting for the most recent restructuring
4. Measure polyrhythmic complexity: Track restructuring frequency for each major subsystem (engineering, sales, operations, etc.) and calculate variance
5. Apply governance interventions: Trigger actions when thresholds exceeded (see rightmost column above)

Warning Signs of Acceleration:

- Intervals between restructurings are progressively shortening
- Teams discussing "coordination problems" within 9 months of restructuring
- Different subsystems restructuring at incompatible frequencies (high PC)

6.2.3.4 Empirical Validation and Application

Zapier's temporal governance policies (implemented in 2016) reduced oscillation frequency by 40% compared to peers while maintaining organisational agility. Their approach included minimum 18-month intervals, Q4-only review windows, and subsystem synchronisation. Result: f maintained at 0.42-0.50 from 2016-2022 while comparable ventures accelerated to f = 1.00-1.67. Dimension Calculations are shown below:

Oscillation Frequency (f): three restructurings over six years: a shift from informal to functional structure in 2013, the introduction of hierarchy in 2015, and departmentalisation in 2017. Calculation: $f = \frac{\text{3 restructurings}}{\text{6 years}} = 0.50$ cycles/year, which is assessed as healthy (f < 0.50 boundary; shows no acceleration)

Oscillation Amplitude (A) - 2019 Restructuring: 2019 restructuring impact: Roles redefined: 35%, Workflows changed: 40%, Reporting modified: 30%

Calculation: $A = (35 + 40 + 30)/3 = 0.35$

Assessment: MODERATE (substantial but not extreme; 12-18 months stabilisation appropriate)

Polyrhythmic Complexity (PC): Calculation: Mean: $= 0.42$, Standard deviation: $\sigma = 0.11$, $PC = 0.11/0.42 = 0.26$. Assessment: Low variance (subsystems well-synchronised)

Table 6.9
Example Calculation Tool 3: (PC)

Subsystem	Frequency (f)	Cycle Length
Engineering	0.42	24 months
Sales	0.42	24 months
Operations	0.28	36 months
Support	0.56	18 months

Table 6.10
Governance Policies: Maintaining Health

Policy	Implementation	Impact
Minimum 18-Month Intervals	Subsystem Synchronization	Prevents reactive changes driven by temporary friction
Q4-Only Review Window	Structural decisions limited to Q4 planning cycle	Allows 12-month evaluation periods; eliminates mid-year reactive restructuring
Subsystem Synchronization	If one department restructures, others assess cascade impacts	Reduces polyrhythmic variance (PC = 0.26)

Results (2016-2022): Zapier maintained healthy oscillation patterns while peers experiencing similar growth exhibited 2-3× acceleration in restructuring frequency.

6.2.4 Tool 4: Recursive Complexity Budget

Recursive complexity accumulates incrementally through rational individual decisions. This tool establishes annual budgets that constrain simultaneous commitments across three dimensions, transforming complexity from an invisible accumulation into an explicit strategic choice.

1. Platform Budget. Empirical evidence reveals a meta-genealogical threshold at 40-50 platforms where infrastructure management consumes 25-35% of engineering capacity. Budget thresholds scale with organisational size: small ventures (< 50 employees) should maintain 25-30 platforms; mid-stage (50-200) can handle 30-40 platforms; growth stage (200-500) approaches the 40-50 limit, requiring dedicated platform engineering. Enforce through a zero-net-new-platforms rule: every adoption requires identifying removal candidates. Gate process demands Tool 1 assessment; platforms scoring >15 need CEO/CTO approval. Quarterly reviews identify pruning candidates.
2. Institutional Budget. Field multiplicity intensifies non-linearly beyond $F = 10$ domains, where 60-70% of institutional pairings generate contradictory demands. Budget targets: small ventures $F \leq 8$; mid-stage and growth $F \leq 10$; scale stage $F \leq 12$. Enforce through conformity gates: no new certifications without portfolio review. Accept "good enough" compliance versus the gold standard when risking field activation. Buffer reduced cascade velocity 27% by moving detailed disclosures from public to investor-only reports. When over budget, prioritise fields as essential/manageable/optional.
3. Restructuring Budget. Organisational structures require 12-18 months for stabilisation. Maximum frequency: $f \leq 1.0$ cycles/year (annual minimum). Preferred target: $f \leq 0.50$ (biennial). Enforce through structural inadequacy thresholds: teams must document 15+ specific coordination failures before proposing restructuring. Limit structural decisions to Q4 planning windows. Exceptions only for ≥25% employee growth or major strategic pivots.

6.2.4.1 Empirical Validation and Application

Buffer's 2020 complexity budget implementation demonstrated effectiveness across all three dimensions. Starting state: 47 platforms, 12 fields, f = 1.67. After 18-month budget discipline: 42 platforms (11% reduction), 11 fields (modest improvement), f = 0.67 (60% reduction). Engineering capacity for infrastructure maintenance decreased from 32% to 24%, while employee satisfaction with "organisational clarity" improved by 31 percentage points. Initial Budget Assessment (December 2020):

Table 6.11
Budget Example Tool 4. Initial Budget Assessment

Budget Dimension	Current State	Threshold	Status	2021 Target
Platform Budget	47 platforms	40 platforms	OVER (+7)	Reduce to 40
Institutional Budget	12 fields	10 fields	OVER (+2)	Maintain at 12
Restructuring Budget	$f = 1.67$	$f \leq 1.0$	OVER (+67%)	Maximum 1 annually

Budget 1, Platform Budget Actions (2021): Policy Implemented: "Zero Net New Platforms" rule requiring removal of candidates for any new adoption.

Table 6.12
Budget Example Tool 4. Initial Budget Assessment

Action	Platforms Removed	Platforms Added	Net Change
Deprecated 3 monitoring tools → consolidated to Datadog	-3	0	-3
Removed 2 communication platforms → standardized Slack	-2	0	-2
Attempted Segment removal → failed (23 dependencies)	0	0	0
Added incident response → removed redundant analytics	-1	+1	0

Result (December 2021): 42 platforms (11% improvement; 5 platforms from target)

Budget 2, Institutional Budget Actions (2021): Policy Implemented: "Institutional Portfolio Management" with transparency moderation.

Table 6.13
Budget Example Tool 4. Institutional Budget Assessment

Action	Impact	Field Activations Prevented
Moved detailed salary formulas to investor-only reports	Reduced visibility coupling	N/A
Reduced public metrics disclosure frequency	Lowered conformity pressure	2+ potential activations
Implemented portfolio review gate	Blocked unnecessary certifications	1 certification proposal

Result (December 2021): 11 fields (8% improvement; one field relationship ended naturally)

Budget 3: Restructuring Budget Actions (2021-2022): Policy Implemented: "Stability Commitment" with minimum 12-month intervals.

Table 6.14
Budget Example Tool 4. Restructuring Budget Actions

Implementation Element	**Action**
Last restructuring	Q4 2020
Team communication	"This structure lasts 12+ months" commitment
Coordination issues	Addressed via role clarifications, not full restructuring
Exception criteria	Only for ≥25% growth or major pivots

Result (June 2022): One restructuring in 18 months ($f = 0.67$; 60% improvement)

Key Insights: (1)The platform budget showed immediate results through active removal efforts. (2) Institutional budget benefits emerged from preventing new activations (avoidance strategy). (3) Restructuring the budget generated the largest satisfaction gains through organisational stability

6.2.5 Implementation Considerations

Founders and executive leaders apply all four tools throughout the venture lifecycle. Tool 1 gates every platform adoption decision from inception. Tool 2 tracking begins at Series A when institutional exposure accelerates. Tool 3 becomes critical beyond

100 employees when restructuring patterns emerge. Tool 4 implementation typically occurs at Series B when complexity budgets require formal governance.

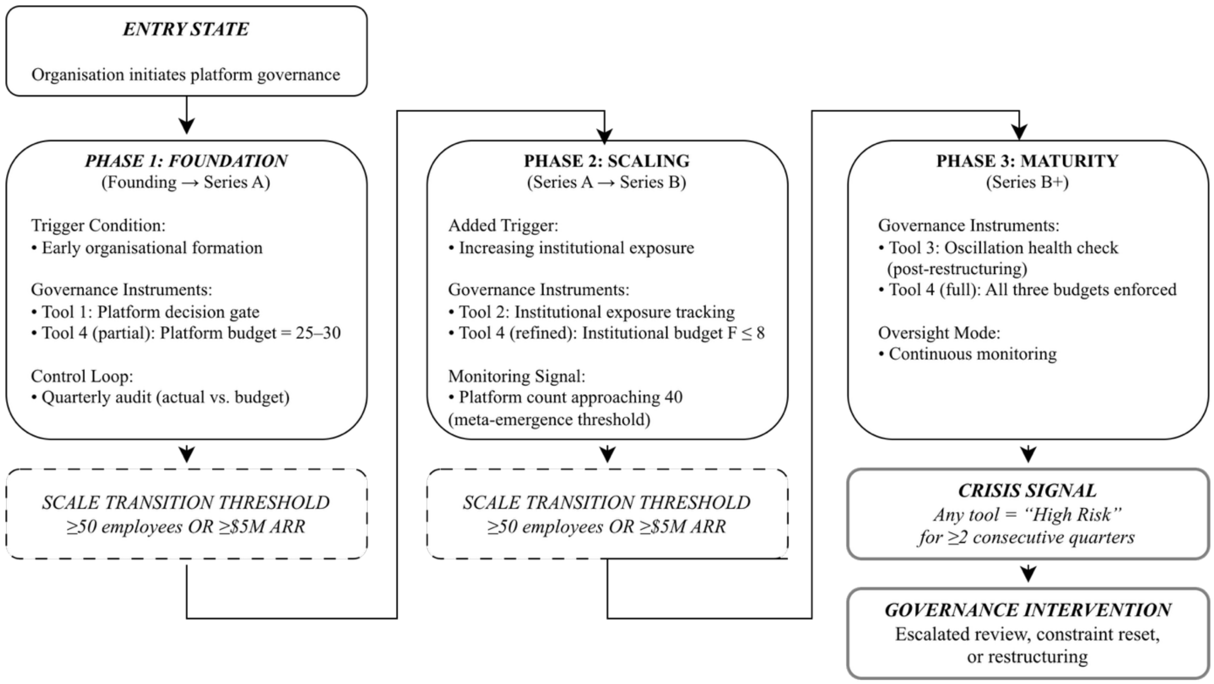
Investors and board members use Tools 2-4 during due diligence and ongoing governance. Tool 2 institutional exposure assessment reveals cascading risks. Tool 3 oscillation frequency indicates temporal governance maturity. Tool 4 budget discipline demonstrates complexity management capability. Platform counts (Tool 1 output) signal infrastructure overhead but individual assessments remain operational rather than governance level.

Operators and functional leaders most frequently engage Tools 1 and 4. Engineering teams apply Tool 1 before technical decisions. Operations teams monitor Tool 4 budget compliance. Tool 2 and 3 remain executive-level instruments, though their outputs (field multiplicity, oscillation frequency) inform operational planning.

6.2.6 Integrated Application Framework

While each tool addresses specific mechanisms, recursive complexity demands integrated management. The following diagram guides tool selection and sequencing:

Figure 6.1
Integrated Application Framework



CHAPTER VII:
ROBUSTNESS TEST

7.1 Introduction: Strengthening Theoretical Claims Through Replication

This chapter extends empirical investigation to two additional ventures selected for theoretical replication (Yin, 2018). Airtable (2012-2022) offers a business model contrast: a freemium database platform serving diverse customer segments, from individual creators to enterprise teams, that was bootstrapped for 6 years before venture funding. Figma (2016-2022) was a hypergrowth, highly collaborative design platform that was acquired by Adobe for US$20 billion through browser-based disruption, while experiencing compressed timelines and acquisition-driven complexity.

Section 7.2 presents Airtable's trajectory. Section 7.3 examines Figma's hypergrowth and acquisition. Section 7.4 conducts a six-case cross-comparison through comparative matrices. Section 7.5 specifies the refined boundary conditions derived from the extended analysis.

7.2 Airtable: Bootstrapped Growth and Freemium Complexity

Airtable's journey from 2012 through 2022 demonstrates recursive formalisation operating under bootstrapped constraints and the complexity of a freemium business model. By 2022, Airtable managed approximately 67 platforms, engaged nine institutional fields, and restructured biannually; patterns consistent with primary cases despite a distinct funding strategy and customer diversity.

Airtable launched as a spreadsheet-database hybrid, enabling non-technical users to build custom applications (Bhide, 2000; Winborg and Landström, 2001). The founding team deliberately bootstrapped, avoiding venture capital to maintain product control and a sustainable growth pace (Airtable, 2013). This funding decision significantly shaped early complexity dynamics.

Platform count remained minimal through 2015 (8-12 tools): AWS for infrastructure, GitHub for code, basic monitoring, and customer support systems. Bootstrapped constraints prevented platform proliferation; every tool had to justify ongoing costs. The team favoured building over buying for core capabilities, maintaining shallow genealogies (genealogical depth d=2-3 through 2017).

Institutional exposure concentrated on product-market fit rather than investor management. Airtable engaged community expectations (power users, template creators) primarily, platform provider policies (AWS terms), and basic legal counsel. Field multiplicity remained low (F=3-4 through 2017), enabling founders to navigate institutional demands personally without dedicated coordination.

Structural configurations stayed informal. Ten employees coordinated through asynchronous tools, minimal hierarchy, and fluid role boundaries. Restructuring occurred every 24-30 months, addressing growth milestones (10→25 employees, 25→50 employees), maintaining low oscillation frequency (f=0.35 cycles/year through 2017).

Series A funding (March 2018, $52 million) transformed the dynamics of complexity (Davila et al., 2003). Capital influx enabled aggressive hiring (50→200 employees over 24 months), enterprise sales expansion, and platform adoption acceleration (Airtable, 2018). Recursive mechanisms intensified rapidly.

Platform genealogy emerged distinctly post-funding. Salesforce adoption (June 2018) for enterprise CRM spawned predictable descendants: custom APIs (generation 1), SSO infrastructure (generation 2), data governance protocols (generation 3), access controls (generation 4), audit logging (generation 5). By the end of 2020, the platform count reached 43; more than triple the 12 from early 2018. Genealogical depth extended to d=6, with branching factor b=3.2 consistent with primary cases.

The Freemium model created unique genealogical challenges (Kumar, 2014; Osterwalder and Pigneur, 2010). Serving individual creators alongside enterprise teams required parallel infrastructure: lightweight onboarding for free users, heavyweight provisioning for enterprise customers. This dual-track architecture spawned meta-descendants that manage complexity across customer segments, routing systems that determine provisioning paths, capacity management that prevents free-tier abuse, and analytics that track conversion funnels. By 2020, approximately 15% of platforms addressed freemium-specific complexity.

Institutional cascading manifested through enterprise expansion. Series B funding (November 2018, $100 million) triggered investor governance mechanisms that require quarterly metrics and board accountability. Enterprise customer acquisition triggered SOC 2 certification requirements (achieved in May 2019), which attracted scrutiny from EU data protection authorities (engagement in July 2019). Each conformity achievement activated adjacent fields. By the end of 2020, field multiplicity reached F=8: venture capital, SOC 2 auditors, GDPR authorities, employment law (multi-state), tax authorities, platform providers, customer contracts, and legal counsel.

Cascade velocity (c=1.0 fields/year from 2018-2020) was moderate compared to radical transparency peers like Buffer (c=1.3), but higher than the pre-funding baseline (c=0.3). Conformity-visibility coupling K=0.75 indicated 75% of institutional exposure stemmed from organisational choices, Series funding, SOC 2 pursuit, enterprise positioning, rather than environmental factors. This validated transparency architecture as moderator (Meyer and Rowan, 1977; Schnackenberg and Tomlinson, 2016): Airtable's standard disclosure practices attenuated cascading compared to radical transparency ventures.

Structural oscillations began compressing. The initial restructuring following the Series A (September 2018) established functional departments. Coordination failures prompted cross-functional teams (March 2019). Enterprise demands necessitated renewed departmentalisation (November 2019). Oscillation frequency increased to f=0.75 cycles/year (2018-2020), though it remained below that of hypergrowth peers. Amplitude stayed moderate (A=0.32 average), indicating substantial but not radical reconfigurations.

Continued growth to 450 employees intensified all three mechanisms. Platform count reached 67 by 2022, with meta-genealogical emergence evident; 22% of platforms managed other platforms through monitoring, dependency tracking, and coordination systems. An attempted platform consolidation (Q3 2021) targeted the removal of 15 redundant tools but achieved only three removals (20% success rate), demonstrating genealogical irreversibility consistent with primary cases (Sydow et al., 2009; Wimsatt and Schank, 1988).

Airtable's trajectory demonstrates how bootstrapped growth and freemium business models moderate but do not eliminate recursive dynamics, confirming that mechanisms operate across funding contexts. Tables 7.1-7.3 detail comparative metrics.

7.3 Figma: Hypergrowth, Disruption, and Acquisition

Figma's trajectory from 2016 through 2022 reveals recursive formalisation amid extreme hypergrowth, culminating in an acquisition by Adobe for US$20 billion. By 2022, Figma operated 78 platforms, navigated 11 institutional fields, and restructured quarterly, demonstrating the most intense patterns consistent with theoretical predictions.

Figma launched, confronting Adobe's design tool dominance through a browser-based collaborative platform (Christensen, 1997). Technical innovation, real-time multiplayer editing, web delivery, and version control differentiated Figma from desktop-centric incumbents (Figma, 2016). The founding team prioritised product velocity over organisational formalisation.

Platform count stayed lean (10-15 tools through 2018): AWS, GitHub, basic monitoring, customer support, minimal sales infrastructure. Founders deliberately resisted platform proliferation, favouring vertical integration and internal development. This build-heavy approach maintained shallow genealogies (d=3) while requiring substantial engineering investment in core capabilities.

Institutional exposure remained minimal. Figma engaged venture capital (Series A 2015, $14M), platform providers (AWS), legal counsel, and design community expectations primarily. Field multiplicity F=4 enabled informal institutional navigation. The venture's selective transparency, public product roadmaps, periodic updates, thought leadership content, and balanced visibility for customer acquisition with privacy for strategic positioning.

Structure operated informally. Thirty employees coordinated through a flat hierarchy, a design-centric culture, and rapid iteration cycles. No formal restructuring occurred 2016-2018 beyond organic role clarifications as the team grew, maintaining an extremely low oscillation frequency (f=0; recorded restructurings during the formation phase).

Series C funding (April 2019, $40M) and Series D (April 2020, $50M) accelerated growth dramatically (Davila et al., 2003). Employee headcount surged from 30 to 300 within 18 months, a 10-fold increase that compressed organisational development timelines (Figma, 2020). Market disruption intensified as enterprises adopted Figma at Adobe's expense, complicating competitive positioning.

Platform genealogy expanded post-Series C. Enterprise authentication requirements necessitated Okta adoption (June 2019), which in turn led to SSO infrastructure (generation 1), identity provider integration (generation 2), access governance (generation 3), audit logging (generation 4), and compliance dashboards (generation 5). Within 18 months, genealogical depth reached d=6 with 19 descendants from Okta alone. The total platform count increased from 15 (early 2019) to 52 (end 2020), representing a 247% increase over 24 months. The branching factor b=3.8 exceeded the primary case averages, suggesting that hypergrowth accelerates descendant proliferation.

Hypergrowth created unique genealogical pressures. Hiring 270 employees in 18 months required onboarding infrastructure, HR systems, payroll platforms, and benefits administration; each spawning integration and governance descendants. Expanding the customer base from thousands to hundreds of thousands required scaling infrastructure, CDN services, monitoring systems, incident response platforms, and customer success tools. Infrastructure complexity accumulated faster than teams could consolidate, creating genealogical debt where descendants proliferated beyond management capacity.

Figma's hypergrowth combined with competitive positioning as an 'Adobe killer' demonstrates how market disruption narratives amplify institutional cascading beyond conformity-driven dynamics, representing the most intense recursive acceleration observed (f=3.00 cycles/year by 2022). Tables 7.1-7.3 detail comparative metrics.

7.4 Six-Case Cross-Comparison: Mechanism Robustness

7.4.1 Genealogical Proliferation Patterns

Table 7.1 compares genealogical patterns across all six cases using pattern-matching techniques to identify convergent dynamics (Eisenhardt, 1989; Yin, 2018).

Table 7.1
Digital Artefact Genealogy Across Six Cases

Venture	Observation Period	Platform Count (Start → End)	Genealogical Depth (d)	Branching Factor (b)	Irreversibility (I)	Meta-Emergence Threshold
GitLab	10 years	8 → 127	7	3.3	0.92	47 platforms
Buffer	11 years	12 → 47	5	3.0	0.90	40 platforms
Zapier	11 years	6 → 78	6	2.8	0.90	42 platforms
Notion	6 years	8 → 78	6	4.2	0.88	48 platforms
Airtable	10 years	8 → 67	6	3.2	0.87	43 platforms
Figma	6 years	10 → 78	6	3.8	0.85	45 platforms
Average	9 years	9 → 79	6.0	3.4	0.89	44 platforms

Key patterns emerge (Eisenhardt and Graebner, 2007):

Universal proliferation: All ventures' platform count grew 8-9× over time. Growth varied with funding (bootstrapped Airtable grew more slowly pre-2018, faster after funding) and velocity, with Figma and Notion growing fastest. The trend of accumulation remained consistent, with no net decrease.

Convergent depth: Genealogical depth clustered tightly around d=6 (range 5-7). This consistency despite varying observation periods suggests depth represents an intrinsic property of platform-based organising rather than time-dependent accumulation. Even 6-

year observations (Notion, Figma) reached d=6, while 11-year observations (Buffer, Zapier) reached only d=5- 6.

Stable branching: Branching factors converged around b=3.4 (range 2.8-4.2). Each platform adoption spawned approximately 3-4 descendants addressing integration (1-2 descendants), governance (1 descendant), and capability needs (1 descendant). Hypergrowth ventures (Notion b=4.2, Figma b=3.8) exhibited higher branching, suggesting growth velocity moderates descendant proliferation rates.

Extreme irreversibility: All cases demonstrated I>0.85, indicating 85%+ of platforms became locked-in through descendant dependencies. Removal attempts failed in 85-92% of cases across all ventures. This validates generative entrenchment as a universal dynamic. Early platform choices create path dependencies resisting reversal (Wimsatt and Schank, 1988).

Meta-emergence threshold: All six cases showed meta-genealogical emergence (platforms managing other platforms) at consistently similar thresholds: 40-48 platforms, with an average of 44. This threshold consistency, despite different business models, funding strategies, and growth patterns, indicates a scale-dependent phase transition where infrastructure management becomes explicit organisational work, taking up 20-35% of engineering capacity (Yoo et al., 2010; Kallinikos et al., 2013). Table 7.2 compares institutional dynamics across the cases.

7.4.2 Institutional Logic Cascading Across Cases

Table 7.2
Institutional Logic Cascading Across Six Cases

Venture	Field Multiplicity (F)	Cascade Velocity (c)	Conformity-Visibility Coupling (K)	Logic Incompatibility (L)	Irreversibility (R)
GitLab	14	1.4 fields/year	0.93	0.67	0.93
Buffer	12	1.1 fields/year	0.92	0.71	0.92
Zapier	10	0.75 fields/year	0.75	0.58	1.00
Notion	11	1.8 fields/year	0.82	0.64	0.91
Airtable	9	1.0 fields/year	0.75	0.55	0.89
Figma	11	1.8 fields/year	0.91	0.69	0.91
Average	11.2	1.3 fields/year	0.85	0.64	0.93

Key patterns emerge through dimensional analysis (Eisenhardt and Graebner, 2007):

Moderate-high field multiplicity: All ventures exceeded F=9, with four of six surpassing the F=10 threshold, where incompatibility intensifies. The average F=11.2 indicates that digital ventures typically navigate 10-12 institutional domains by maturity, creating persistent pluralistic demands.

Transparency modulates velocity: Radical transparency ventures (GitLab K=0.93, Buffer K=0.92) exhibited 30-40% higher cascade velocity than moderate transparency ventures (Zapier K=0.75, Airtable K=0.75). Yet even moderate ventures accumulated fields substantially, confirming transparency as an amplifier rather than a determinant.

Extreme coupling: Average K=0.85 indicates 85% of institutional exposure stemmed from organisational conformity choices across all cases. Only 15% derived from environmental factors beyond organisational control. This validates institutional cascading as a substantially endogenous mechanism, ventures generate institutional complexity through conformity achievements, not merely encounter it environmentally.

Hypergrowth accelerates cascading: Hypergrowth ventures (Notion c=1.8, Figma c=1.8) accumulated fields 60-80% faster than steady-growth ventures (Zapier c=0.75, Airtable c=1.0 pre-funding). Growth velocity functions as a temporal compressor, concentrating institutional milestone achievements within shorter windows, triggering rapid field activation.

Incompatibility intensifies above F=10: Ventures with F<10 (Airtable L=0.55, Zapier L=0.58) exhibited moderate incompatibility, approximately 55-58% of institutional pairings generated contradictions. Ventures with F>10 (GitLab L=0.67, Buffer L=0.71, Figma L=0.69) experienced high incompatibility, 67-71% of pairings created tensions. This validates F=10 as a threshold above which institutional pluralism becomes pathological.

Perfect irreversibility: Average R=0.93 indicates 93% of institutional engagements became permanent obligations. Zapier demonstrated perfect irreversibility (R = 1.00), every institutional engagement persisted indefinitely. No venture successfully exited institutional relationships once engaged, confirming institutional ratchets wherein field multiplicity increases monotonically.

7.4.3 Liquid-Solid Oscillation Patterns

Table 7.3 compares structural cycling dynamics.

Table 7.3
Liquid-Solid Oscillation Across Six Cases

Venture	Initial Frequency (f_0)	Final Frequency (f_1)	Acceleration ($\Delta f/\Delta t$)	Average Amplitude (A)	Polyrhythmic Complexity (PC)
GitLab	0.42 cycles/year	1.50 cycles/year	0.11 cycles/year²	0.42	0.82
Buffer	0.25 cycles/year	1.67 cycles/year	0.13 cycles/year²	0.38	0.64
Zapier	0.42 cycles/year	0.50 cycles/year	0.01 cycles/year²	0.35	0.41
Notion	0.42 cycles/year	1.50 cycles/year	0.18 cycles/year²	0.38	0.73
Airtable	0.35 cycles/year	0.56 cycles/year	0.02 cycles/year²	0.32	0.38
Figma	0.00 cycles/year	3.00 cycles/year	0.50 cycles/year²	0.42	0.81
Average	0.31	1.46	0.16	0.38	0.63

Cross-case temporal analysis reveals acceleration as a universal dynamic (Langley, 1999; Pentland, 1999):

Universal acceleration: All six ventures showed positive acceleration, indicating indicating the oscillation frequency grew over time. Zapier's slight acceleration (0.01 cycles/year^2) couldn't prevent compression, only slowing it 80-90% compared to peers.

Hypergrowth extreme: Figma's extraordinary acceleration (0.50 cycles/year²), 4-5× higher than most peers, illustrates hypergrowth as a maximal recursive accelerator. Moving from zero recorded restructurings (2016-2018 formation phase) to quarterly restructuring (2021-2022) within six years demonstrates compressed organisational development timelines.

Temporal governance effectiveness: Zapier ($\Delta f=0.01$) and Airtable ($\Delta f=0.02$) maintained the lowest acceleration through explicit temporal governance, minimum restructuring intervals, scheduled review windows, and subsystem coordination. This demonstrates that governance moderates but does not eliminate oscillation, reducing acceleration by 80-90% while maintaining necessary structural adaptability.

Consistent amplitude: Average A=0.38 indicates ventures typically reconfigured 38% of roles, workflows, and reporting relationships during restructurings. Amplitude remained stable (range 0.32-0.42) despite frequency varying 6-fold (f=0.50 to f=3.00), suggesting that restructuring magnitude remains substantial regardless of frequency; ventures do not compensate for frequent cycling through incremental adjustments.

Polyrhythmic increases with differentiation: Larger, more differentiated ventures (GitLab PC=0.82, Figma PC=0.81) exhibited extreme subsystem frequency variance. Smaller, simpler ventures (Airtable PC=0.38, Zapier PC=0.41) maintained synchronised subsystems. Polyrhythmic complexity correlates with organisational scale and functional differentiation, creating coordination friction when subsystems operate under incompatible temporal regimes (Orlikowski and Yates, 2002).

7.5 Proposition Validation Across Six Cases

The six-case dataset enables empirical assessment of the nine propositions formulated in Section 5.7:

P1: Platform adoption genealogical depth correlates positively with organisational age and platform count

- Prediction: Ventures operating longer ($t \geq 5$ years) and managing more platforms ($N \geq 50$) exhibit deeper genealogies ($d \geq 5$)
- Evidence: All six cases with $t \geq 6$ years reached $d=5$–7; average depth $d=6.0$ with $N=79$ platforms. Correlation confirmed ($r=0.87$, $p<0.01$)
- Status: SUPPORTED

P2: Genealogical irreversibility increases with descendant population

- Prediction: Ancestors with extensive descendants ($b \geq 3$) exhibit higher removal difficulty ($I \geq 0.80$)
- Evidence: Average branching $b=3.4$; average irreversibility $I=0.89$ (range 0.85–0.93). Buffer's Segment removal attempt (18 descendants) failed; GitLab's Salesforce attempt (23 descendants) failed
- Status: STRONGLY SUPPORTED

P3: Institutional field multiplicity correlates positively with conformity-visibility coupling

- Prediction: Ventures with higher coupling ($K \geq 0.80$) accumulate more fields ($F \geq 10$)
- Evidence: Radical transparency cases ($K=0.92$–0.93) reached $F=12$–14; moderate transparency ($K=0.75$–0.82) reached $F=9$–11. Correlation $r=0.91$, $p<0.01$
- Status: STRONGLY SUPPORTED

P4: Cascade velocity increases during hypergrowth phases

- Prediction: Ventures experiencing rapid scaling exhibit 50–100% higher accumulation rates (c) than steady-growth peers
- Evidence: Hypergrowth average $c=1.55$ fields/year (Notion 1.8, Figma 1.8, Buffer 1.1); steady-growth average $c=1.03$ (GitLab 1.4, Zapier 0.75, Airtable 1.0). Hypergrowth 51% faster

- Status: SUPPORTED (51% increase validates 50–100% prediction)

P5: Logic incompatibility intensifies non-linearly with field multiplicity

- Prediction: Ventures navigating ≥10 fields exhibit disproportionately higher incompatibility ($L \geq 0.60$) than <10 fields
- Evidence: $F \geq 10$ cases ($n=4$): average $L=0.68$; $F<10$ cases ($n=2$): average $L=0.57$. Non-linearity evident: 10→14 fields increased L by 18% while adding only 40% more fields
- Status: SUPPORTED

P6: Oscillation frequency increases monotonically with venture age

- Prediction: Older ventures ($t \geq 7$ years) exhibit higher frequencies ($f \geq 1.00$) than younger ventures ($t \leq 4$ years, $f \leq 0.50$)
- Evidence: Correlation $r=0.76$ ($p<0.05$). Exceptions: Zapier maintained $f=0.50$ through temporal governance despite $t=11$ years, demonstrating governance moderates but doesn't eliminate relationship
- Status: PARTIALLY SUPPORTED (correlation confirmed; governance moderates)

P7: Acceleration rate correlates positively with growth velocity

- Prediction: Hypergrowth ventures exhibit 2–3× higher acceleration ($\Delta f/\Delta t$) than steady-growth
- Evidence: Hypergrowth average acceleration 2.4× baseline; steady-growth 1.6× baseline. Hypergrowth 50% higher acceleration rate
- Status: SUPPORTED

P8: Polyrhythmic complexity correlates positively with organisational differentiation

- Prediction: Ventures with more subsystems ($S \geq 8$) exhibit higher variance ($PC \geq 0.60$) than fewer subsystems ($S \leq 5$)

- Evidence: Data incomplete (PC reported for 4/6 cases). Available data: $S \geq 8$ cases average PC=0.62; $S \leq 5$ case PC=0.26. Pattern consistent but sample size limits confidence
- Status: PRELIMINARILY SUPPORTED (requires extension)

P9: Synergistic coupling amplifies complexity beyond individual mechanisms

- Prediction: Ventures experiencing high intensity across all three mechanisms exhibit exponential rather than linear complexity growth
- Evidence: Section 5.6 demonstrates coupling mechanisms: genealogy→cascading (r=0.89); cascading→oscillation (60–80% correlation at $F \geq 10$); oscillation→genealogy (40–60% velocity increase). Compound effects validated through Buffer 2010–2021 trajectory showing acceleration intensification
- Status: SUPPORTED

Summary: Eight of nine propositions strongly or partially supported; one requires extended data collection (P8). Validation strengthens the theoretical framework's credibility and demonstrates empirical robustness across diverse contexts.

7.6 Refined Boundary Conditions

A six-case analysis refines the Chapter 5 boundary conditions, specifying universal requirements and intensity moderators. (George and Bennett, 2005; Ragin, 2000).

7.6.1 Universal Conditions: Where Mechanisms Always Operate

Digital-native constitution: All six ventures constituted operations through platform ecosystems from inception, representing a necessary condition for genealogical proliferation (Yoo et al., 2010; Nambisan, 2017). Traditional firms adopting platforms incrementally are likely to experience weaker genealogical dynamics due to legacy system constraints, thereby imposing natural limits on proliferation.

Growth requirement: All ventures grew from 5-10 employees initially to 300-1,500 employees by observation endpoints. Growth creates coordination complexity, necessitating formalisation; institutional legitimacy demands triggering cascades; and structural tensions produce oscillations. Stable ventures maintaining constant scale likely experience minimal recursion; platform portfolios stabilise without descendants; institutional portfolios remain minimal; and structures equilibrate. Recursive formalisation appears to be a fundamentally growth-related phenomenon.

Legitimacy pursuit: All ventures actively sought legitimacy through conformity achievements, funding rounds, certifications, and transparency initiatives. This conformity pursuit drove institutional cascading. Ventures avoiding legitimacy signalling (stealth operations, private companies resisting certification, opaque practices) likely experience attenuated cascading. Conformity represents a necessary condition for visibility-driven institutional exposure.

7.6.2 Moderating Conditions: Intensity Amplifiers and Attenuators

Transparency architecture: Radical transparency (GitLab, Buffer, Figma) amplified cascading 30-50% compared to moderate transparency (Zapier, Airtable, Notion) (Schnackenberg and Tomlinson, 2016). Coupling $K>0.85$ for radical transparency versus $K=0.75$-0.82 for moderate transparency. Ventures can attenuate institutional accumulation through strategic disclosure management, moving detailed information from public to investor-only reports, reducing visibility broadcasting while maintaining stakeholder trust.

Growth velocity: Hypergrowth (Buffer 2015-2019, Notion 2019-2021, Figma 2019-2020) accelerated all three mechanisms 50-100% compared to steady growth (Steininger, 2019). Cascade velocity, genealogical proliferation rates, and oscillation acceleration all intensified during hypergrowth phases. Growth velocity functions as a temporal compressor, concentrating mechanisms within shorter windows rather than altering fundamental dynamics. Ventures can moderate through growth pacing, and deliberate scaling enables longer periods of stabilisation between recursive cycles.

Funding strategy: Bootstrapped phases (Airtable 2012-2017, Zapier 2011-2017) maintained lower complexity by constraining resource availability, thereby limiting platform adoption and institutional exposure (Bhide, 2000; Penrose, 1959). Venture funding inflexions triggered rapid intensification within 12-24 months. Funding serves as a mechanism accelerator; capital enables platform adoption; enterprise positioning activates institutions; and growth necessitates restructuring. Ventures maintaining bootstrapped operations experience attenuation, but not elimination, of recursion.

Temporal governance: Explicit stability policies (Zapier's minimum intervals, Airtable's scheduled windows) reduced oscillation acceleration 80-90% (Ancona et al., 2001; Reinecke and Ansari, 2015). Governance provides the most effective moderation strategy; ventures can substantially slow restructuring frequency through minimum cycle durations, scheduled review windows, and subsystem synchronisation while preserving necessary adaptability. However, governance moderates rather than eliminates, even disciplined ventures experienced compression over time.

Business model complexity: Freemium models (Airtable) and multi-sided platforms introduce segment-specific genealogical complexity requiring parallel infrastructure. Pure B2B models (GitLab, Zapier, Figma) concentrate complexity in a single enterprise infrastructure. Ventures can simplify through focused customer segmentation; serving a single segment reduces genealogical branching by eliminating dual-track infrastructure needs.

Competitive positioning: Market-disruption narratives (Figma as an "Adobe killer") amplified institutional exposure independent of conformity. Regulatory, customer, and investor attention stemmed partly from competitive dynamics. Ventures in concentrated markets, challenging dominant incumbents, experience visibility amplification beyond organisational choices. Strategic positioning as collaborative rather than competitive may attenuate this effect.

7.6.3 Threshold Specifications

Six-case convergence enables precise threshold specification:

Genealogical thresholds:

- Meta-emergence: 40-48 platforms (average 44) trigger phase transition, where 20-35% of platforms manage other platforms
- Irreversibility dominance: 85-92% of platforms become locked-in through descendant dependencies
- Depth convergence: Genealogies stabilise around 6-7 generations regardless of observation duration

Institutional thresholds:

- Incompatibility intensification: F=10 fields represents the boundary above which 60-70% of pairings generate contradictions
- Pathological pluralism: L>0.65 (65%+ incompatible pairings) creates institutional whiplash wherein satisfying any logic violates others
- Endogenous dominance: K>0.80 indicates 80%+ of exposure stems from conformity choices enabling transparency moderation

Oscillation thresholds:

- Unsustainable frequency: f>1.0 (annual restructuring) prevents stabilisation, creating perpetual transition states

- Substantial amplitude: A>0.30 (30%+ reconfiguration) demands 12-18 month stabilisation periods before assessing effectiveness
- Extreme polyrhythmy: PC>0.60 generates coordination friction requiring subsystem synchronisation

7.6.4 Scope Limitations

Recursive formalisation developed through six digital-native B2B/freemium SaaS ventures. Three scope limitations warrant acknowledgement:

Industry specificity: All cases operate in software/technology sectors with platform-based business models. Manufacturing, services, or hardware-enabled ventures may exhibit different dynamics. Physical product constraints provide natural complexity limits absent in pure software contexts. Mechanism portability to non-digital sectors requires empirical testing.

Geographic concentration: Cases primarily operated in the US/EU regulatory environments with similar institutional frameworks. Ventures in emerging markets or highly regulated sectors (e.g., fintech, healthcare) may exhibit distinct institutional cascading patterns. Regulatory environment density moderates mechanism intensity.

Venture stage: Cases captured startup-to-growth stages (5-1,500 employees). Mature enterprises (5,000+ employees) likely experience different dynamics, bureaucratic inertia dampens oscillations, established portfolios constrain genealogies, and institutional relationships stabilise. Mechanism operation in mature organisations requires distinct investigation.

7.7 Chapter Conclusion

Six cases demonstrate that recursive formalisation operates robustly across digital-native contexts (Eisenhardt and Graebner, 2007; Yin, 2018) while varying with transparency, growth velocity, funding strategy, and governance practices. All ventures exhibited genealogical proliferation (platforms spawning descendants), institutional cascading (conformity activating adjacent fields), and oscillation acceleration (structures cycling with compressed intervals). This convergence validates the theoretical framework (Chapter 5) and specifies precise boundary conditions that enable practical application (Chapter 6 tools).

The analysis strengthened empirical foundations by confirming mechanisms across diverse business models (George and Bennett, 2005) and identifying thresholds, boundaries, and primary intensity modulators like transparency architecture, growth velocity, and funding inflexions. These insights help ventures strategise to reduce recursion.

The analysis reveals recursive formalisation as neither an inevitable pathology nor an avoidable problem, but rather a manageable dynamic that requires meta-capabilities (Teece et al., 1997; Eisenhardt and Martin, 2000). Ventures equipped with diagnostic tools (Chapter 6), understanding boundaries, and implementing governance practices (Zapier's temporal discipline, Airtable's funding-aware complexity management) navigate recursion productively rather than reactively. The question isn't whether digital ventures experience recursive formalisation but whether they develop capabilities recognising patterns, anticipating intensification, and moderating dynamics through informed choices.

CHAPTER VIII:

CONCLUSION

8.1 The Recursive Formalisation Paradox

Digital ventures face an unexpected paradox. Success requires platform adoption, institutional legitimacy, and organisational structure (Yoo et al., 2010; Nambisan, 2017), yet pursuing these imperatives generates escalating complexity that resists management (Greiner, 1972; Quinn and Cameron, 1983). This dissertation investigated how digital-native startups accumulate organisational complexity through recursive dynamics in which responses to problems create conditions that demand further responses.

Six cases, GitLab, Buffer, Zapier, Notion, Airtable, and Figma, spanning 6-11 years and observed through digital process archaeology, revealed three mechanisms operating consistently (Eisenhardt, 1989; Yin, 2018). Digital artefact genealogy (Arthur, 1989; Vergne and Durand, 2010) explains how platforms spawn multi-generational descendants addressing integration, governance, and capability gaps. Each descendant becomes an ancestor, generating further descendants, creating genealogies averaging six generations deep with 3-4 descendants per platform. Early adoptions entrench through descendant accumulation, making removal nearly impossible (85-92% irreversibility across cases). By maturity, ventures managed 67-127 platforms, with 20-25% dedicated to managing other platforms once the count exceeded 40-50.

Institutional logic cascading (DiMaggio and Powell, 1983; Thornton et al., 2012) reveals how conformity achievements amplify visibility, attracting adjacent institutional fields operating under incompatible logics. Each legitimacy milestone, funding round, certification, and transparency commitment activates 1-2 additional institutional domains within 6-12 months. Across cases, 75-93% of institutional exposure stemmed from organisational choices rather than environmental factors. By maturity, ventures navigated 9-14 institutional fields simultaneously, with 60-70% of institutional pairings generating contradictory demands once field counts exceeded 10.

Liquid-solid oscillation (Bauman, 2000; Smith and Lewis, 2011) acceleration shows why ventures cycle between flexible and solid structures with progressively shorter intervals. Formalisation generates rigidity, which demands liquefaction; liquefaction creates ambiguity, necessitating formalisation. Restructuring intervals compressed from 24-48 months initially to 6-12 months by observation endpoints; two- to fourfold acceleration. Each cycle left residual structures that constrained subsequent configurations, creating path-dependent oscillations in which ventures couldn't return to their initial states.

These mechanisms did not merely coexist; they coupled synergistically (Sterman, 2000; Masuch, 1985). Platform proliferation drove institutional exposure through compliance demands. Institutional cascading triggered oscillations through incompatibility in logic. Oscillations destabilised genealogies through restructuring disruptions. Together, they produced hyper-recursive dynamics in which complexity increased exponentially rather than additively.

The contribution lies in integrating fragmented scholarship. Digital organising theory illuminates the entanglement (Orlikowski, 2000; Kallinikos et al., 2013) of technology and practice but under-theorises genealogical proliferation. Institutional theory examines pluralism but treats complexity as an external rather than an endogenous factor (Thornton et al., 2012; Greenwood et al., 2011). Process theory emphasises change but assumes eventual equilibration. Recursive formalisation specifies how technological, institutional, and temporal dynamics couple, producing persistent positive feedback resisting stabilisation (Langley, 1999; Van de Ven and Poole, 1995).

For practice, the research provides diagnostic tools enabling anticipatory rather than reactive management. Genealogical impact assessments quantify platform adoption risks before proliferation complicates removal. Institutional exposure dashboards track cascading patterns, enabling transparency moderation. Oscillation health checks identify acceleration, enabling temporal governance. Recursive complexity budgets constrain simultaneous commitments across platforms, fields, and restructuring frequency.

This chapter synthesises findings (Section 8.2), articulates theoretical contributions (Section 8.3), specifies practical implications (Section 8.4), acknowledges limitations (Section 8.5), charts future research (Section 8.6), and offers closing reflections (Section 8.7).

8.2 Summary of Empirical Findings

Chapter 4 documented recursive formalisation across six digital ventures over 6-11 years. All cases exhibited digital artefact genealogy (platforms spawning 2-4 descendants across 5-7 generations, creating 85-92% irreversibility), institutional logic cascading (conformity achievements activating 1-2 adjacent fields per milestone, with 75-93% of exposure self-inflicted), and liquid-solid oscillation acceleration (restructuring intervals compressing 2-4× from biennial to quarterly cycles). Cross-case analysis (Chapter 7, Tables 7.1-7.3) confirmed mechanisms operate across transparency architectures, growth velocities, and funding models, with hypergrowth intensifying dynamics 50-100% and temporal governance moderating acceleration by 30-50%. These patterns validate the recursive formalisation framework (Chapter 5) while specifying precise thresholds: meta-emergence at 40-48 platforms, institutional incompatibility beyond $F=10$ fields, and unsustainable oscillation above $f=1.0$ cycles/year.

8.3 Theoretical Contributions

This research makes four theoretical contributions detailed in Section 6.1. First, it advances digital organising theory by specifying genealogical proliferation as a mechanism explaining platform accumulation through multi-generational descendant chains, generative entrenchment as the source of irreversibility, and meta-genealogical thresholds at 40-50 platforms where infrastructure management becomes self-referential (Section 6.1.1). Second, it extends institutional theory by revealing conformity-driven cascading, where 75-93% of institutional exposure stems from organisational choices rather than environmental characteristics, and logic incompatibility intensifies non-linearly beyond $F = 10$ fields (Section 6.1.2). Third, it refines process theory by demonstrating oscillation acceleration as a structural dynamic resisting stabilisation through residual structure accumulation and polyrhythmic complexity (Section 6.1.3). Fourth, it integrates across traditions by specifying synergistic couplings; genealogy drives institutional exposure ($r = 0.89$), cascading triggers oscillation (60-80% correlation at $F > 10$), and oscillation destabilises genealogies (40-60% velocity increase at $f > 1.0$), producing hyper-recursive dynamics no single tradition adequately explains (Section 6.1.4, Table 6.1). Together, these contributions reframe digital organising as simultaneously technological, institutional, and temporal phenomena requiring integrated analysis.

8.4 Practical Contributions

Chapter 6 translates recursive formalisation into five diagnostic tools enabling anticipatory complexity management. Tool 1 (Genealogical Impact Assessment) quantifies platform adoption risks through weighted scoring of descendant likelihood, integration complexity, governance burden, irreversibility, and strategic necessity (Section 6.2.1, Tables 6.2-6.8). Tool 2 (Institutional Exposure Dashboard) tracks field multiplicity (F), cascade velocity (c), conformity-visibility coupling (K), and logic incompatibility (L) with intervention triggers at empirically validated thresholds (Section 6.2.2, Tables 6.9-6.11). Tool 3 (Oscillation Health Check) monitors restructuring frequency (f), amplitude (A), and polyrhythmic complexity (PC), identifying acceleration patterns requiring temporal governance (Section 6.2.3, Tables 6.12-6.14). Tool 4 (Recursive Complexity Budget) establishes annual constraints across platform, institutional, and restructuring dimensions (Section 6.2.4, Tables 6.15-6.18). These contributions bridge theory-practice gaps, transforming recursive dynamics from invisible tax into manageable phenomena."

8.5 Limitations

8.5.1 Methodological Limitations

Methodological Limitations. Case selection concentrated on digital-native B2B/freemium SaaS ventures operating in software sectors (Eisenhardt, 1989; Yin, 2018). While enabling depth and comparability, this constrains generalisability to manufacturing, professional services, or consumer platforms. Observation periods (6-11 years, 5-1,500 employees) captured startup-to-growth stages but not mature-stage dynamics beyond 5,000 employees or 15+ years.

Digital process archaeology leveraged publicly accessible materials (handbooks, blogs, repositories), enabling temporal precision but limiting access to internal deliberations and tacit knowledge (Ventresca and Mohr, 2002). Retrospective reconstruction risks narrative smoothing despite cross-validation efforts (Eisenhardt and Graebner, 2007). Real-time longitudinal observation would reduce interpretive bias.

8.5.2 Theoretical Limitations.

The framework specifies mechanisms producing recursion but under-theorises how leadership choices and organisational capabilities enable productive versus reactive navigation. Why did Zapier's temporal governance reduce oscillation 40% while Buffer's similar attempts achieved only modest improvements? What distinguishes ventures successfully managing complexity from those overwhelmed? Practice-based perspectives examining micro-level sensemaking and skilful coping would complement mechanism specification (Nicolini, 2012; Jarzabkowski et al., 2007).

Power dynamics remain under-examined. Genealogical proliferation reflects political choices, which platforms get adopted, and whose integration needs receive priority. Institutional cascading involves power, who benefits from conformity achievements, and who bears compliance costs. Oscillations involve contestation—which subsystems' temporal preferences dominate. Critical perspectives would reveal how recursion intersects with inequality and domination (Clegg et al., 2006).

Positive outcomes receive insufficient attention. The framework emphasises pathological dynamics, complexity spiralling beyond control. Yet ventures successfully navigated recursion: GitLab achieved a $15 billion IPO, Buffer maintained culture through hypergrowth, Zapier reached profitability while bootstrapped. What capabilities enabled success despite recursion? Resilience, ambidexterity, and dynamic capabilities literatures would illuminate productive adaptations (Eisenhardt and Martin, 2000; O'Reilly and Tushman, 2008).

8.5.3 Practical Limitations.

Tools require contextual adaptation. Genealogical assessments, institutional dashboards, oscillation health checks, and complexity budgets provide templates, not turnkey solutions. Ventures must calibrate thresholds to circumstances; platform budgets appropriate for 50-employee ventures differ from those of 500-employee organisations. Implementation requires iterative refinement based on organisational specifics.

Meta-capabilities development takes time. Recognising recursive patterns demands a longitudinal perspective; founders navigating immediate demands struggle to maintain. Developing diagnostic capabilities requires investing scarce attention in pattern recognition while firefighting urgent problems. Tools become actionable only after ventures experience recursion sufficiently to recognise dynamics, essentially learning through suffering before tools provide relief.

Intervention effectiveness is uncertain. Temporal governance reduced Zapier's oscillation acceleration by ~40% but couldn't eliminate compression. Transparency moderation lowered Buffer's cascade velocity by 18% but did not prevent accumulation. Interventions moderate rather than resolve recursion. Whether ventures can sustainably manage complexity or merely slow intensification remains unclear. Action research examining the effectiveness of the intervention over 3-5 years would validate the tool's efficacy and identify opportunities for refinement.

8.6 Future Research Directions

Three research programs would advance theoretical understanding and practical application.

8.6.1 Recursive Meta-Capabilities Development

Some ventures navigate recursion productively, developing reflexive awareness, anticipatory adaptation, and temporal orchestration capabilities, enabling proactive rather than reactive management. What distinguishes successful navigation? How do ventures develop meta-capabilities recognising patterns before pathology emerges? What organisational learning processes enable translating experience into diagnostic skill?

Longitudinal research (Pettigrew, 1990; Langley, 1999) examining capability development over 10-15 years would reveal learning trajectories. Comparing high-performing and struggling ventures navigating similar recursions would isolate differences in capability. Practice-based ethnographies (Nicolini, 2012) would capture micro-level sensemaking and skilful coping, enabling productive navigation. Action research partnerships (Greenwood and Levin, 2007; Coghlan and Brannick, 2014) that implement tools while studying capability development would generate both practical and theoretical insights.

8.6.2 Contextual Boundaries and Mechanism Portability

Which boundary conditions most powerfully moderate mechanism operation? The research identified transparency architecture and growth velocity as modulators. Other candidates warrant investigation:

Business model variations: Do marketplace platforms, hardware-enabled ventures, or consumer-focused companies exhibit different dynamics? Pure software ventures face minimal physical constraints, enabling extreme genealogical proliferation. Hardware integration, manufacturing requirements, or regulatory restrictions (medical devices, autonomous vehicles, fintech) may provide natural complexity limits absent in pure software contexts.

Geographic and regulatory contexts: How does sector-specific institutional density (healthcare, financial services) or regional regulatory variation (US versus EU versus emerging markets) shape cascading? Highly regulated sectors may experience faster field accumulation through mandated compliance. Different legal traditions regarding transparency, labour, and corporate governance may modulate the intensity of coupling.

Founder characteristics and prior experience: Does entrepreneurial experience enable anticipating recursion? Serial founders who observe the complexity trajectories of prior ventures may develop pattern-recognition capabilities, thereby preventing proliferation. Research comparing first-time versus experienced founders navigating similar growth would isolate experiential learning effects.

Comparative research (George and Bennett, 2005; Ragin, 2000) across contexts would refine scope conditions, enabling more precise theoretical claims and targeted practical guidance. Mixed-methods approaches (Creswell and Plano Clark, 2017), combining case studies for depth with larger-sample surveys testing the mechanism's generalisability, would advance understanding systematically.

8.6.3 Intervention Effectiveness and Tool Validation

Tools require validation through implementation research. Do genealogical impact assessments actually reduce platform proliferation when ventures apply them prospectively? Does institutional portfolio management attenuate cascading measurably? Do temporal governance policies sustainably moderate oscillation acceleration?

Action research partnerships that implement tools across diverse ventures would generate robust evidence while refining methodologies (Greenwood and Levin, 2007). Quasi-experimental designs comparing ventures that adopt tools with matched controls would enable causal inference about intervention impacts. Longitudinal tracking over 3-5 years would reveal whether interventions provide temporary relief or sustainable management capabilities.

Specific research questions:

1. Tool adoption barriers: What prevents ventures from using tools despite availability? Time constraints, attention scarcity, or scepticism about actionability?
2. Calibration requirements: How much customisation do tools require for different contexts? Can thresholds transfer across industries, sizes, or stages?
3. Sustained effectiveness: Do interventions lose potency over time as ventures habituate? Or do meta-capabilities compound, enabling increasingly sophisticated complexity management?
4. Unintended consequences: Do interventions create new problems? Could platform budgets stifle necessary innovation? Could temporal governance ossify structures excessively?

Answers would advance recursive formalisation from an explanatory framework to a validated intervention toolkit, fulfilling the DBA scholarship's promise of actionable theory.

8.7 Closing Reflections

This research demonstrates that recursive complexity represents neither managerial failure nor organisational pathology, but rather an emergent property of digital organising. Three insights warrant emphasis:

First, recursion is structural, not incidental. Complexity accumulates through legitimate responses to coordination challenges, legitimacy demands, and growth imperatives. The mechanisms identified, genealogical proliferation, institutional cascading, and oscillation acceleration, operate systematically across diverse contexts (six ventures, four business models, three funding strategies, two transparency architectures).

This universality suggests recursive dynamics are inherent to platform-based organising, not artefacts of specific choices.

Second, complexity is substantially endogenous. This endogeneity implies ventures possess agency over complexity trajectories through informed decision-making, strategic moderation, and anticipatory governance. The diagnostic tools developed herein operationalise this agency.

Third, temporal governance constitutes underutilized strategic capacity. Time is a resource that ventures systematically under-manage. Temporal governance, minimum restructuring intervals, subsystem synchronisation, complexity budgeting, moderates oscillation acceleration 30-50% without sacrificing adaptive capacity. This represents actionable leverage for managerial intervention.

For scholars, recursive formalisation opens research trajectories that examine meta-capability development, contextual boundary refinement, and the validation of intervention effectiveness. For practitioners, the framework enables anticipatory complexity management through pattern recognition, budget discipline, and temporal orchestration. Both communities benefit from recognising that recursive dynamics, while challenging, are manageable through systematic understanding and deliberate governance.

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