



Mechanisms of service ecosystem emergence: Exploring the case of public sector digital transformation

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ABSTRACT

This research extends literature on the emergence of service ecosystems by developing new theoretical insight and explanation into how service ecosystems experience change and stability over time. Empirically, our case study focuses on digital transformation in the New Zealand public sector and the enterprise services market in 2010–2017. The exploratory and illustrative study builds on 22 in-depth interviews and extensive document analysis. We reveal three key mechanisms of service ecosystem emergence: compression, ecotonal coupling, and refraction. These mechanisms contribute to overcoming conflationary theorizing and the value of emergence in service research by establishing emergent relationality and a processual intertwining of being and becoming. These become the basis of multi-levelled, multidimensional complexity and cumulative organizing. We conclude the work by discussing the paper's contribution to service research.

1. Introduction

The service ecosystem concept is an increasingly influential unit of analysis based on assumptions that describe a systemic and processual view of service and exchange. In adopting an 'ecosystem perspective', service-dominant logic (S-D logic) research joins a multitude of academic disciplines, popular business press and firms within the technology, financial services, manufacturing, and healthcare sectors that have broadened their level of analysis and emphasized interdependence (Adner, 2017; Jacobides, Cennamo, & Gawer, 2018). Central to the popularity of these concepts is the desire to see beyond organizational boundaries and perceive multiple tiers of stakeholders, activities, and social structures that impact their interactions.

The driving principles of the ecosystem concept are interdependence, dynamism and multilayered organization, which collectively underpin a systemic orientation, shifting from static and mechanistic assumptions to a more transcending view of complex wholes, relationships and processes (Möller, Nenonen, & Storbacka, 2020; Vargo et al., 2017). This view drives fundamental questions directly related to how systems are formed and ordered (Kleinaltenkamp, Corsaro, & Sebastiani, 2018; Reynoso, Barile, Saviano, & Spohrer, 2018). These questions and the very foundations of 'systems' as "a set of elements standing in

interrelation among themselves and with the environment" (von Bertalanffy, 1975, p. 159) draws attention to the explanatory relevance of the concept of emergence. Emergence recognizes the constitutive nature of the relations between components of a system (Bhaskar, 2008; Bunge, 2000, 2003). Emergence is, therefore, considered a valuable construct for advancing the studies of service ecosystems, as it avoids reductionist simplifications and, instead, allows scholars to focus on the complex reality of real-life service systems (Polese, Sarno, & Vargo, 2020).

While we recognize the pioneering interest in the emergence of service ecosystems (Peters, 2016; Polese et al., 2020; Taillard, Peters, Pels, & Mele, 2016), how service ecosystems gain and retain their form and the nature of emergence in these processes remain unclear. Current thinking suggests that through their practices, actors create both the micro-level resource integration and structural conditions that enable and constrain their activities in a continuing process of structuration (Jaakkola, Aarikka-Stenroos, & Ritala, 2019; Siltaloppi & Wieland, 2018). Service ecosystems are, consequently, understood as emergent by nature. However, the explanatory conditions of emergence have yet to be explored as a mechanism – the ways of acting of the combined relations (structures) of systems (Bhaskar, 2008) – which describe how the entities that comprise systems together with their properties, activities, and relations, produce change and stability. We believe it is necessary to

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understand these mechanisms to answer the calls for further theoretical development in this field (Poese et al., 2020).

Therefore, this paper aims to study the role of emergence using mechanisms to explain change and stability in service ecosystems over time. We undertake an embedded case study to answer our central research question: what mechanisms of service ecosystem emergence can be identified, and how do these illustrate the nature of emergence within service ecosystems? The case examines ICT and digital reform in the New Zealand public (government) sector and the enterprise services market, representing a service ecosystem. The presented case provides a rich setting, reflecting the increasingly complex social and business configurations envisioned by the ecosystem concept together with the increasingly ubiquitous issues of maturing technology and business models for service delivery and significant government digital reform programmes (Barile et al., 2016; Picazo-Vela, Gutiérrez-Martínez, Duhamel, Luna, & Luna-Reyes, 2018).

The remainder of this paper is structured as follows. First, we review the key literature pertaining to service ecosystems and emergence before presenting our emergentist framework. We then discuss the case methodology used to collect the data and the means of analysis. Next, we discuss the findings revealing three key mechanisms: compression, ecotonal coupling, and refraction. These mechanisms provide insight into the changing composition of the structure of the service ecosystem, the generative nature of emerging boundaries, and the role of history and layered organization in shaping the trajectory of the service ecosystem. Lastly, we discuss the results and present the implications of our study.

2. Literature review

2.1. Service ecosystems

A systems perspective of markets is increasingly gaining attention in the marketing literature (El-Ansary, Shaw, & Lazer, 2017; Layton, 2007). S-D logic literature explicitly emphasizes a systems orientation, focussing on a more dynamic and holistic perspective of exchange and value co-creation. This view is predicated on continuous, interactive resource integrations among a broader configuration of actors, enabled and constrained by organizing contextual conditions (Vargo & Lusch, 2016). S-D logic scholars have adopted a service ecosystem orientation to capture this systemic view (Vargo & Lusch, 2017). A service ecosystem is defined as “a relatively self-contained, self-adjusting system of resource-integrating actors connected by shared institutional arrangements and mutual value creation through service exchange” (Vargo & Lusch, 2016, pp. 10–11). The service ecosystem concept encourages ‘zooming out’ from micro-contexts of exchange, identifying a broader range of actors and their interdependence with technologies and meso and macro-level institutions, capturing both the dynamic interactions of actors and the influence of the social-economic context (Vargo & Lusch, 2016; Wieland, Vargo, & Akaka, 2016).

Subsequently, these conditions of interconnectedness and different levels of aggregation have led to the explicit consideration of how agency (actor’s actions and use of resources) is exercised within, and influenced by, the sociocultural, material and ideational structure of these systems. Institutional theory, structuration theory and practice-based approaches have been advocated as central frameworks to conceptualize these complex actor-exchange systems (Sitaloppi & Wieland, 2018; Vargo & Lusch, 2016). Institutional arrangements (collection of laws, norms, symbols, beliefs, etc.) and resource integrating and transferring practices create system stabilities characterized by shared, cooperative and coordinated activities and understandings (Barile, Saviano, Poese, & Di Nauta, 2012). However, the complexity of service ecosystems and the many relations within means that service ecosystems are characterized as ‘inter-institutional systems’ in which multiple interrelated sets of institutions co-exist (Sitaloppi & Wieland, 2018; Vargo & Lusch, 2016). Consequently, actors compete, negotiate

and coordinate behaviour, meaning institutions are not static and can be shaped from the micro-level (Jaakkola et al., 2019; Thornton, Ocasio, & Lounsbury, 2012).

Recognizing that service ecosystems can be shaped poses two fundamental questions: (1) how do social features of the world influence behaviour, and what exactly are these features? Moreover, (2) How do actors behave or interact with the social world? (Elder-Vass, 2010). These questions are pivotal in understanding how service ecosystems are structured, how they evolve and how actors shape these systems (Barile et al., 2016; Mele et al., 2018; Reynoso et al., 2018; Vargo & Lusch, 2017)? The challenge for research is to theorize how change and stability occur in the structure of service ecosystems and the nature of the dynamics involved.

These questions sit at the centre of the systems concept, as a “set of elements standing in interrelation among themselves and with the environment” (von Bertalanffy, 1975, p. 159), with the resulting organization determining how a system comes to be, and therefore, how it may function and change. This notion of complex relationality and organization brings to the fore the concept of emergence, which recognizes the constitutive nature of relations that give rise to and sustain systems (Slade-Caffarel, 2020).

2.2. Emergence

Emergence transcends research disciplines and traditions, considering that compositional entities (systems) have properties or powers that are not possessed by their parts. Consequently, emergence leads to the notion of systems as theoretical and conceptual entities, beyond the simple aggregation or collection of components (Bunge, 2000; Elder-Vass, 2005). Emergence has long sat at the heart of the very problems service ecosystems researchers now address, including explaining social phenomena such as how individuals and their relations give rise to macro-social phenomena, like markets and shared social practices (Kleinaltenkamp et al., 2018; Taillard et al., 2016). Emergent properties and structures have come to the fore as service scholars recognize different levels of complexity (interaction and organization) in their explanations of value co-creation.

Emergence remains a somewhat nascent topic in the service ecosystem literature. Taillard et al. (2016) examined shared intentions as emergent properties which create institutions that form the structure of a service ecosystem. Peters (2016) addressed emergent resource integration; contrasting resources create new and unique properties (emergent) against those with summative resource properties. Poese et al. (2020) linked emergence to service systems, highlighting that actors’ knowledge is needed for detecting as well as initiating the emergence of new properties in service ecosystems. These papers illustrate core concerns of emergence, including the existence of properties neither possessed by the constituents or precursors nor the fundamental constitutive role of structuring sets of relations in entities (Bunge, 2000; Elder-Vass, 2005).

Considering emergence as both a process and a constitutive force, it is synchronic and diachronic (Mingers, 2014). Synchronic emergence describes the relations between systems and their components that exist at a point in time, while diachronic emergence refers to the way systems develop over time (Elder-Vass, 2010). Both features of emergence demonstrate the prominence of novelty as properties are irreducible to, and unpredictable from, the lower-level phenomena from which they emerge (Wan, 2011). ‘Novelty’ drives divergence between ‘epistemological’ or ‘weak’ emergence and ‘ontological’ or ‘strong’ emergence (Bedau, 2002; Bunge, 2003).

Weak’ emergence’ relates to the position that emergent phenomena, while ontologically and causally reducible to lower-level entities, are unpredictable. Chalmers and Clayton (2006) suggest that weak emergent properties may be termed interesting, non-obvious consequences of low-level properties. This view recognizes aggregate global behaviour of certain systems and reconciles these with the operation of micro-level

processes whose interactions are interwoven in a complicated network, such that the global behaviour has no simple explanation. The corollary being that emergence equates simply with the spontaneous generation of orderly patterns in complex systems of heterogeneous agents (components) (Sawyer, 2005). A strong or ontological view of emergence has much more significant consequences for understanding how the world is structured and how we investigate and respond to how service ecosystems adapt and evolve and an actor's ability to shape and influence these systems. A strong view permits that conditions of emergence are bound to systems as real existing social objects in which lower-level structures can modify the relations of higher-order structures, and therefore their properties and powers, and that higher-order structures change the state of possibilities and conditioning of lower levels (Bhaskar, 1989).

This strong view shifts from a merely analytical rhetoric of emergence, to a view that the world is composed of interpenetrating complex systems, real irreducible wholes – emerging from the relations of their parts, which exist as parts of larger wholes (Bhaskar, 2008; Simmonds & Gazley, 2018a). Consequently, a strong view of emergence, asserts that while the complexity of systems is indeed the consequence of interactions at lower levels, it is “interactions of parts of the system with each other; interactions of parts of the system with the system as a whole; and interactions of the system with other systems with which it intersects, within which it is nested, and with which it may share interpenetrating components” (Byrne & Callaghan, 2013, p. 173). Therefore, in understanding systems we must understand how the form of the whole causally co-determines the component structures and how these structures causally mediate or condition each other and, consequently, the whole.

This paper argues that the strong ontological position is important for understanding service ecosystems and emergence as the basis of complex, multilayered systems and the irreducibility and causal efficacy of their constitutive features. This foundation guards against a principal problem that disrupts complex systems and the explanatory role of emergence – conflation, or the collapse of the complex relationality of the world (Archer, 1995). A weak view of emergence easily drives conflation, as meso and macro-level systems and structures are formed and reformed through individual actions and the reproduction of relationships and shared meanings, seemingly as patterns (Akaka, Vargo, & Lusch, 2012). This tendency is problematic as it creates reductionism, collapsing complex and multidimensional systems into localized actors and their activities. The resulting methodological individualist ontology drives the ‘exhaustion principle’ in which ‘individuals determine the social world in the sense that once all the relevant facts about individuals are set, then so too are all the facts about social entities, events, etc.’ (Kincaid, 1994, p. 499). This situation is prevalent in the critiques of organizational scholars whose focus on interactions leads to eliminating the fields’ structure, which provides the conditions for interactions (Emirbayer & Johnson, 2008). As a further consequence, without real emergent properties, structures are activity-dependent in the present tense, “[a] leap is made from the truistic statement, ‘no people: no society’, to the fallacy, this society because of these people here present” (Archer, 1990, p. 86). Consequently, research is ill-equipped to move beyond immediate social situations or static reconstructions, blurring the complex history and processes of systems into recursive models of practice in the here and now (Bates, 2006; Mutch, 2019; Peters, Vanharanta, Pressey, & Johnston, 2012; Simmonds & Gazley, 2018a).

Subsequently, a strong view of emergence is necessary to study service ecosystems, ensuring we view systems as consisting of localized actors and their activities and the relations between actors and the broader social and material contexts they are embedded in. The emergent structures of systems are not inert collections of individuals acting in particular micro-situations, reproducing particular behaviours using particular objects and symbolic expressions (Porpora, 2015). Additionally, shifting away from localized and present activity-dependence provides for the diachronic conditions of emergence through which

history and the formation and dissipation of layered structures impact the present and provide the contexts in which action and interaction take place (Suddaby & Foster, 2017). Viewing systems, not as patterns ‘emerging’ from micro-interactions, but as irreducible layered structures, allows for the very different timeframes that exist between unfolding situated activity and the emerging frames of social and economic systems (Bates, 2006; Peters et al., 2012; Simmonds & Gazley, 2018a). This perspective is fundamental for research aiming to address multiple levels and their relevant temporal and spatial dimensions (de Leeuw & Gössling, 2016). The strong view provides the basis for the emergentist framework that will form the basis of this study.

3. An emergentist framework for service ecosystem analysis

To present an emergentist framework, we draw on the recent work of Simmonds, Gazley and Dallenbach (Simmonds, 2018; Simmonds & Gazley, 2018a; Simmonds, Gazley, & Daellenbach, 2018). These authors have advocated ontological emergentism as a means to redress the issue of conflation. Simmonds (2018) recently argued that a strong view of emergence requires that (1) the social world is constructed of stratified levels of organization in which entities emerge, along with their properties and powers; (2) these entities operate in complex and mutually modifying interrelations at multiple stratified levels, and; (3) stability and change result from the complex interplay of the causal powers of such temporally/spatially stratified relations. These theoretical assertions inform an analytical framework built on a structured relational world that is compositionally multidimensional (objective material, intersubjective relational, interobjective institutional and subjective) and multileveled, stretching from individual cognition to the overarching structure of socio-technical environments. We argue that these conditions can be combined with the morphogenetic cycles approach of Archer (Archer, 1995, 2011, 2013), viewing service ecosystems as diachronically emergent through cycles of structural conditioning, social interaction and structural elaboration/reproduction. These features allow us to present the framework in Fig. 1, derived from the work of Simmonds, Gazley and Dallenbach (Simmonds, 2018; Simmonds & Gazley, 2018a; Simmonds et al., 2018).

In advancing the nature of emergence in service ecosystems, we argue that it is necessary to theoretically and analytically capture a strong view of synchronic and diachronic emergence. Firstly, we capture synchronic emergence by arguing that the events of service ecosystems result from synchronic complex interchanges of interacting powers possessed by entities at various levels of composition. This position is sustained by a view of service ecosystems as hierarchically composed of complex structures, differentiated entities and relations, as irreducible wholes, each having its own irreducible emergent powers. Secondly, we capture diachronic emergence as grounded in these levels of structure having a history of, as well as always being ‘caught up’ in, development. Context, and subsequently present organization and interaction potentials, are created in the history of past interactions, interconnections, and events. However, the outcomes from interactions are emergent, recognizing the non-deterministic realized, part realized or blocked nature of multidimensional and multileveled structural powers characterizing the complex interchanges of synchronic emergence.

3.1. Components of the framework

The analysis begins with identifying the conditioning of the service ecosystem context (structural conditioning). This involves identifying the events, histories, and interaction patterns that created this context. This stage identifies the extant structures, their powers, and properties which allow us to understand the setting (the state of possibilities) of the interaction period we wish to study.

We then examine the dynamics of social interaction, in which actors, through service and resource-integrating practices, actualize the interplay of the powers at different levels of structure, producing the complex

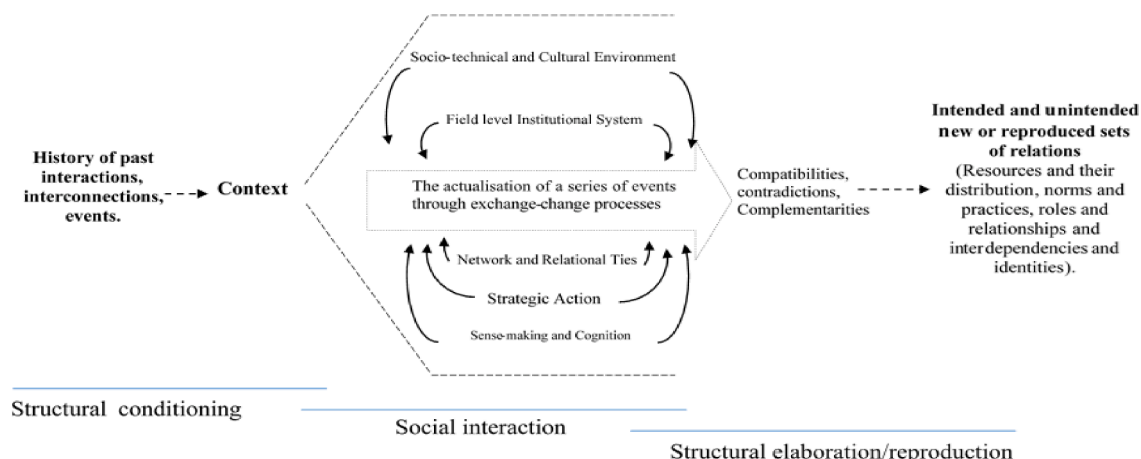


Fig. 1. Emergentist framework.

interchanges that generate a series of events. Our framework argues that emergence and multi-dimensionality provide for phenomena as unique structures with different characteristics, causes and consequences, requiring understanding the complex interplay and relationships among all these features. Fig. 1 acknowledges identified heuristic causally efficacious levels of structure, for example, the power of: (1) cognition and sensemaking to shape relationships and networks (Henneberg, Naudé, & Mouzas, 2010); (2) strategic action to shape the institutional environment (Koskela-Huotari, Edvardsson, Jonas, Sörhammar, & Witell, 2016); (3) network relationships to determine opportunities and sensemaking for individuals (Ahuja, 2000); (4) overarching institutions to shape relationships and determine self-perception and behaviour (Greenwood, Oliver, Suddaby, & Sahlin-Andersson, 2008); and (5) the broader socio-technical and cultural environment along with fundamental shifts, that have a directional effect on the nature of entire exchange and service systems (i.e. the creation of new markets, industries and social groupings) (Barile et al., 2016).

Finally, the outcomes of this process are addressed, directing attention to structural elaboration and/or reproduction, in which we uncover the new or reproduced relations that make up the structures, and consequently, their properties and powers manifest through the compatibilities, contradictions and complementarities of structural powers. New relations may be found in the emergence of new actors, roles, resources, power, interdependencies, institutions, and norms.

3.2. A means of theorizing and explanation

The framework's conditions require theorizing and subsequent explanation to be built on offering mechanistic accounts. These accounts are conjectures, positing under a set of structural conditions, how through the actualization of a set of multi-level causal powers, systems may experience change and or stability. The basis of this approach is the analytic separation of the different powers, properties and temporality of strata, which are then re-assembled to gain understanding and explanatory purchase. The aim is to theorize the nature of the multiple determination of events and the interactions which constitute, reproduce and transform structures. This means theorizing the particular "ways of acting" and the tendencies of the structures within the service ecosystem (Bhaskar, 1998, p. 38). Mechanisms do not reside in people nor the contextual environment; rather, they are the processes that unfold in or among systems explaining their emergence, persistence, and change over time (Bunge, 2004).

This framework and connected means of theorizing allow us to pursue the objective of furthering the understanding of emergence in service ecosystems through illustrating mechanisms as "ways of acting" within service ecosystems, explaining change and stability in service

ecosystems over time.

4. Methodology

We conduct a case study to explore the framework presented and better understand emergence within service ecosystems. Aligning with this paper's conceptualization, case study methodologies have been advocated as an appropriate strategy to explore the interaction of structure, events, actions, and context to identify and explicate causal mechanisms (Ackroyd & Karlsson, 2014; Easton, 2010). A single service ecosystem (single case) is utilized for this research as it enables an in-depth, coherent and flexible understanding of complex phenomena from a variety of perspectives over time (Dubois & Gibbert, 2010). In particular, we adopt an embedded case study, "in which evidence is investigated at least partly in subunits, which focus on different salient aspects of the case" (Scholz & Tietje, 2002, p. 2). Our subunits include a range of collectively involved organisations in this case of digital transformation of the public sector and form a service ecosystem (Ozcan, Han, & Graebner, 2017). Embedded units of a case "add significant opportunities for extensive analysis, enhancing the insights into the single case" (Yin, 2009, p. 52). The embedded case design is powerful for addressing systems because it allows the multi-level nature of the system to be addressed by analyzing the subunits separately and between the different subunits to represent the larger system (Yin, 2003, 2009).

The preference for cases is that they are information-rich with respect to the topics under investigation (Eisenhardt & Graebner, 2007; Patton, 2002; Stake, 1995). As a result, purposive sampling (Patton, 2002) is used to select a case that centres on the ongoing digital transformation of the New Zealand Central Public sector. This case is particularly pertinent as the digital transformation of government embodies the 'ecosystem' perspective, as economic and societal actors coevolve with advances in digital technologies and infrastructures to support the goal of alignment across a complex socio-technical system (Jacobides, Sundararajan, & Van Alstyne, 2019). Digital transformation in government is built on integrated socio-technical transformations, which contend with overlapping organizations, functioning in a complex range of policy, legislative and operational environments, existing monolithic technology systems and conflicting organizational missions and priorities (Eppel & Lips, 2016; Juell-Skielse, Lönn, & Päiväranta, 2017; Weerakkody, Omar, El-Haddadeh, & Al-Busaidy, 2016). This complexity is multiplied by the increasing reliance on networks of solution providers, necessary to develop and deliver digital competencies to and for government (Duhamel, Gutiérrez-Martínez, Picazo-Vela, & Luna-Reyes, 2018; Simmonds & Gazley, 2018b; Warland & Mayer, 2017). Consequently, this context presents the conditions of synchronic emergent complexity requiring understanding technology-mediated

change reflecting the interactions between organizational factors (goals, processes, and resources), institutional factors (laws and regulations), new technologies, and collaboration with networks of stakeholders (Christensen & Lægred, 2013; Klievink, Bharosa, & Tan, 2016; Nograšek & Vintar, 2014). Diachronic emergence is also present in this context, recognizing the significant history and conditioning of the government's legislative and operational environments (Eggers & Bellman, 2015; Picazo-Vela et al., 2018; Pilemalm, Lindgren, & Ramsell, 2016). Similarly, the socio-technical complexity of digital transformation combined with this structural conditioning, emphasizes emergent, non-linear outcomes (Hinings, Gegenhuber, & Greenwood, 2018; Holmström, 2018; Majchrzak, Markus, & Wareham, 2016). These features of digital transformation in government are considered areas requiring systematic empirical evidence (Mergel, Edelmann, & Haug, 2019). Particularly research that goes beyond ICT artefacts as linear tools can improve our understanding and integration of the relationships between institutional arrangements, organizational factors, technologies and socio-economic contexts (Castelnuovo & Sorrentino, 2018; Gong, Yang, & Shi, 2020; Picazo-Vela et al., 2018; Tassabehji, Hackney, & Popović, 2016).

4.1. Description

The ongoing digital transformation of the New Zealand Central Public-sector represents a service ecosystem as a system of resource-integrating actors connected by shared institutional arrangements and mutual value creation through service exchange (Lusch & Nambisan, 2015).

The case centres on a significant period of major government reform programmes, both holistically and specifically within ICT and digital services. These reform programmes reflect efforts to transform the ways services are delivered, driven by budgetary pressure, rising citizen expectations, legacy technology systems and significant changes in the technological market. New Zealand is highly regarded as a global leader in digital government and the pursuit of 'as-a-service' models for provisioning ICT systems and infrastructure (The Fletcher School, 2018). However, New Zealand is also known for having been a leader in New Public Management reforms of the 1980s and 90s, which were built on structural devolution and single-objective agencies and semi-autonomous organizations (Scott & Bardach, 2019). While this approach created efficiencies in single functions, it left few incentives or capabilities to work together as a whole public sector. Procurement, relationships and technology were designed, built and operated individually by agencies, creating duplication, lengthy and costly processes and significant barriers to integrative capabilities like data sharing across public agencies. This situation initiated a series of reform programmes through the 1990s and 2000s, which had primarily failed due to a lack of a holistic, systemic approach to capabilities, goals and technologies and supporting leadership, accountability structures, and enabling structural and regulatory change (Scott & Boyd, 2017). Table 1 provides a glossary of terms in the case and analysis.

In 2010, the government adopted new directions and priorities for Government ICT Strategy, shifting away from siloed agency-based structures by introducing new cross-government governance arrangements for the use, development, and purchasing of government ICT. The aim was to rationalize investment, procurement and delivery of ICT infrastructure and software, reducing duplication and standardizing while leveraging the operational scale of government to improve innovation and reduce costs. In 2012, this programme came under a broader transformation effort in government, 'The Better Public Service programme (BPS)', responding to central inefficiencies and dissatisfaction with public services and policy outcomes. The reforms focussed on changing the decision rights, rules, capabilities and incentives of the public management system.

A core focus was moving away from vertical accountability structures and introducing new cross-government models, including

Table 1

Glossary of terms used in the case.

Term	Case Understanding	
Better Public Service programme	The Better Public Services initiative was launched in 2012 for the public service to focus on and organise around ten significant problems over the next five years, providing a platform for cross-agency collaboration and joined-up government.	(Scott & Boyd, 2017)
Cloud Computing	A model for on-demand network access to a shared pool of configurable computing resources. Resources are on-demand, can be accessed through any device, are dynamically assigned elastically scalable.	(Mell & Grance, 2011)
Common Capability	A government sourcing programme. Any business or ICT capability that can potentially be used by more than one agency, or across the whole of government.	(Department of Internal Affairs, 2013)
ICT Infrastructure	ICT infrastructure includes hardware (mainly physical servers), network equipment, data centres, facilities, and related equipment, which is used to develop, operate, manage, and support ICT services.	(Bwalya, Du Plessis, & Rensleigh, 2012)
Infrastructure as a Service (IaaS)	Computing infrastructure—servers, storage, network, and operating systems— available as virtualised resources and delivered as an on-demand service	(Mell & Grance, 2011)
ICT Stack	A technology stack refers to the range and organisation of a set of technologies, software, and tools that are used in the development and deployment of digital capabilities.	(PCMag.com, 2021)
Public Cloud Private Cloud Hybrid Cloud	Cloud deployment models: public cloud (cloud resources available to different organisations through a provider over the public Internet) and private cloud (cloud infrastructure owned by an organisation). Hybrid cloud is a structured combination of these.	(Briggs & Eduardo, 2017)
Software-as-a-service (SaaS)	Applications hosted by a provider on a cloud infrastructure accessed over a network or a program interface.	(Mell & Grance, 2011)

governance arrangements, capabilities and funding models that incentivize collaboration and prioritize integrated services. Changes to the core legislative and institutional architecture of the public sector helped facilitate this process. Changes to the way the government procures ICT have been central to transformation, including common capabilities and all-of-government ICT procurement contracts. Common capabilities are built on the procurement of a solution by a lead agency for the benefit of multiple agencies, or the whole of government, allowing agencies to adopt these products from a panel of approved suppliers without the need to undertake a full procurement process.

Intertwined with these shifts in government were core technological shifts towards cloud services and the servitization in the IT industry. These changes reshaped customer expectations and the business models of providers. Existing business models were disrupted (large capital expenditure on hardware and software) and placed under pressure. Competitive landscapes opened up, creating markets for services across different layers in the IT stack (from infrastructure to applications) and industry or regulation-specific services and development. Government particularly focussed on collaborating with the private sector to develop 'as-a-service' products, reducing the need for agencies to own and operate commodity technology.

The main data sources were in-depth interviews and extensive document analysis. Twenty-two in-depth interviews were conducted between 2017 and 2018, with different individuals representing

Table 2
Summary of Interviews and Document Sources.

Organisation type	Number of organisations	Number of Interviews	Document types	Number of documents
Government Agency	4	8	Industry and General Media	191
State-Owned Enterprise	1	1	Reports from organisations and related entities	98
Multinational Service Provider	4	5	Web pages/ documents	93
Local Service Provider	5	8	Other (Cabinet Papers, Speeches, Presentations)	60
Total	14	22		442

fourteen organizations from across the service ecosystem (Tables 2 and 3 provide descriptions of the interview participants and document sources). Participants were purposively selected based on their positions and ability to provide rich insight into their organizations and environment (Yin, 2009). All interviewees held key positions within their organizations, ensuring they were able to reflect on the trajectory of the system. Because their organizations came from different positions in the service ecosystem, they provided insight into the different individual structural conditions each is embedded in while forming the overall system. Throughout the process, 442 documents, published between 1995 and 2017, were analyzed based on participants’ recommendations and searching archival public databases. Documents included publicly available industry media, newspapers, company documents, commentary and government documentation, as well as documentation supplied by participants.

Table 3
Overview of Interview Participants.

Coding	Organisation type	Informant role	Interest in Organisation	Interview length
A	Local Service Provider	CEO	Partnerships with major multinationals and key local networks	60 min
		Director	Involvement in multiple agencies projects	45 min
B	Local Service Provider	Regional Manager		30 min
		Government Business Owner	Key government service provider	50 min
C	Multinational Consultant	Managing Director (Regional)	High number of agencies as customers	
			Central partner in government transformation	30 min
D	Multinational Software Provider	Managing Director (Regional)	Large number of agency relationships	
			Major multinational provider with a unique business model	45 min
E	Multinational Service Provider	Project Manager	Key relationships with local providers	
		Government Account Director	Very high-volume supplier to the public sector	45 min
F	State-owned Enterprise	CTO	Major industry incumbent	30 min
			Peripheral position as a State-owned enterprise	35 min
G	Government Agency	CTO	Customer of service providers	
		Relationship Manager	Central Agency	40 min
H	Government Agency	ICT External Relationship Manager	Significant Business transformation	40 min
		Business change director	Considerable engagement with the private sector	50 min
I	Government Agency	Relationships Director	Core agency in ICT and digital transformation	40 min
		Procurement manager	Extensive engagement with the private sector	40 min
J	Government Agency	Manager – integrated services	Strong Procurement Function	45 min
		Programme Lead	Central Agency	45 min
K	Local Service Provider	Business manager	Programme lead in external engagement	60 min
		IT architect	Central Public-Sector department	50 min
L	Multinational Service Provider	Manager of Public Sector Relationship	Role in performance and oversight	
			Major National Incumbent	45 min
M	Local Service Provider	Director	Key relationships with other providers	30 min
			Central provider to government	
N	Local Consultancy	Consultant and Industry Observer	Central partner in government transformation	45 min
			Major industry incumbent	45 min

4.2. Analysis

The primary objective of this research is to uncover mechanisms that further the understanding of emergence in service ecosystems. Drawing from Wynn Jr and Williams (2012) and Mingers (2014), we relied on a retroductive methodology by asking ‘what is it about the structures which might produce the effects at issue?’ (Sayer, 1992, p. 95). We set out to describe the characteristics of the structures that, if they were to act in the postulated way, would account for the events in the system and the subsequent outcomes (Bhaskar, 1989).

The first step was to empirically describe the case by creating a reconciled and organized sets of events. Conceptual maps, created using the programme Decision Explorer, supported the creation of a case database, allowing rich and flexible representations as a sensemaking strategy to begin developing (Langley, 1999). Event-structure analysis (ESA), and its associated computer program, ETHNO (Heise, 1989), was used to undertake a compositional analysis and linking analysis, to set out events as cycles of conditions, actions, and consequences. Respectively, these provide interfaces to structure how events in a narrative associate people, things, and actions, and then identify the type of linkages between events (Buttriss & Wilkinson, 2006). The outcome of this process was an event structure diagram, outlining the causal structure of events, by listing each event’s prerequisites and consequences while simultaneously displaying the coded composition. This structuring then allowed bracketing sequences of events and abductively redescribing these as more general abstract features of cycles, working towards describing what was happening in the service ecosystem structures (the mechanisms) through iterative thought trials and pattern matching (Wynn Jr & Williams, 2012). From this process, different sequences of events are described by a similar generative force, relying on a logic of metaphor and analogy (Appendix A provides an example of this data structure). The result was an identified set of mechanisms – compression, ecotonal coupling and refraction – which describe the

Table 4
Summary of Data Analysis Process.

Analysis Step	Description	Analysis Task
Resolution	Resolve the complex phenomena into components. Identify the particular events of interest and the relevant structures to which they relate.	<ul style="list-style-type: none"> • A database of incidents is created using the data from the interviews and document analysis. • Visual maps were created using each interview and a master map of all data. • Incidents are reconciled into a list of chronological events
Redescription	An explanation of the constitution and the patterns of events in an explanatory meaningful way is built. Linking events as complex sequences and branching paths of conditions, actions, and effects and organising these sequences within the proposed framework.	<ul style="list-style-type: none"> • Chronological event list is entered into ETHNO • Each event is coded according to the coding scheme • The linking function using the available prompting questions is conducted in ETHNO • Sequences of linked events are bracketed as cycles. • Events in these cycles are redescribed abductively confronting the data with existing frameworks in use. • The redescrptions are organised using the structure of the research framework
Retroduction	Positing generative mechanisms which may be interacting or causing the events under study.	<ul style="list-style-type: none"> • Visual mapping was used to conjecture different patterns that explained series of events and indicated particular changes to structures and relations that were evident between events

ways the structures were ‘acting’. Table 4 sets out The steps undertaken in the analysis process.

5. Findings

Three explanatory mechanisms were identified that occur at multiple levels and instances in the case. These mechanisms provide insight into the particular “ways of acting”, and the tendencies of the structures (Bhaskar, 1998, p. 38) within the service ecosystem, offering insight into the conditions of emergence. Table 5 provides an overview of these mechanisms: compression, ecotonal coupling and refraction. Table 6 provides a summary of the findings. Appendix B presents illustrative quotes of the mechanisms and their manifestations.

Table 5
Overview of Mechanisms.

Mechanism	Description
Compression	Compression represents the contraction of relations across the subjective (sensemaking), intersubjective (relational), interobjective (institutional) and objective (material) conditions of service ecosystems, creating changes in the possibilities of action, the flows of resources and the interaction between actors.
Ecotonal coupling	Ecotones are emergent relational structures manifesting within interaction and tension between structures. Ecotones are a generative tendency that changes ecosystems’ functioning and structure by creating a transitional and interactional zone between different subsystems and offer niches for unique roles, innovation and development in technology, new practices, and interactions.
Refraction	Refraction refers to the ‘bending’ of properties and trajectories such that their effect emerges as a distortion of what would have been their unmediated structural tendency. Refraction focuses on the diachronic emergence of structures and the interrelations between structures within and across time.

Table 6
Summary of Findings.

Mechanism	Findings summary	Features of emergence
Compression	<p>Compression, driven by economic destabilisation, limits degrees of freedom for agency and strengthens the dependency between government and service providers.</p> <p>Compression is enacted as government agencies are consolidated and service providers reduce relational and material distance between themselves and government</p> <p>Government reform strategies compress competing logics, priorities and paths of action</p> <p>Common Capabilities compress service providers opportunities and the relationship structure with agencies</p> <p>Closure of the market compels provider investment helping compress the geographical distance between cloud infrastructure and government.</p> <p>The affordances of new technology compress the specificity of artefacts and practices separating agencies</p> <p>Compression through the convergence of technology blurs industry boundaries, drives business model and value proposition change and puts pressure on competencies</p> <p>Actors experience compression of time through the programme targets and the rapid pace of development enabled by technology.</p>	<p>Compression demonstrates multi-dimensionality and stratification by addressing a common generative ‘way of acting’ of structures.</p> <p>Compression occurs across different levels and dimensions of structures for example in industries, government priorities, technology artefacts, the material distance between actors and subjective experiences</p>
Ecotonal Coupling	<p>Ecotones emerge from the tensions at the boundaries between distinct fields</p> <p>Actors fill niche roles creating new, and mediating the flows of, interactions and resources</p> <p>Ecotones are enacted in accelerator programmes as differentiated interaction zones</p>	<p>Ecotonal coupling demonstrates multidimensional interactions between structures and the emergent outcomes of the interaction of boundary structures, including new positions, ties, resources, and interaction fields.</p>
Refraction	<p>Economic conditions and change of government stimulate reform across the 1980s and 2010 onwards.</p> <p>Earlier reforms provide courses of action and levers of change while manifesting the conditions that require change</p> <p>The trajectory of reform is refracted through existing institutionalised structures such as agency autonomy and the changing technology and social environment</p> <p>Technology implementation and innovation are refracted through the field structures of government requiring adaption and new interactional, institutional and cognitive structures</p>	<p>Refraction suggests the influences of the past and the broader environment.</p> <p>Refraction demonstrates a complex relationship between the past, present and future</p>

5.1. Compression

Compression refers to the contraction or shortening of relation structures, such that interactional structures are shifted, and the intensity of the operation of powers and feedback is intensified. The effects of compression are an increase in the pace of change, different social-relational structures and different conditions of possibility in action and interaction. Compression occurs across the multidimensional nature of relations and is present at different structural levels. Compression emerges from the destabilization of existing agential, institutional, and network relational structures and is a directive force in the emergence of resulting structures. The following section explores the empirical evidence demonstrating five key examples of compression.

5.1.1. Reproducing compressive environments in organizational structure

The 2008–2009 Global Financial Crisis (GFC) had the destabilizing effect of impacting available resources. The force of the GFC's shock and the lack of access to resources compressed the possibilities for action and the perceived opportunities available to actors. The government was forced to choose between pursuing austerity measures or developing significant service reforms at reduced cost. The government initially sought reform by enacting and reproducing the compressive forces in the environment by restructuring agencies to manage resources and consolidate functions. The Ministry of Primary Industries was created from the Ministry of Fisheries, Ministry of Agriculture and Forestry and the Food Safety Authority mergers from 2010. Archives New Zealand and Libraries were integrated into the Department of Internal Affairs. More substantially, the Ministry of Business Innovation and Employment (MBIE) emerged from this programme, integrating the Ministry of Economic Development, the Ministry of Science and Innovation, the Department of Labour, and the Department of Building and Housing.

5.1.2. Compression through an overarching ecosystem logic

Compression in the government operating environment creates the necessary destabilization to set the basis for developing an 'issue frame', which set a platform for mobilizing support for transformation. The establishment of the 'Directions and Priorities for Government ICT' and subsequent 'Government ICT Strategy and Action Plan' aligned actions and decision making for management with investment in ICT. In particular, cross-government products and services were adopted. These narratives were broadened to every aspect of the public sector through the Better Public Service Programme. These overarching plans and strategy directives create a field structure, compressing potential diverging paths for the separate government agencies, and creating institutional forces which dictate behaviour, roles and relationships.

Both the 'Directions and Priorities for Government ICT' and the 'Government ICT Strategy and Action Plan' sought to align decision-making and coordinate management and investment in ICT through cross-government products and services. This approach focussed on All-of-government and common capabilities contracts, establishing the government as a single customer of a panel of suppliers, negotiating standard conditions and services. In doing so, competing logics available to agencies in making ICT decisions and subsequent actions were compressed, centralizing choices and reducing fragmentation in potential action. These contracts and oversight within central agencies make the pressures of embeddedness in the system more salient, allowing the coercive force of the strategy to pressure actors. This shift in the institutional cues and signals available to agencies creates normative and mimetic pressures.

5.1.3. Compression changing the nature of service providers' relationships with the public sector

This compression also created relational change between agencies and suppliers, as the 'demand profile' was compressed from individual relationships between agencies and suppliers to a single point in the office of the Government Chief Information Officer (GCIO). This change

created power within the GCIO role, not only over the decisions of agencies, but also over suppliers, by restricting access to agencies as customers. Service providers, therefore, experienced a compression of their own opportunities. In the case of IaaS, the failure of Organisation K to be appointed to this panel compelled the acquisition of Organisation B. Organisation B had a central position in the technology stack of government and had undertaken significant infrastructure modernization. This infrastructure modernization reduced the material distance between the data centre capability and government, which had been problematic as large multinationals had not seen the value in the market of building this infrastructure in New Zealand. Having to send and store data overseas created a host of perceived risks around security and data sovereignty which, particularly in the adoption phase of these new capabilities, acted as fundamental barriers. The compression of the market for these vendors compelled investments and allowed them to compress the material distance of infrastructure and, therefore, the institutional and cognitive distance which drove risk perceptions.

Other organizations also sought to compress the material and social distance between themselves and government agencies, as compressive economic conditions pressured service organizations to adapt and derisk their revenue streams by servicing the public sector. Service providers brought their operations to Wellington (the capital city) to build better relationships and presence with the public sector.

5.1.4. Compression created by the changing affordances of technology and competition in converging markets

Compression was also evident in the convergence afforded by technology changes. Cloud infrastructure and other commodity digital technologies are inherently flexible, consolidating capability specificity and, therefore, heterogeneity in the practices and materiality of use. Cloud computing's core features (dynamic scalability, virtualized physical resources and architecture) make it fundamentally accessible and usable across different contexts, which was fundamental to aligning the perceived distances between the activities and requirements of agencies.

Compressive convergence of computing, communications, content, and hardware had a profound influence on the ICT industry. Amazon emerged at the forefront in cloud offerings, and several large players (e.g. Organisations C and E) focussed on vertical integration, particularly through acquisitions. Organisation K demonstrated these forces, contracting their business to New Zealand and shifting from a traditional telecommunications provider to a digital solution provider. These changes included rebranding efforts, acquisitions across several layers in the cloud market stack, millions of dollars of investment in data centres, and creating a range of digital services arms.

5.1.5. Compression through transformation targets and the changing pace of change

The final illustrative example of compression comes from relating time to cognitive, social and institutional properties. Firstly, compression operated through the reform plan targets. These targets were publicly notified and tied to performance reviews of agencies and their Chief Executives (CEs). These targets had the effect of compressing time as experienced by the actors, compressing the relationship between the present state and the future timeframe. Compression, therefore, influences important cognitive structures (priorities, problem agendas, etc.) guiding actors' behaviour. The time-based pressure of the targets built momentum by establishing urgency through prioritization of options and establishing symbolic and material signals of progress. Service providers also felt this experience of compressed time. They reported the changing affordances of technology and competition in converging markets saw greater pressure to maintain pace with developments by competitors and markets. The future, such as the next project or the next round of changes to network products, comes faster towards the present – compressing the cognitive distance between the two.

5.1.6. Summary

Compression generates change, creating feedback that is influential across structures and relations. These findings point to the influence of compression within different structures across levels and in different relations and properties. Compression was found in the system environment, particularly economically and technologically; the coupling between actors in different fields (public and private sectors); the roles, business models and networks positions of organizations; as well as the experience of actors in their roles. Compression also demonstrated the complex compositional nature of different structures. For example, compression in technology, changing its materiality and affordances, drives changes in the relationships between customers and service providers.

5.2. Ecotonal coupling

The second explanatory mechanism, ecotonal coupling, introduces the emergent nature of the interactions between different structural fields. The increased coupling and greater dynamism in the interactions between the fields of the international technology market and the New Zealand Public Sector, in an unstable environment, provide the conditions for this mechanistic process. Ecotonal coupling is grounded in the emergence of new relational structures within the interaction and tension between these different fields. This process is a generative tendency through which transitional and interactional zones emerge between different subsystems (fields). These offer niches and a structure for unique roles, enabling innovation, new practices and relationships to emerge. As a result, new actors and frames of interaction can overcome technological and social structural distances and tensions.

In the case study, the conditions of this generative coupling came from the challenges of interactions between actors in fields divided by a rich landscape of regulatory frameworks, processes, norms, and sense-making characteristics. These challenges were particularly evident in the early stages of government planning to change the ICT strategy and procurement process. Strict regulatory frameworks and processes, particularly around data sovereignty and security, placed institutional limits on changes and actions distinct from the private sector. Moreover, the Public Sector system is vast and diverse with a complicated heritage built on agencies designing, building and operating their own technology solutions, creating an incredibly complex ICT environment. Together these features created divisions between the material and normative and cognitive frameworks used in organizing the practices, resource integrating activities and relationships in each field, foregrounding boundary features of significant difference and tension. These challenges were exacerbated by the instability generated by new capabilities and business models in the technology market.

5.2.1. The opportunity to establish niche roles and leverage the emerging ecotonal landscape

Local service providers took the opportunity to inhabit the space between the two fields and enact the required bridging role. However, they also sought to utilize the unique emerging structure to pursue innovation. Actors changed their network structures in order to enact specialist roles, integrate a range of capabilities and provide adaptive solutions while developing relationships with actors from both fields. The institutional complexity and underdeveloped interactional orders in this space provided opportunities to shape their activities and resources to bridge the interface between the two fields effectively. New resources and services were created, drawing on the technological infrastructure of multinational providers and the specifications of government agencies. Organisation B used their bridging role to overcome data sovereignty and security issues, using their geographic proximity to meet government requirements while partnering with multinationals to deliver their services. These developments created boundary objects, such as self-service portals, which helped bridge the interface between the fields. One example is the development cloud platform providing

users with a flexible self-service portal and in-country solutions for data management and development, which integrates applications and workloads selectively with the cloud infrastructure provided by multinational providers.

5.2.2. Enacting ecotonal spaces

The government also sought to enact ecotonal coupling through accelerator programmes that recognize the division between the public and private sector and the slower pace of innovation programmes in the public sector. Three Accelerator programs, beginning in 2015, focused on government partnering with the private sector to co-design innovative solutions and start-ups. The accelerator programs were run through an independent incubation and acceleration program specialist. The programmes brought together entrepreneurs, software developers, start-up specialists and members of government agencies into 12-week projects. These teams utilized lean methodologies to deliver a minimum viable product which was then 'pitched' to public/private sector investment panel as a fundable project.

The accelerator becomes a new way of sourcing and procuring innovations, and a means to overcome the problem of funding early-stage innovations in the public sector. These spaces challenge risk aversion and legitimize iterative development while drawing on entrepreneurs and other specialized capabilities to recombine existing government practices with diverse templates for action. Solutions can be tested faster, are cheaper and provide less risk for agencies and cross-sector collaborations. For actors outside of government, the accelerator structure offers the opportunity to engage with government agencies without the expensive specialized relationships and institutionalized legitimacy often required. These actors are no longer excluded by the institutional boundaries that prevent access to the field or the opportunity to collaborate with the public sector.

5.2.3. Summary

Ecotonal coupling is part of the interactional tension between fields creating an emergent structure. These tensions, resulting from differences between the fields, create the need and opportunity for a mediating structure at this interactional boundary. The findings demonstrated the evolution of actors coming to inhabit this structure and creating a transitional and interactional space. These actors could draw on the structural conditions in this space, particularly given its position outside the direct influence of the fields. This saw them perform important roles in mediating and transforming resources and interaction across the distinct fields.

5.3. Refraction

The third explanatory mechanism, Refraction, focuses on the distortions or 'bending' of properties and trajectories within and across emergent levels of organization, recognizing the mediational nature of complex interchanges across time. Refraction emphasizes diachronic emergence as being crucial for understanding context, as the emergent properties of structures in the 'past', stretch into the 'present' to condition and influence actors. Moreover, it demonstrates how actor's agency and change are determined, not only by what is spatiotemporally present within a specific context, but also by the causal efficacy of the 'massive presence of the past and the outside'. The diachronic emergence of structures suggests that their outcomes cumulatively develop, transforming and ultimately shaping particular trajectories and interactions influencing, directly and indirectly, courses of action and events.

5.3.1. Refraction of past reforms into the present

The public sector reform programmes provide a basis for refraction. Two significant periods of reform across the 1980–90s and under the BPS programmes two decades later, were entangled, demonstrating the refractive nature of the service ecosystem. Both periods reveal

similarities that suggest structural commonalities and connections. Firstly, economic destabilization features prominently in the conditions of reform, a fiscal crisis of the early 1980s and the GFC of 2008–2009. Secondly, a new governing party was introduced after three successive terms in opposition during both periods. The incoming party focussed on lifting public sector efficiency, drawing from private-sector models. Lastly, both sets of reforms drew from reforms in Australia, the United Kingdom and other OECD countries.

The earlier period of reform created conditions for the most recent period, evidenced by changes to the State Sector Act (1989 Amendment) and the Public Finance Act (1992 Amendment), which saw many small single-purpose agencies created, led by CEs with a focus on departmental autonomy and performance-related individual contracts. These features created the structural conditions targeted by the BPS reform as well as a pattern of 18 subsequent reform initiatives from the late 1990s to the late 2000s. These cultural and institutionalized features, the high levels of autonomy for agencies and their CEs, and the large number of single-function organizations, made it difficult to enact strong reforms that did not encounter resistance. The BPS programme emerged as both a response to earlier reforms but also drew from the 1980s reforms, aiming to take on the coherence of their design, proceeding with legislation and enacting reforms affecting all facets of government: structure, appointments, business models and new accountability regimes.

The progression between the two epochs of reform provided a history that directed courses of action. Narratives of past reforms were used as resources of change. Actors who had experienced severe cost-cutting and failed reforms could stand at the intersection of past, present and future, providing particularly conditioned visions of the future and interpretations of history. Previous change efforts, such as administrative reorganization and an internal focus, were replaced by the integration of ICT into a broader digital transformation under the BPS programme. CEs' responsibilities and accountabilities were changed from the immediate and vertical measures of the 1980s reforms to a collaborative, horizontal and future focussed state. Similarly, New Zealand's position as a leader in innovation in the public sector following the 1980s' reforms, also provided a cultural narrative to impart directionality to a new set of changes. The significant amount of time since the last major reforms provided clarity on gains and weaknesses and a necessary point of inflexion to juxtapose the very different conditions in which the government might operate in the future.

5.3.2. Refraction of diffusing technology through different fields

The government's increased dependency on the ICT private sector, particularly in response to compressive forces, also leads to refractive tendencies. Exposure to normative influences in the market impacted on the sensemaking of government leaders, driving them to adopt new procurement models and capabilities. Involvement with incubators and accelerator programs provided different design and development methodologies, resulting in tangible programmes of work and minimal viable products. This also provided results for stakeholders outside the formalized program of government business case development and authorization.

The refractive trajectories are not always perceived positively. For example, the introduction, development and deployment of cloud solutions have followed a refractive trajectory from the private sector into the public sector, with a resultant clash between traditional bureaucratic institutional logics and newer market and corporate logics. This tension highlighted the efficiency contradictions between the fields of government and the technology market. The process of transferring the models and technology from the market to government is refracted through the public sector's institutional structure and existing operating models, with risk-averse concerns undermining potential efficiencies.

5.3.3. Summary

The findings of refraction emphasize the role of the past and history and existing structural layers in influencing present actions. Refraction

also highlights how actors mobilize the past. Consequently, the mechanism of refraction gives weight to the conceptualized assertion of the causal efficacy of the 'massive presence of the past and the outside', considering that structure and present organization and interaction potentials, are created in the history of past interactions, interconnections, and events.

6. Discussion

Two central conditions, (1) emergent relationality (synchronic emergence) and (2) the processual intertwining of being and becoming (diachronic emergence), are illustrated through the research findings. Through expression in the mechanisms of compression, ecotonal spaces and refraction, the findings support the need for strong conceptions of synchronic and diachronic emergence as a foundation of service ecosystems. Emergent relationality recognizes service ecosystems as causally efficacious, stratified and differentiated structures, highlighting their irreducibility in both modalities of power (different types of relations) and levels of structure. The interrelated processes of being and becoming bring the features of diachronic emergence – the cumulative development of structures – together with recognising the stratified nature of causal efficacy, accounting for structures' asymmetric and asynchronous timing. This perspective provides for emergence in cause and form, reflecting not just an organizing heuristic but differentiated and irreducibly interpenetrating structures, in the processes of structural being and emergent becoming.

6.1. Emergent rationality

Emergent relationality builds from the finding's examples of structures, properties and powers existing across levels and dimensions. Compression is seen to affect (1) the agency and subjective sensemaking of actors through their experience of time; (2) the intersubjective and material distance between actors as they attempt to move closer to their customers relationally and physically, and (3) the interobjective distance between fields and different market institutions, as resource interdependency increases and the convergence of technology shifts value propositions and the nature of products and services. Compression demonstrates multi-dimensionality and stratification by addressing a common generative 'way of acting' within the sensemaking (subjective), relational (intersubjective), institutional (interobjective) and material (objective) conditions of structures. Compression demonstrates the premise that social entities exist in relation to stratified levels of organization in which irreducible entities emerge along with social, ideal, material or artifactual properties and powers.

Similarly, ecotonal coupling illustrates the generative and emergent nature of structures, focusing on the role that tension and boundaries play in creating new positions, ties, resources, and interaction fields. At the boundary between the technology industry and the government, differentiated structures create divisions between the material relations and the normative and cognitive frameworks used in organizing the practices, resource integrating activities and relationships in each field. Subsequently, the pressures within these relations result in an emergent multidimensional structure between the two systems, characterized by roles of actors, relationships and institutional infrastructures. These emergent features go beyond a single network structure, such as bridging ties or boundary-spanning (Greenwood, Raynard, Kodeih, Micelotta, & Lounsbury, 2011; Koskela-Huotari, Siltaloppi, & Vargo, 2015). The case findings demonstrate network relationships through the actors inhabiting the ecotonal space and their roles in transferring and transforming resources. These actors create and use boundary objects to overcome geographical limitations by providing in-country infrastructure and cloud platforms. Moreover, the findings highlighted the boundary work these actors do in integrating the demands and frames of reference of the different fields they bridge, using their unique position in the institutional structures to create new practices of resource

integration.

Consequently, the case demonstrates the many ways in which different structures, from individual actors to overarching fields, may be related in the social realm. This differentiated nature illustrates service ecosystems operate as a layered whole: a complex configuration of physical materiality, relational situatedness, cultural constructions and actors' subjectivity. The concepts of irreducibility and causal efficacy, embedded within a strong view of emergence, are seen as crucial to determining cause allowing for interacting powers, by entities at a variety of levels of composition.

6.2. Diachronic emergence and being and becoming

The second condition grounded in the strong view of diachronic emergence and the intertwining of being and becoming is illustrated through the mechanism of refraction. The findings demonstrate how structures developed in the past influence the sensemaking of actors, their decisions, the narratives and institutional work in the present. Refraction demonstrates how emergent properties of the 'past', such as the formation of institutions, stretch into the 'present' of lower levels upon activation to condition and influence actors. Previous reform efforts discouraged some courses of action while encouraging others based on perceived success in the past. Even when intended outcomes were not achieved, previous reforms provided conditions from which government actors could draw, mobilizing past events and efforts to identify existing failures and use these as a foundation for change.

Consequently, acknowledging the causal efficacy of the past upon different structures is paramount. Therefore, the presence of the past exists as part of a service ecosystem's structural composition and is potentially powerful in the presence of temporally stratified layers. Refraction illustrates the 'massive presence of the past and the outside' and the different roles of history and cumulative developments that shape conditions of action and the mediational nature of different structural levels within a service ecosystem.

6.3. Theoretical contribution

This paper has focussed on the conceptual and explanatory relevance of the concept of emergence within service ecosystems, offering a strong 'emergentist' view. We have set out to identify mechanisms that illustrate synchronic and diachronic conditions of emergence within service ecosystems. The analysis and findings have discussed three core mechanisms that demonstrate these conditions of emergence as the irreducible causal efficacy of multi-levelled and multidimensional structures and their cumulative development. This paper, therefore, helps contribute to the understanding and empirical relevance of emergence in service ecosystems literature. At the centre of this contribution is the role the two central conditions of emergence, rationality and diachronic being and becoming, play in overcoming the issue of conflation, arising from a weak view of emergence (Simmonds, 2018; Wan, 2011). Two core issues of conflation – the deconstruction or collapse of the complexity of context and forms and effects played out over time – defeat a realistic system orientation that can capture the central principles of interdependence, dynamism and organization.

Subscribing to a strong view of emergence, supported by the condition of emergent relationality, drives the need to address multidimensional and multileveled features of service ecosystems. Their complexity is captured in multi-causality and contingency associated with upward and downward causations and causal efficacies across the spectrum of subjective and objective features. There is a need to accommodate the compositional and emergent nature of the configurations and activities of actors as well as social positions and other kinds of entities, such as artefacts or institutions. This recognition of emergent relationality overcomes one-dimensional theorizing or conflating of social properties, contextual or embedded features. This is important for moving forward with the study of service ecosystems as this issue has plagued disciplines

that inform its development. For example, problems associated with a lack of dimensionality and levels of analysis are seen in the continued difficulty of integrating micro and macro theories of institutional analysis (Delbridge & Edwards, 2013; Martin, Currie, Weaver, Finn, & McDonald, 2017). These difficulties are driven by the inability to address "more materialist, interest-driven explanations of behaviour and ideational, normative explanations" (Hinings, Tolbert, Greenwood, & Oliver, 2008, p. 473), which also leads to the term 'institution' gathering conceptual ambiguity and losing its explanatory power (Alvesson & Spicer, 2018; Fleetwood, 2008).

Structurationist and practice-based accounts have similarly been critiqued for ignoring complexity in issues of power and position and failing to account for non-uniform impacts across different actors and forms of agency (de Leeuw & Gössling, 2016). Hinings, Logue, and Zietsma (2017) note that practice and structurationist-inspired institutional theory has increasingly neglected other infrastructural elements of fields such as formal governance, field-configuring events, status differentiators and organizational models, in pursuit of institutional logic contestation and change. Similarly, Suddaby (2010, p. 15) argues that management journals are full of empirical examinations of institutional agency, where "any change, however slight, is now 'institutional' and any change agent is an "institutional entrepreneur", thereby failing to account for the conditions and forces that enable this (Zietsma, Groenewegen, Logue, & Hinings, 2017). A strong view of emergence and the notion of emergent relationality challenge efforts to collapse 'without remainder', differing relations and structures into a single explanatory feature. Thinking in this way opens up the incorporation of a greater range of complexity and reflects a view of service ecosystems as regulated and transformed by various evolving mechanisms, by considering subjective, intersubjective, material and symbolic aspects at micro, meso and macro levels of research.

Recognizing and prioritizing diachronic emergence and the processual nature of conditioning, interaction and outcomes, are also fundamental to studying service ecosystems. Besides identifying action and interaction as causes of events, explanations must include the conditions necessary for their existence. The conditioning of processes leads to the accretion of structure – the central idea of diachronic emergence – which produces conditioned pathways of actor interaction (Delbridge & Edwards, 2013). A focus on local practice must be contextualized with attention to the cumulative embedding conditions under which these practices are undertaken and avoid positioning actors as external to, or simply producing, their social context. The nature of emergence captured here becomes a foundation for avoiding falling into service ecosystems as static situated contexts. The static, substantialist mode of thinking has affected service research, distorting process and change and reducing historical and social structures and forces to contextual variables in order to address micro-level patterned activity (Giesler & Fischer, 2017; Lowe & Rod, 2018). However, this paper's perspective of emergence does not adopt a strong process view, in which individuals, organizations and societies 'are deemed to be epiphenomena of primarily fluxing and changing patterns of relationships and event clustering' (Nayak & Chia, 2011, p. 283). The conceptualization advanced in this research argues that the world consists of structures, not just events (actions, interactions), but as complex entities, endowed with causal powers, that combine and interact to produce actual events. Consequently, we avoid "a sociology of the present tense" (Archer, 1990, p. 86) and the reductionist tendency to see all social orders and formations arising from local phenomena (Emirbayer & Johnson, 2008). Consequently, conflation is overcome by allowing research to acknowledge the differentiated and stratified nature of service ecosystems and forms and effects played out through time. These affordances in analysis and theorizing are sustained by a commitment to both synchronic and diachronic emergence.

7. Future research and limitations

There is significant potential to explore multiple service ecosystems with the framework advanced in this study, developing further insights into the mechanisms at work across different contexts and systems. The case was sampled purposively for both its depth and richness in understanding service ecosystems and contemporary issues facing many large transforming actors and systems. The present study used an intensive single case-study design, a limitation that nevertheless establishes the basis for further research to develop and conceptually refine the proposed mechanisms, analytical framework and metatheoretical approach. Subsequently, other research settings can provide essential points of comparison and extension. As part of this expansion, service ecosystem research could benefit from cross-disciplinary theoretical work. While the insights from institutional theory are a good example of this, there are many avenues for explanatory concepts and devices across the sociology of markets, organizational studies, socio-technical studies, sociology and other domains that will provide insight into the multi-level and multidimensional nature of service ecosystems. The literature would benefit significantly from a survey of the particular types of entities and structures that constitute an ecosystem, along with relevant examples of their properties, powers and causal tendencies.

More specifically, the identified mechanisms call for future empirical exploration. Ecotonal coupling and the generative nature of boundaries are likely to emerge given ongoing convergences among technology, industries and markets. These features will require understanding of the conditions under which these areas emerge, the types and roles of actors and their own understanding of coevolution. Not enough research addresses the relations and interactions between distinct fields or systems and how they might be causally implicated in the changes and stability of each other (Furnari, 2016). The connections between fields brought forward by compression and ecotonal coupling also highlights the importance of studying interacting fields and service ecosystems.

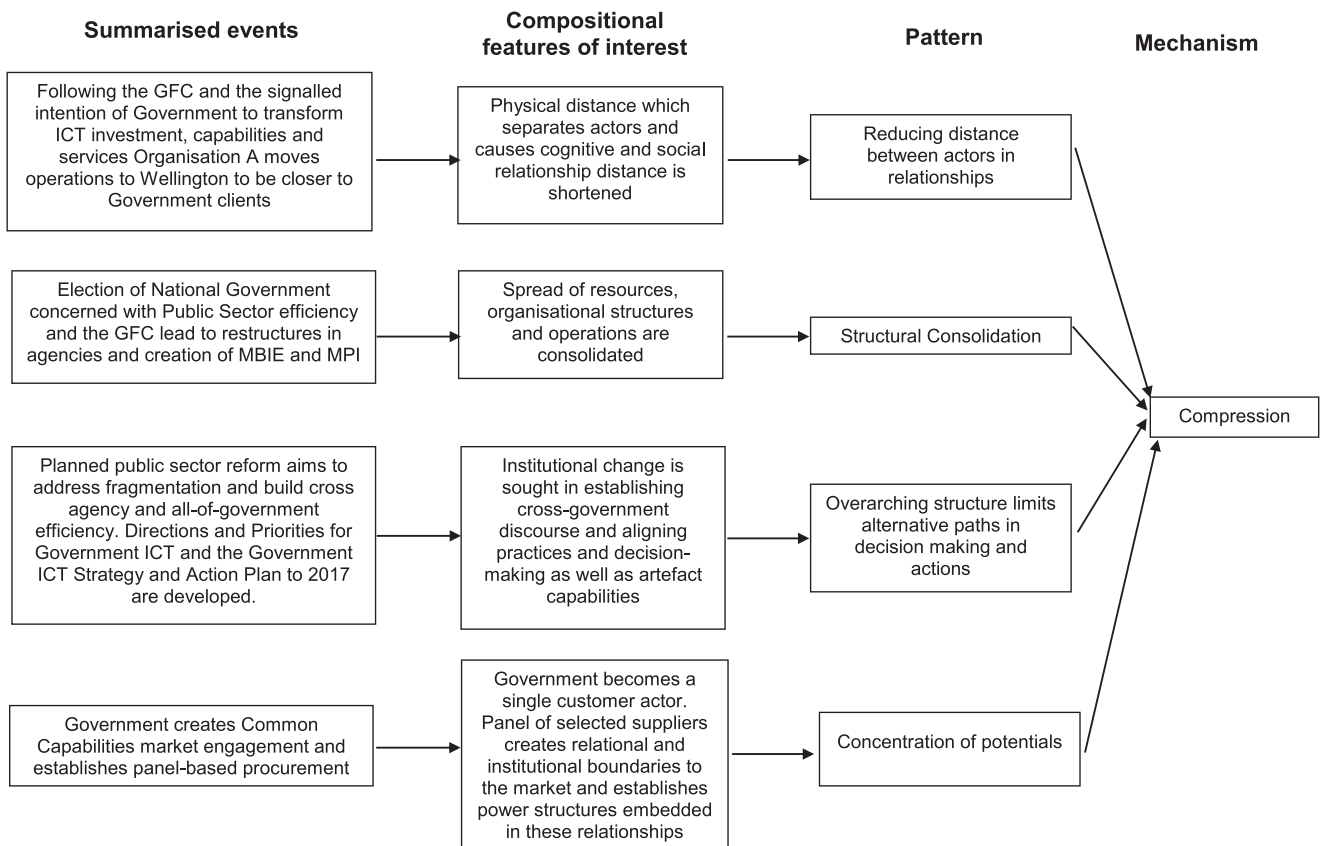
Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. An example of the logic of retroduction



Appendix B. Illustrative quotes of the mechanisms and their manifestations

Compression

Compression through an overarching ecosystem logic	<p><i>We have not only signed up for those results but we have signed up to the publication of them and the regular reporting of them in a way that no other Cabinet has ever done. It's quite a big step for politicians to voluntarily cut down their room for manoeuvre about what they are trying to achieve.'</i></p> <p>Former Finance Minister <i>Agencies saw themselves as needing bespoke solutions, particularly not buying off the shelf products. It was important to not think that every single agency was unique. They all said they were, they all said my problems are my problems, 'we are not anything like my neighbours so come talk to me individually'. It just wasn't the case. Particularly for much of the commodity infrastructure, capabilities etc.</i></p> <p>SOFTWARE ACQUISITION STRATEGY LEAD <i>The GFC was part of the reasoning to expand our operation and commit to Wellington. We needed to de-risk the commercial space when the economy starts to decline'. Government is about relationships. You need to be there, relationships are personal.'</i></p> <p>CEO SERVICE PROVIDER</p>
Compression changing the nature of Service Provider's Relationships with the Public Sector	<p><i>They created panels of providers that they wanted to engage with. Unless you get on a panel it makes it pretty hard to engage on projects over a certain amount. It changes the game, the whole commercial construct is bound by these panels so if you're not on it, it makes it very hard.'</i></p> <p>RELATIONSHIP MANAGEMENT SERVICE PROVIDER</p>
Compression created by the changing affordances of technology and competition in converging markets	<p><i>"Traditionally, we've operated further down the stack in infrastructure particularly. However, we can now develop a portfolio of new on-demand services, overlaying management and self-service capabilities and we are using our partnerships with the big players to create wired in public cloud offerings.</i></p> <p>SERVICE PROVIDER RELATIONSHIP MANAGER</p>
Compression through transformation targets and the changing pace of change	<p><i>'We're now in a position where those traditional telco services providers are rapidly changing. There is an argument that the biggest telco are now organisations like Microsoft (Skype) which is replacing telecom services. We need to change and break away from the traditional ICT model to a new as a service model. For telecommunications that was difficult because they were used to be putting big systems into a building and running that into the ground across 10–12 years.'</i></p> <p>SERVICE PROVIDER ANALYST</p>
	<p><i>'The Better Public Services programme was a bold move, I don't think any other government in the world had stated targets that they were going to achieve with specific results...The targets are all published, the progress is published every six months. So there is accountability and pressure and this is channelled through from ministers and the layers of management'.</i></p> <p>MANAGER OF SUPPLIER/COMMERCIAL STRATEGY AND DELIVERY</p>
	<p><i>'Historically, we would have customers lay out a plan for a year to roll their next project out, today that needs to look like three months. We are now moving at a different pace, driven by what is now possible for the business and even more importantly for our competitors.'</i></p> <p>CEO SERVICE PROVIDER</p>

Ecotonal Coupling

The opportunity for niche roles and to leverage the emerging ecotonal landscape	<p><i>'There is always a market for local providers, and for those offering managed services, particularly when services like AWS remain at a distance and have a limited operational presence in New Zealand. Digital expertise and experience is highly sought-after, particularly when you look at the capability gaps in the market'.</i></p> <p>AGENCY IT MANAGER</p>
Enacting Ecotonal Spaces	<p><i>We're cloud agnostic, and we'll provide services across platforms. So it's changing the focus and those services that we can now overlay are we are adding value. Drilling into capacities and service use through the dashboarding and data we're pulling and finding ways to optimise their cloud environment, which is our value add.</i></p> <p>RELATIONSHIP MANAGEMENT SERVICE PROVIDER</p>
	<p><i>'It is possible to leverage emerging technology and best practice without a large upfront investment in developing these capabilities in-house. Government departments aren't equipped to do the agile, iterative processes built on trial and fail that you get in the private sector. So we have to step outside of that and find a place to get these capabilities together and give access to the government platform'.</i></p> <p>GOVERNMENT RELATIONSHIP MANAGEMENT DIRECTOR</p>
	<p>Procurement approaches often do not encourage new ideas from outside, rather relying on government determining the need, and seeking ideas from potential providers. When we change this and bring different groups together and leave behind the traditional processes we get access to all that creativity and the necessary components to do something with it'.</p> <p>PROCUREMENT ANALYST</p>

Refraction

Refraction of the past reforms into the present	<p><i>New Zealand is not expected to be directed from the centre. The New Zealand environment has a very siloed structure but a recognition for collaborative work. Earlier reforms have created that siloed structural independency. So that the condition and it has meant we've been slower than others. Australia and the UK have taken a much more mandated approach. They're both countries we look to. To a certain degree, they have crashed and burned. We've moved slower in some aspects but otherwise there is a hiss and a roar and then intense push back.'</i></p> <p>GOVERNMENT RELATIONSHIP MANAGEMENT DIRECTOR</p>
	<p><i>The [BPS] results addressed one of the key issues in the Public Sector, fragmentation, which came about in the late 80's early 90's...I don't think it would have happened if it wasn't for the leadership. Central figures were committed to changing state sector performance and were willing to set difficult targets to achieve that"</i></p>

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Compression

Refraction of diffusing technology through different fields

BPS RESULTS PROGRAMME ANALYST

The choice to undertake and believe in big data and analytics, and the focus on these capabilities was an ideology that was unusual for government but became mandatory in this government. There has been a lack of understanding, appreciation for the value and definitely organisation of the information in the government's hands. If you look at where the market is going and the competition and commercial incentive now in data there is a real drive to develop the tools to basically monetise that information. There isn't obviously that same underlying logic in government, so it has taken engagement to change that mind-set.

DIRECTOR SERVICE PROVIDER

The common capability IaaS is not Cloud, in its true sense. The initial introduction allowed standardised operation, consolidated government procurement and solved the need to set up and manage systems all over New Zealand. It is a lot better than where we were, say seven years ago. Yet effectively it is a product that has been put into the market. Therefore when you put it up against competing offerings, it is more expensive, has less functionality, more complex contracts, and doesn't really have a projected future.

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