

ECOSYSTEM EMERGENCE: AN INVESTIGATION OF THE EMERGENCE PROCESSES OF SIX DIGITAL SERVICE ECOSYSTEMS

Llewellyn D W Thomas

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Innovation & Entrepreneurship Group
Imperial College Business School
South Kensington London SW7 2AZ United Kingdom

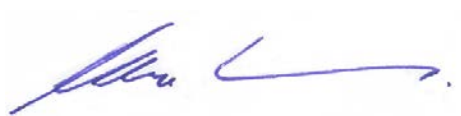
For Isabel, Hydra and Guillem.

DECLARATION

This is to certify that:

- (i) The thesis comprises only my original work towards the PhD except where indicated;
- (ii) Due acknowledgement has been made in the text to all other material used;
- (iii) Due acknowledgement has been made in the text to my co-authors with whom I have worked on research manuscripts;
- (iv) The thesis is less than 100,000 words in length, exclusive of bibliography and appendices.

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ABSTRACT

This thesis investigates processes of ecosystem emergence. Ecosystem research has thus far focused on understanding the structure and dynamics of already existing ecosystems. However much less attention has been devoted to the emergence of ecosystems. I first theoretically develop an institutional approach to ecosystems, arguing that the ecosystem is an organisational field which has value co-creation as its recognised area of institutional life. Synthesising the theories of dominant design, social movements, and institutional entrepreneurship, I identify four activities that drive the processes of ecosystem emergence: resource, technological, institutional and contextual activities. Empirically, I compare the emergence sequences of six digital service ecosystems – Amazon, eBay, Facebook, Google, Salesforce and Wikipedia – using a narrative explanation methodology, applying event colligation, optimal matching, direct inspection, frequency analysis and an innovative statistical bootstrapping technique. I find that emergence sequences of each case are significantly dissimilar and that there are three phases of emergence – Initiation, Momentum, Control. The first of these phases is similar across cases, but subsequent phases exhibit increasing dissimilarity as the ecosystem evolves and takes on idiosyncratic characteristics. To explain these findings, I develop an ecosystem perspective that explicitly integrates value co-creation processes as an important regulator of the evolution of ecosystems. I suggest that idiosyncratic logics of value co-creation result in differing value creation processes. I show that the three distinct phases of ecosystem emergence form a coherent, distinctive whole when considered from the perspective of value co-creation. Emphasising that value appropriated must first be co-created, I propose the ‘ecosystem model’ as an analytic tool to better conceptualise value co-creation and appropriation in ecosystems. I discuss the implications of these contributions for ecosystem research, institutional theory, and strategic management practice.

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1 INTRODUCTION

For many years Nokia reigned as the unassailable market leader in mobile phones. In 2006 it sold hundreds of millions of phones, had a market capitalisation of €110 billion, tightly controlled its supply chains and had a close relationship with telecommunications carriers. In the same year Apple launched a phone and Google announced an alliance to create an open source mobile operating system. Nokia was aware of the threat that these players represented. It released its own operating system, Symbian, as an open source project and jointly launched (with Symbian) an app store called Horizon. In 2009, after the failure of Horizon, it launched the Ovi app store in 36 countries simultaneously. However, Symbian suffered from an unwieldy governance structure and was perceived as being unwelcome to app developers. And neither app store was particularly successful – Horizon only garnered 60 apps after six months and Ovi was discontinued in 2012. While Apple and Android were able to attract other organisations, developers and individuals to their mobile platform, Nokia closed down the Symbian open source project in 2011. By May 2012 Nokia's market capitalisation had fallen to €14.8 billion and Apple and Android had come to dominate the market for smartphones. While Apple and Google had created vibrant ecosystems, Nokia languished.

As the example of Nokia demonstrates, the emergence of ecosystems can rapidly undermine apparently unassailable positions in seemingly matured and settled industries. The continuous diffusion of information and communication technologies (ICT) across industry sectors and the associated spread in the use of 'platform strategies' (Gawer & Cusumano, 2002, 2008) increasingly focuses managerial attention on 'business ecosystems' or 'innovation ecosystems' (Adner, 2006; Iansiti & Levien, 2004b; Iyer & Davenport, 2008; Moore, 1993). Reflecting this uptake in managerial attention, research attention also seems to be increasing (see for instance Adner & Kapoor, 2010; Baldwin, 2012; Gulati, Puranam, & Tushman, 2012; Nambisan & Sawhney, 2011; Tiwana, Konysnski, & Bush, 2010). In strategy research, the term 'ecosystem' has often been used to refer to a network of interconnected organisations that are linked to or operate around a focal firm or a platform (Adner, 2012; Adner & Kapoor, 2010; Iansiti & Levien, 2004a, b; Moore, 1993, 1996; Teece, 2007). The attractiveness of the ecosystem construct rests on its ability to evoke and highlight interdependencies between organisations and the collectivities in which they operate, and to provide a fresh way to think about specialisation, co-evolution, and co-creation of value (Adner, 2012; Adner & Kapoor, 2010; Autio & Thomas, forthcoming; Frels, Shervani, & Srivastava, 2003; Iansiti & Levien, 2004b).

Ecosystems generally incorporate a central focus around which production and use side participants are organised; either a focal firm (Adner & Kapoor, 2010; Teece, 2007), a central hub firm (Iansiti & Levien, 2004a, b; Moore, 1993, 1996), or a platform (Cusumano & Gawer, 2002; Gawer & Cusumano, 2002). Following Autio and Thomas (forthcoming), I define an ecosystem as: *a network of interconnected organisations, connected to a focal firm or a platform, that incorporates both production and use side participants, and creates and appropriates value*. The explicit inclusion of use

side participants differentiates the ecosystem from other network constructs in strategy literature, such as clusters, innovation networks, and industry networks, all of which are focused on the production side. Similarly, the combination of use and production side participants differentiates the ecosystem from those of user networks and communities, which focus on the use side. On the other hand, ecosystems research can be considered part of a wider and heterogeneous body of network literature in strategy research. In this literature, the inclusion of both production and use side participants is not a unique characteristic of ecosystems, as both sides are also included in strategic networks (Gulati, Nohria, & Zaheer, 2000; Jarillo, 1988), business networks (Anderson, Hakansson, & Johanson, 1994; Möller & Svahn, 2006), value nets (Nalebuff & Brandenburger, 1996), value networks (Christensen & Rosenbloom, 1995; Stabell & Fjeldstad, 1998) and value constellations (Normann & Ramirez, 1993). Strategy scholars have been recently revisiting issues concerning the collectivities within which organisations operate, introducing such concepts as the meta-organisation (Gulati et al., 2012), which explicitly includes ecosystems in its typology, and actor-oriented architectures (Fjeldstad, Snow, Miles, & Lettl, 2012).

Thus far, much of the ecosystem literature has focused on understanding the interdependent structure and dynamics of *already existing* ecosystems, with research attention focused on issues such as value co-creation and value appropriation (Adner & Kapoor, 2010; Jacobides, Knudsen, & Augier, 2006; Pierce, 2009), network structure (Brusoni & Prencipe, 2009; Ginsberg, Horwitch, Mahapatra, & Singh, 2010; Jacobides et al., 2006; Luo, Baldwin, Whitney, & Magee, 2012), platform leadership (Gawer & Cusumano, 2002; Schilling, 2009), governance (Nambisan & Sawhney, 2011; Tiwana et al., 2010) and the economics of multisided markets (Eisenmann, Parker, & Van Alstyne, 2009; Evans, 2009). Much less attention has been devoted to the *emergence* of ecosystems, however. The early ecosystem literature proposed a four stage model of an ecosystem lifecycle (Moore, 1993), and more recently Gawer (2009) has suggested an evolutionary typology of platform leadership, further developed by Thomas, Autio, and Gann (forthcoming) who proposed an evolutionary dynamic driven by varying levels of architectural openness and logics of value creation. Other literatures also appear to offer useful insight for addressing this issue. The industrial economics literature offers insights into participant adoption strategies in multi-sided market contexts (Eisenmann, 2008; Eisenmann, Parker, & Van Alstyne, 2006; Hagiu & Eisenmann, 2007), and the alliance formation literature offers insights into the social context of prior alliances and interdependence (Gulati, 1995, 1999). In addition, the behavioural strategy literature has indirectly considered ecosystem emergence strategies, suggesting alliance portfolio creation strategies (Ozcan & Eisenhardt, 2009), manipulation of organisational boundaries and market construction (Santos & Eisenhardt, 2009), and strategies to catalyse network formation (Hallen & Eisenhardt, 2012). However, although these provide valuable insight, these earlier approaches generally consider ecosystem *creation* – the intentional actions by a hub firm to create an ecosystem – as distinct to the more nuanced perspective of ecosystem *emergence* – how complex

systems arise out of a set of interactions. In addition, none specifically examines the *processes* underlying ecosystem emergence.

The lack of research on ecosystem emergence represents an important gap, given that many organisations, particularly in sectors where ICT has a significant influence, explicitly seek to create ecosystems and drive these to their advantage. Understanding both ecosystem emergence as well as ecosystem creation are vital to understanding industrial performance in today's highly specialised industrial landscape. As value creation processes become increasingly intertwined (Moore, 1996; Nalebuff & Brandenburger, 1996; Normann & Ramirez, 1994), it is worthwhile to start considering how ecosystems emerge in the first place, what activities and dynamics characterise ecosystem emergence and evolution, and under which conditions could ecosystem innovators stand a realistic prospect of achieving success. It is my ambition in this thesis to investigate *the emergence processes of ecosystems*.

Providing insight into this gap is important not only for ecosystem theory, but also for managerial practice, as both entrepreneurial start-ups and industry incumbents seek to promote and facilitate ecosystem emergence to gain strategic edge over rivals. The ecosystem is becoming a new referent for competitive strategy, with the locus of competition shifting from the firm to the network (Doz & Kosonen, 2008; Gulati et al., 2000; Iansiti & Levien, 2004b; Iyer, Lee, & Venkatraman, 2006; Moore, 1993; Normann & Ramirez, 1993). An example is the current competitive battle between operating systems for smartphones – namely Apple iOS, Blackberry OS, Google Android, and Microsoft Windows Phone. The competition between these smartphone operating systems is not simply between Google, Apple, Blackberry and Microsoft as hub firms; it is also between the participants in their respective ecosystems, and the ecosystems as a whole.

To explore ecosystem emergence requires a coherent theoretical framework with which to structure the investigation. To date ecosystem research has adopted complementary theoretical perspectives that reflect its emphasis on interdependent networked organisations engaged in value co-creation. In their review, Autio and Thomas (forthcoming) illustrate how existing ecosystem literature has drawn on the notion of networks as a distinct 'mode' of organisation as compared to markets and organisational hierarchies (Hennart, 1993; Thorelli, 1986); emphasised the social embeddedness of economic action (Granovetter, 1985; Uzzi, 1997); adopted the ideas of 'network organisation' and 'virtual organisation' (Miles & Snow, 1986); incorporated value chain, market structure and value appropriation considerations (Jacobides et al., 2006; Porter, 1980, 1985; Teece, 1986); echoed ideas from the resource-based, core competence and relational views (Barney, 1991; Dyer & Singh, 1998; Prahalad & Hamel, 1990); and recognised the differing sources of innovation (Von Hippel, 1988). In an attempt to introduce some coherence into this heterogeneity, Autio and Thomas (forthcoming) identify three dominant theoretical lenses that drive current ecosystem research. The value creation lens focuses on value creation processes, building upon and extending industrial organisation frameworks

of strategic management, notably those addressing industry structure, industry value chains and value appropriation in industry contexts. The network embeddedness lens emphasises the structural and relational aspects of networks, and considers prerequisites and constraints of operation within ecosystems. Finally, the network management stream lens focuses on the management strategies and tactics for coordinating and managing within network contexts.

Although these theoretical underpinnings have provided a fertile soil for ecosystem thinking to develop, they have not yet coalesced into a coherent theoretical framework to help understand ecosystem emergence processes. This is a shortcoming, as however useful the ecosystem construct may be, it also has limits, and sometimes the strong mental images evoked by this attractive metaphor may obscure differences between a given phenomenon and the metaphor used to make sense of it. Powerful and attractive metaphors such as the ecosystem do not negate the need for coherent theory that has been explicitly developed to describe the phenomenon of interest and not some analogous phenomenon. Given that the ecosystem is increasingly being utilised to portray a model of the collectivity, if not the environment (see for instance, Teece, 2007), in which an organisation operates, one potential theoretical lens to understand this complex construct is provided by organisation theory.

Within organisation theory there is a rich history of study of the collectivities and populations within which organisations operate (hereafter ‘organisational collectivities’), and of the interdependencies between organisations within these collectivities. Much of this research has considered the influence of the collectivity on the structure of an organisation. For instance, resource dependency theory examines power relations between an organisation and the providers of its resources (Pfeffer & Salancik, 1978); organisational ecology seeks to understand how populations of organisations are transformed by the differential success of constituent members (Hannan & Freeman, 1977); and institutional theory considers how organisations conform to their institutional environment (Meyer & Rowan, 1977). Similarly, transaction cost economics (Williamson, 1975) and network approaches (Granovetter, 1973; Kilduff & Tsai, 2003), although not strictly organisation theory, have also provided insight into the relationships within organisational collectivities. These theories have resulted in a diverse collection of conceptual models, including the ‘organisational set’ (Evan, 1966; Thompson, 1967); ‘interorganisational field’ (Litwak & Hylton, 1962; Warren, 1967); ‘interorganisational collectivity’ (Van De Ven, Emmett, & Koenig, 1974); ‘organisational population’ (Astley, 1985; Carroll, 1984; Hannan & Freeman, 1977); ‘interorganisational community’ (Astley, 1985; Carroll, 1984); ‘interorganisational network’ (Benson, 1975); ‘interorganisational domain’ (Trist, 1983); ‘industry system’ (Hirsch, 1972, 1985); ‘societal sector’ (Scott & Meyer, 1983); and ‘organisational field’ (DiMaggio & Powell, 1983). Hence, given the maturity and sophistication of organisation theory approaches to modelling and understanding the relationships between organisations within collectivities, the adoption of an organisation theory approach to ecosystems could provide the theoretical coherence and operationalisation techniques required for a comprehensive investigation of

the emergence processes of ecosystems. Therefore, my second ambition is to *develop an organisation theory approach to ecosystems*.

1.1 Research questions and approach

The overarching question addressed by this thesis is: why and how do ecosystems emerge? Ecosystem emergence considers how complex systems arise out of a set of interactions. The focus of attention is not particularly on the activities of a particular actor, but of the more generalised processes which result in ecosystem emergence. I do not directly consider ecosystem creation, the actions and strategies through which a hub firm constructs an ecosystem. As a consequence I aim to develop a theory of ecosystem emergence, not of ecosystem creation.

I have both theoretical and empirical goals. In terms of theory, I aim to develop an organisation theory approach to ecosystem research, and, from this basis, identify the types of activities that shape ecosystem emergence. As there exist a variety of theoretical frameworks that have been applied to ecosystem contexts, my first theoretical goal is to provide a coherent theoretical framework with which to structure an investigation into why and how ecosystems emerge. My second theoretical goal is to take this theoretical framework and analytically develop an understanding of the activities which drive the emergence of ecosystems. The identification of these activities enables an empirical analysis of ecosystem emergence. Empirically, as there has been limited research into the emergence processes of ecosystems, my goal is to investigate if the emergence processes of ecosystems exhibit similarities across different ecosystems. Although extant research suggests that there are a number of stages to ecosystem emergence (Moore, 1993), the existence of these has not been verified empirically. Moreover, by comparing the emergence processes of ecosystems across cases, I seek to provide for more systematic future research on ecosystem emergence processes, and also, provide rich insight that guides practitioner action in this domain. To create this contribution, I compare the emergence sequences of selected ecosystems using process methods. Specifically, I investigate three research questions:

1. *How can organisation theory be applied to understand ecosystems?*
2. *What activities drive the emergence processes of ecosystems?*
3. *Do ecosystem emergence processes exhibit similarities across cases?*

In addition to these three questions, I also consider the question of *why* the emergence processes under investigation are similar or different, seeking to shed light upon any causal mechanisms that might help explain similarities or differences across cases.

1.2 Method and data

This thesis employs a narrative explanation process approach, which takes the contributions of events to a particular outcome and then configures them into a coherent, complete episode

(Polkinghorne, 1988). Put differently, narrative explanation conceptualises development and change processes as a sequence of events which exhibit unity and coherence over time (Poole, Van De Ven, Dooley, & Holmes, 2000). Ecosystem emergence will be explained as the result of the order in which events unfold, and of particular conjunctions of events and contextual conditions. Given the limited theory and understanding of the emergence processes of ecosystems in digital service contexts, I use a case study based design, as rich detailed data is required (Edmondson & McManus, 2007; Siggelkow, 2007). Case studies provide rich detail (Langley, 1999; Van De Ven, 1992; Weick, 2007), capture multiple levels of context and recurrent patterns in process data (Pettigrew, 1992), and contain the same narratives that organisations use to plan, enact, interpret and evaluate their own actions and those of others (Pentland, 1999).

The research setting is digital services. Digital services are often designed as incomplete systems (Garud, Jain, & Tuertscher, 2008), necessitating their inclusion in a network (ecosystem) of other complementary services. As a consequence many digital services are not necessarily consumed directly or alone, but instead are consumed by other services, or jointly consumed. Digital services also exhibit many of the characteristics of a high velocity environment, in that there are rapid changes in demand, competition, and technology (Bourgeois & Eisenhardt, 1988). Six successful ecosystem emergence processes are investigated – Amazon, eBay, Facebook, Google, Salesforce, Wikipedia – which together illuminate the phenomenon of interest and cover a range of polar types (Pettigrew, 1990; Yin, 1984). These six cases are heterogeneous within the context of digital services and potentially provide a level of generalisability beyond their context (Leonard-Barton, 1990).

Methodologically, the analysis relies on coding and reduction of raw narrative case data to sequences of objectively coded events. These events are then analysed and compared using phasic analysis. To create the temporal sequence of events that explains an observed stream of incidents (Poole et al., 2000), event colligation is applied to incident data extracted from the case narratives (Abbott, 1984, 1990a; McCullagh, 1978; Walsh, 1958; Whewell, 1847). Distinguishing between an incident as a raw datum and an event as a theoretical construct (Abbott, 1984), event colligation is a technique where any number of incidents are selected as indicators of an event. Thus, whereas an incident is an empirical observation, an event is not directly observed; it is a construct that explains a pattern of incidents. These constructed events are then coded using the activities of ecosystem emergence theoretically derived in Chapter 3.

The primary process method applied to these event sequences is phasic analysis, where each case sequence is analysed with the goal of discerning sub-sequences. Put differently, phasic analysis attempts to capture the overall coherency of development and change at a higher level than fine-grained micro-level structure (Poole et al., 2000). The fundamental assumption of phasic analysis is that the overall process can be described in units larger than the underlying events. Three different phasic analysis techniques are applied to the coded event data. Optimal matching compares whether any two sequences

have similarities in the code patterns, with statistical significance bootstrapped through the generation and analysis of ten thousand random sequences for each case. Direct inspection, a qualitative technique, enables the determination of phases through interrogation of the case narratives, related theory, and the manual discernment and sorting of pattern sequences into higher level sequences. Frequency analysis consists of the quantitative analysis of the occurrences of codes, such as code counts per period or within a moving window. Together these three techniques enable a comparison of the emergence processes of the six digital service ecosystems.

1.3 Structure of the thesis

This thesis is structured as a monograph and comprises seven chapters.¹ Following this introduction, Chapter 2 first reviews the characteristics of an ecosystem, deriving six attributes that enable an evaluation of the suitability of different organisation theory approaches to organisational collectivities. I then review models of collectivities in organisation theory, evaluating the ecosystem construct against each model, concluding that the organisational field has most relevance. I argue that the organisational field construct has a number of facets distinguished by their recognised area of institutional life, and that the ecosystem can be usefully viewed as an organisational field where value co-creation is its recognised area of institutional life.

Chapter 3 synthesises the literatures addressing organisational fields, institutional formation and change, dominant design, social movement theory, and institutional entrepreneurship and proposes four activities of ecosystem emergence. I identify resource and technological activities that occur at the level of the firm, such as resource acquisition and digital service design. I also identify institutional activities that occur at multiple levels of analysis, such as governance and identity construction. I also identify contextual activities that occur outside the ecosystem, such as actions of regulators and the media.

Chapter 4 outlines the process methodology, where raw narrative data is reduced to sequences of objectively coded events that are then compared using phasic analysis. The chapter details the methodological basis of the process methodology and describes the techniques of sequence data generation and analysis, including data collection, event colligation, phasic analysis and statistical bootstrapping.

Chapter 5 reports the results of the comparison of the six empirical cases. The first comparison, of the complete event sequences of each of the six cases, finds that the sequences are significantly dissimilar to one another. The second comparison finds that there are three phases of ecosystem emergence. Phase I, or Initiation, consists of the initial idea and digital service development, resource gathering and early operation. In Phase II, or Momentum, the ecosystem begins to grow rapidly, driven by increasing numbers of participants (driven by positive network effects), aggressive marketing, much

¹ Parts of this chapter and the following chapters are included in two co-authored papers with Professor Erkki Autio which have been presented at a number of conferences.

press and societal interest, as well as competitor activity. In Phase III, or Control, the ecosystem is established as the undisputed leader and the focus of activity moves from expansion to control and value appropriation. The third comparison compares each phase across cases, finding that the first phase is similar across cases, but subsequently the similarities decrease from one phase to the next as the ecosystem evolves. To explain these findings I argue that the idiosyncratic logics of value co-creation of each case result in differing emergence sequences. More specifically, I argue that in the first phase, when the logics of value co-creation are nascent, there are similarities due to the common requirements of resource gathering and the development of the digital service. However, in the second phase the idiosyncratic and path dependent logics of value co-creation are embedded and extended, and in the third phase idiosyncratic value appropriation and control logics created, resulting in increasing dissimilarities in the event sequences of each case.

Chapter 6 discusses the implications of both the theoretical and empirical contributions for ecosystem research, institutional theory and strategic management practice. Specifically considering the important role of the logic of value co-creation on ecosystem evolution, I discuss how the close relationship between value co-creation and appropriation in ecosystem contexts requires an ‘ecosystem model’ – the rationale of how an ecosystem co-creates, delivers and shares value.

Chapter 7 concludes the thesis, outlining the contributions to theory, method and practice, limitations, and directions for future research.

2 THE ECOSYSTEM AS AN ORGANISATIONAL FIELD

This chapter reviews the characteristics of the ecosystem, deriving six attributes that enable an evaluation of differing models of organisational collectivities from within organisation theory. (For a full review and evaluation of the ecosystem literature, see Autio & Thomas, forthcoming.) I review conceptualisations of organisational collectivities in organisation theory, outlining relevant models from resource dependency theory, organisational ecology and institutional theory, and assessing their resonance with the ecosystem construct. Concluding with a discussion of the organisational field construct, which represents perhaps the dominant lens for the portrayal of organisations and their collectivities in organisation theory, I argue that institutional theory, and the organisational field construct in particular, has the strongest resonance with the ecosystem construct.

I then argue the ecosystem should be considered a type of organisational field, in that it consists of those network and institutional elements that are both the defining characteristics of an organisational field. Noting that an ecosystem has an analytic focus on value co-creation, I review the differing analytic foci of the organisational field, arguing that the organisational field construct has four facets where each facet represents a different recognised area of institutional life. The dominant facet, as originally suggested by DiMaggio and Powell (1983), is represented by a common industry as the distinguishing area of institutional life. The second facet is represented by common technologies as the distinguishing area of institutional life (Garud, Jain, & Kumaraswamy, 2002), and I also discuss the related notions of technological trajectories (Dosi, 1982) and dominant designs (Abernathy & Utterback, 1978; Anderson & Tushman, 1990). The third facet of organisational fields is represented by social issues as the distinguishing area of institutional life (Hoffman, 1999). Discussing this, I also introduce social movement theory into my analysis (McAdam & Scott, 2005; Rao, Morrill, & Zald, 2000). The fourth facet is represented by the market as the distinguishing area of institutional life (Beckert, 2010). The chapter concludes by suggesting that ecosystems are distinguished – both as a category and as a theoretical concept – by a fifth facet, value co-creation, which acts as the fifth recognised area of institutional life (Adner & Kapoor, 2010; Iansiti & Levien, 2004b; Moore, 1993).

2.1 Characteristics of an ecosystem

In strategy research, the most common conceptualisation of the ecosystem was first proposed by Moore (1993), who used the term to describe the set of organisations and consumers that surround a focal organisation, and which contribute to its performance. Moore explicitly adopted a biological metaphor and viewed the company not as a member of a single industry but as part of a ‘business ecosystem’. For Moore, a business ecosystem is an economic community supported by a foundation of interacting organisations and individuals, and which includes suppliers, lead producers, competitors and other stakeholders (Moore, 1996). In their influential book, Iansiti and Levien (2004a) propose the ecosystem as loose networks of suppliers, distributors, outsourcing firms, makers of related products or

services, technology providers and others that both affect, and are affected by, the creation and delivery of a hub firm's own offerings. Even more broadly, an ecosystem can be considered to include the community of organisations, institutions and individuals that impact the focal organisation, such as customers, competitors, complementors, suppliers, regulatory authorities, standard-setting bodies, the judiciary, and educational and research institutions (Teece, 2007).

Research into ecosystem dynamics suggests three main characteristics that best describe ecosystems. These are discussed below, and a number of key attributes derived which can be used to evaluate models of organisational collectivities that have been developed within organisation theory.

2.1.1 Value-creating networks

A defining characteristic of ecosystems is that they are dynamic and purposive value-creating networks in which the participants co-create value (Adner, 2006; Adner & Kapoor, 2010). Typified by a system-level goal of value co-creation (Gulati et al., 2012), an ecosystem explicitly and holistically considers the role of complementary asset providers in value creation and appropriation (Teece, 1986). Moving beyond the value chain to consider the wider network of value creating participants, ecosystems extend the concept of a value chain to that of a system, including any organisation that impacts the focal organisation in some manner (Iansiti & Levien, 2004b). By embedding themselves in a complex set of network relationships (Granovetter, 1985; Gulati et al., 2000), ecosystem participants combine their individual offerings into a coherent, customer-facing solution, in the process co-creating value that would not be possible for a single participant alone (Adner, 2006; Adner & Kapoor, 2010). However, these are not the arms-length or hierarchical transactions of Williamson (1975), as the co-creation of value here relies on investments in relation-specific assets, substantial knowledge exchange, and non-market governance mechanisms (Dyer & Singh, 1998). As a consequence, ecosystems have a logic of mutual exchange that operates differently from that of markets and hierarchies.

In order to facilitate value co-creation, the relationships in an ecosystem efficiently move information, innovations and resources around the network (Adner, 2012; Iyer et al., 2006). The movement of information, innovations and resources is not constrained to a particular locality, with value co-creation independent of the physical locations of the ecosystem participants. Although not explicit in the extant ecosystem literature, location independence is implied through the empirical examples adopted in ecosystem research (see for instance Adner & Kapoor, 2010; Iansiti & Levien, 2004a; Moore, 1993) as well as through theoretical development (see for instance Teece, 2007). A healthy ecosystem is productive in that it can consistently transform technology and other raw material of innovation into lower costs and new markets, as well as continuously adapting and evolving to changes inside and outside of it (Basole, 2009; Iansiti & Levien, 2004b). Due to their embeddedness in the network, each ecosystem participant is symbiotic to and co-evolves with other participants (Iansiti & Levien, 2004b; Li, 2009), driven by technological interdependence (Adner, 2012; Adner & Kapoor, 2010). Symbiosis and co-evolution in ecosystem contexts means that each participant of the ecosystem

ultimately shares the fate of the network as a whole, regardless of that individual participant's strength or power (Iansiti & Levien, 2004b).

The dynamics of value co-creation mean that opportunities enabled by ecosystems are not necessarily equally distributed amongst participants (Adner & Kapoor, 2010; Burt, 2004). There is a heterogeneous pattern of relationships, both of strength and number of direct and indirect ties (Adner & Kapoor, 2010; Cusumano & Gawer, 2002; Li, 2009; Pierce, 2009). Often there is a hub firm within the network, providing a coordination role (Cusumano & Gawer, 2002; Iansiti & Levien, 2004b; Li, 2009; Pierce, 2009). These hub firms often are at the centre of multi-sided markets where value creation is driven by both direct and indirect positive network externalities underpinned by standards and lock-in (Cusumano, 2010; Gawer, 2009; Katz & Shapiro, 1985, 1986; Thomas et al., forthcoming). Such hub firms are central to the health and stability of an ecosystem, as not only do they drive the collective performance of the network (Pierce, 2009), they also increase the ease with which nodes can connect to each other (Evans, Hagiu, & Schmalensee, 2006; Gawer & Cusumano, 2002; Iansiti & Levien, 2004a). Hub firms naturally emerge in networks, regardless of the quality of the networked system, its participants, or the specific nature of their connections (Barabási, 2002; Barabási & Albert, 1999; Cohen, 2002b; Newman, 2001). For instance, in digital service ecosystems it was found that while the number of digital services grew in a linear fashion, the distribution of complementors to hub firms followed a power law, implying a small number of hub firms provided for a majority of complementors (Weiss & Gangadharan, 2010). A substantive subset of the literature identifies the 'platform' as the coordinating artefact that a hub firm uses, or the services, tools and technologies that other members of the ecosystem can use to enhance their own performance (Cusumano & Gawer, 2002; Iansiti & Levien, 2004b; Li, 2009; Tiwana et al., 2010).

Summarising, ecosystems are characterised by a value co-creating network that is not restricted to a locality, where there is symbiosis and co-evolution between participants, and where a hub firm provides a coordinating role. This characteristic suggests four attributes that are relevant to an evaluation of models of organisational collectivities and the subsequent selection of an appropriate organisational theory approach to ecosystems:

- The model of the environment should conceptualise the relationships of the organisations within the collectivity as a network. Put differently, the unit of analysis should be the network.
- The model of the organisational collectivity should be able to theoretically account for processes of value co-creation which characterise ecosystems.
- The model of the organisational collectivity should not be constrained to a particular locality.
- The model of the organisational collectivity should be able to theoretically account for a dominant central actor.

2.1.2 Governance system

A second characteristic of the ecosystem is the governance system that coordinates the activities of the participants, introducing both regulatory and normative institutional elements into the analysis. All ecosystems have rules and standards that cover interactions between the participants, as these orchestration processes enable ecosystem functioning and survival (Adner, 2012; Gawer & Cusumano, 2002; Iansiti & Levien, 2004a; Nambisan & Sawhney, 2011). For example, for ecosystems that have a central hub firm or platform such as Walmart or Microsoft, participants need to agree to a common contract which provides the regulations that govern collaboration and value co-creation. For more open ecosystems, such as open source projects, during the registration participants may also agree to a limited set of legal requirements. Indeed all functioning value creating collaborative networks require rules and standards (Evans & Wolf, 2005; Nathan & Mitroff, 1991), as ecosystem participants may be both simultaneously competing and cooperating, resulting in complex strategic games (Nalebuff & Brandenburger, 1996). As all ecosystem boundaries are permeable to some extent, a regulatory function is determining how open the ecosystem is to new members (Gulati et al., 2012). Nambisan and Sawhney (2011) have specifically identified processes relating to innovation leverage, innovation coherence, knowledge, membership, stability, and appropriability all of which require agreement on the rules of the game.

However, although ecosystem participants are bound by complex relations that involve mutual interdependence, the degree of stratification between participants can vary (Gulati et al., 2012). Stratification can occur through ownership, such as through the provision of a stable and predictable set of common assets (Gawer & Cusumano, 2002; Iansiti & Levien, 2004b), through being a fundamental technological element of the ecosystem (Gawer & Cusumano, 2008), or through leveraging a brand (Pierce, 2009). Stratification can be also be purposefully introduced into ecosystems, through tiering in task assignment or administration, which can complement other mechanisms of stratification. Gulati et al. (2012) note that in situations of higher stratification through design, a degree of hierarchical decision-making is possible because of defined roles and normative expectations. In situations where stratification occurs through production assets, authority can also be exercised through technological means such as varying the modularity of the product and service (Cusumano & Gawer, 2002; Gawer & Cusumano, 2008; Weiss & Gangadharan, 2010), the standardisation of interfaces (Gawer & Cusumano, 2008; Li, 2009; Tilson & Lyytinen, 2006; Weiss & Gangadharan, 2010) or restricting access (Gulati et al., 2012; Hardy & Phillips, 1998; Pfeffer & Salancik, 1978). Although the authority that results is often limited in scope, especially in open-membership contexts, it can still create a social structure that can guide task identification and assignment, decision-making, and conflict resolution.

In situations of low stratification, where the power afforded is limited, hierarchical decision-making is often impossible. In these situations roles and normative expectations emerge around a peer-based approach to coordination (Gulati et al., 2012). Self-enforcing governance (Dyer & Singh, 1998)

becomes salient, as goodwill, trust and reputation mechanisms being necessary for ecosystem coordination (Gulati, 1995; Larson, 1992; Powell, 1990). For instance, early on in ecosystem research, Iansiti and Levien (2004a: 208) underlined the importance of trust in relation to ecosystem operations, noting that “trust is fundamental ... [as] ... ultimately it decreases operating costs and risk exposure. A well-trusted marketplace will need to spend less in attracting customers and in managing their relationships.” Others have also acknowledged the importance of norms of openness, trust, tact and professionalism in ensuring ecosystem value co-creation, stability and maintenance (see for instance Agerfalk & Fitzgerald, 2008). These attributes also contribute to the participants’ belief that inclusion in the ecosystem will lead to value creation and value capture, as well believing the hub firm will behave in such a way as to maintain stability. In doing so they lead to further conformance to norms.

Summarising, ecosystems are also characterised by a governance system that coordinates the activities of the participants, and which consists of both regulatory and normative elements. This characteristic suggests a further attribute that is relevant to an evaluation of models of organisational collectivities:

- The model of the organisational collectivity should be able to theoretically account for a governance system that includes both regulative and normative elements.

2.1.3 A shared logic

A third characteristic of ecosystems is the importance of a shared logic that consists of cognitive elements such as legitimacy and meaning. Providing for a functioning and stable ecosystem, a shared logic enables differing participants to co-exist with minimal friction, as individual participants may have institutional logics that are specific to their particular industry organisational field (Adner, 2012; Iansiti & Levien, 2004a).

Legitimacy here is socio-political, in that key stakeholders, opinion leaders and wider society accept and endorse the ecosystem and hub firm as appropriate, proper, and cognitive, reflecting a shared understanding of what the ecosystem is about and what it seeks to achieve (Aldrich & Fiol, 1994). For instance, the concept of ‘platform leadership’ (Gawer & Cusumano, 2002) implies cognitive elements through its focus on leadership – a hub firm cannot lead an ecosystem without being seen as legitimate by partners and other ecosystem participants (Olleros, 2008; Sivadas & Dwyer, 2000). To effectively facilitate ecosystems, therefore, hub firms need to gain social acceptability and legitimacy in order to gain a leadership position within the ecosystem (Adner & Snow, 2010; Gawer & Phillips, forthcoming). In particular, hub firms need to perform both practice and legitimacy work in order to ensure that they are accepted as a leader (Gawer & Phillips, forthcoming). Gulati et al. (2012) have indicated that legitimacy in ecosystems can be enhanced through the inclusion of high-status participants at an early stage. Moreover, research has indicated that participating firms are attracted to the dominant actor in an

ecosystem for reasons of legitimacy and stability (Oliver, 1990), which in itself leads to the creation of hub firms in an ecosystem (Barabási, 2002).

Beyond legitimacy, ecosystems also have a shared logic through the mutual awareness of participants that are engaged in a common enterprise of system level value co-creation, with a shared understanding of goals and how they are to be pursued (Adner, 2012; Gulati et al., 2012). In ecosystems the conversation between organisations changes from a firm-centric to an ecosystem perspective, as participants discursively confront the challenges that lie beyond their own immediate responsibilities, consider how they want to organise and address the risks of organisation, and how to act proactively in the future (Adner, 2012). As a consequence, the mutual awareness of common enterprise is more than a simple awareness that each participant is collaborating with others. It extends not only to include norms of behaviour and the goals of collaboration, but also to a common understanding of the logic of value – what and how value is to be co-created and how it is shared. This common understanding of value co-creation results in a collective identity that is embedded in the shared logic, which can be actively supported by the actions of the hub firm (Gawer & Phillips, forthcoming). Moreover, being the centre of the common channels of dialogue and discussion around which issues of value co-creation and sharing arise and evolve (Gawer & Cusumano, 2002; Iansiti & Levien, 2004a), means that hub firms can guide ecosystems through, for example, influencing the on-going discourse and sense-making processes and through the subtle exercise of power (Weick, 1995). Hub firms also encourage the development of an shared logic through innovating new practices, enrolling ecosystem members to engage with these and managing the external tensions (Gawer & Phillips, forthcoming).

Often this shared logic is established very early on, with membership criteria and welcome messages utilised to ensure an understanding of the goals of the ecosystem as well as the regulations, norms, beliefs and practices. For example, Wikipedia established a specialised group of users which engaged with new users to acculturate them into the prevailing norms and practices. The shared logic is also reflected in symbolic and discursive practices (Levy & Scully, 2007; Phillips, Lawrence, & Hardy, 2004). Stratification provides a useful symbolic tool to draw attention to which issues are important and which competencies and behaviours are valued (Gulati et al., 2012). The shared logic is also reflected within the construction of an ecosystem identity, where participants advertise their inclusion in the ecosystem as well as their level of participation through logos and other insignia. Some go as far as to reflect the ecosystem identity within their corporate brand and identity. Stratification-related symbols and discursive practices can also create incentives for other organisations to join as they act as an advertisement of value creation and appropriation within the ecosystem. Many arrange conferences and seminars for ecosystem participants to gather together physically, share their experiences and to debate and agree practices, norms and meanings (Lampel & Meyer, 2008). Much effort is often expended in aligning the perspectives on the future success of the ecosystem, in the process constructing an ecosystem level frame in the same manner as a ‘field-level’ frame (Lounsbury,

Ventresca, & Hirsch, 2003) and legitimating the collective identity (Gawer & Phillips, forthcoming). In doing so the identities and interactions of the ecosystem participants are defined and stabilised (Scott, 2008).

Summarising, ecosystems are also characterised through a shared logic that includes cognitive elements such as legitimacy and meaning. This characteristic suggests a sixth attribute that is relevant to an evaluation of models of organisational collectivities:

- The model of the organisational collectivity should be able to theoretically account for a shared logic that includes cognitive elements such as legitimacy and meaning.

2.2 Models of organisational collectivities in organisation theory

Within organisation theory there is a rich history of the study of the collectivities in which organisations operate, and of the interdependencies between organisations within these collectivities. The models that consider organisational collectivities emerged from attempts to bridge the gap between the microscopic organisational unit of analysis and the macroscopic institutional unit of analysis. These models developed from an analytic consideration of how both the immediate and distal environment influences the structure of the organisation, and differing models consider a range of units of analysis, levels of analysis and types of interdependence.²

Much of this research has considered the influence of the collectivity on the structure of an organisation. For instance, resource dependency theory examines power relations between an organisation and the providers of its resources (Pfeffer & Salancik, 1978); organisational ecology explores how populations of organisations are transformed by the differential success of constituent members (Hannan & Freeman, 1977); and institutional theory explores how organisations conform to their institutional environments (Meyer & Rowan, 1977). Similarly, transaction cost economics (Williamson, 1975) and network approaches (Granovetter, 1973; Kilduff & Tsai, 2003), although not strictly organisation theory, have also provided insight into organisational collectivities. Others have discriminated between technical and institutional environmental sources of interdependence within collectivities, suggesting that complex technologies, social environments and complex exchanges foster the development of rationalised organisational structures (Galbraith, 1973; Thompson, 1967), while highly institutionalised environments lead to the development organisational structures that conform to shared institutional rules (Meyer & Rowan, 1977; Meyer, Scott, & Deal, 1981; Scott, 1983). Technical interdependence models generally stress the incompleteness of the organisation primarily in terms of resource and information flows, while social/cultural interdependence models instead view

² For the sake of clarity, level of analysis points to the scale of the model and the more or less integrated set of relationships, while unit of analysis refers to the distinct unit which is considered by the model.

Table 1 – Overview of main models of organisational collectivities in organisation theory

MODEL	KEY REFERENCE	CORE THEORY	INTERDEPENDENCE TYPE	UNIT OF ANALYSIS	LEVEL OF ANALYSIS
Organisation set	Evan (1966)	Resource dependence	Technical	Focal firm	Horizontal; heterogeneous
Interorganisational field	Warren (1967)	Resource dependence	Technical	Network	Horizontal; restrained geography; heterogeneous
Interorganisational collectivity	Ven de Ven et al. (1974)	Resource dependence	Technical	Network	Horizontal; heterogeneous
Interorganisational network	Benson (1975); Astley (1983)	Resource dependence; network theory	Social/Cultural	Network	Horizontal; vertical; heterogeneous
Organisational population	Hannan & Freeman (1977)	Organisational ecology	Technical	Population	Horizontal; homogeneous
Interorganisational community	Astley (1983)	Organisational ecology	Technical	Community	Horizontal; restrained geography; heterogeneous
Industry system	Hirsch (1972; 1985)	Institutional	Social/Cultural	Industry	Horizontal; vertical; heterogeneous
Societal sector	Scott (1983)	Institutional	Social/Cultural	Industry	Horizontal; vertical; heterogeneous
Business system	Whitely (1992a; 1992b)	Institutional	Social/Cultural	National	Horizontal; vertical; heterogeneous
Interorganisational domain	Trist (1983)	Institutional; negotiated order theory	Social/Cultural	Population	Horizontal; vertical; heterogeneous
Organisational field	DiMaggio & Powell (1983)	Institutional	Social/Cultural	Industry	Horizontal; vertical; heterogeneous

organisations as participating in larger systems of interorganisational relations as well as larger cultural systems (Scott, 1983; Scott & Meyer, 1983).

Resource dependency theory, which examines the power and dependency relations between organisations in a collectivity (Pfeffer & Salancik, 1978), adopts a number of models that vary by unit of analysis and interdependence type. While the organisational set (Evan, 1966) is applicable at the focal firm unit of analysis, the interorganisational field (Litwak & Hylton, 1962; Warren, 1967), interorganisational collectivity (Van De Ven et al., 1974), and interorganisational network (Benson, 1975) each operate at the network level of analysis. These models also vary by interdependence type, with the organisational set, interorganisational field and interorganisational collectivity considering technical interdependence within the collectivity, while the interorganisational network considers social/cultural interdependence. In addition, the interorganisational field and interorganisational collectivity differ by level of analysis. Organisational ecology, in contrast, utilises both the organisational population (Astley, 1985; Carroll, 1984; Hannan & Freeman, 1977) and the interorganisational community (Astley, 1985; Carroll, 1984) as models, both of which operate at differing levels of analysis. Institutional theory, which considers how organisations conform to their regulatory, normative and cognitive environments (Meyer & Rowan, 1977), also utilises a number of models of organisational collectivities, including those of societal sector (Scott & Meyer, 1983), industry system (Hirsch, 1972, 1985), business system (Whitley, 1992a, b), interorganisational domain (Trist, 1983), and organisational field (DiMaggio & Powell, 1983). See Table 1 above for an outline.

The main models of organisational collectivities from organisation theory are discussed below in the context of their primary theories and their relevance to the ecosystem construct.³ Contingency theory and its later elaborations (Van De Ven, Ganco, & Hinings, 2013), such as the configuration (Meyer, Tsui, & Hinings, 1993), complementarity (Whittington, Pettigrew, Peck, Fenton, & Conyon, 1999), complexity (Anderson, 1999) and creative (Romme, 2003) perspectives are not reviewed, as here analytic attention is instead directed to attributes of the environment such as technology, size and uncertainty, rather than the collectivities in which an organisation resides. Transaction cost economics is also not explicitly reviewed, as this analytic approach generally conceives of organisational collectivities in a similar manner to resource dependence theory, with much of the focus on the organisation set (Davis & Powell, 1992; Evan, 1966). Similarly, network approaches (Granovetter, 1973; Kilduff & Tsai, 2003) are not explicitly developed, as the research on interorganisational networks has also tended to follow the logic of resource dependence theory: networks of interorganisational resource exchanges confer power and dependence, which in turn motivate

³ This is by no means the first review of this literature, in particular see Scott & Meyer (1991) and Davis & Powell (1992), although it is the first to evaluate the literature in the context of the ecosystem construct.

organisations to establish ties with others (Davis & Powell, 1992). Where relevant both transaction cost economics and network approaches are noted.

2.2.1 Resource dependence theory models

Resource dependency theory is based on the notion that an organisation's pattern of dependence on environmental resources results in external constraints and control (Pfeffer & Salancik, 1978). These are determined by the differential power of the heterogeneous organisations that have a relation with the focal organisation. A number of models of organisational collectivities have been adopted in resource dependency theory, each varying by type of interdependence, unit of analysis and level of analysis.

At the focal firm level, and analogous to the earlier conception of the 'role-set' of Merton (1957), Evan (1966) suggested the *organisation set* as the network of organisations in the focal firm's environment. In an organisation set the relations between the focal organisation and its organisation set are mediated by the role-sets of its boundary personnel, the flow of information, the flow of product or services, and the flow of personnel. Depending on the relative value and scarcity of critical resources that are provided within the organisation set, the resulting interorganisational system is a set of power and dependence relationships between firms. Compositionally, the organisation set consists of two components: the input organisation set consisting of those organisations that supply resources such as personnel, materials, capital, legality and legitimacy; while the output organisation set consists of those to which the focal organisation supplies a good or a service, such as a market, an audience or a client system. Conceptually, the organisation set is a weak model of organisational collectivities because it focuses attention on direct connections and flows, and views the environment from the vantage point of a single organisation (Scott, 1983; Scott & Meyer, 1983).

Moving beyond the focal firm to consider the network unit of analysis, other models focus instead on the relational elements between organisations either expressed as flows or linkages (Scott, 1983). For instance, the *interorganisational field* model focuses on the pattern of relations that link a collection of diverse organisations into a common network. This notion is based upon the observation that the interaction between any two organisations is affected, in part at least, by the nature of the organisational pattern or network in which they find themselves (Warren, 1967). Clark (1965) suggests that these interorganisational patterns are neither overtly bureaucratic nor political in nature, characterised instead by a less formal structure, looser accountability and shared responsibilities. As such, the patterns of interorganisational relations are characterised by social conflict and unstructured authority (Litwak & Hylton, 1962), particularly in the arenas of resource procurement and allocation, political advocacy and organisational legitimation (Galaskiewicz, 1985). Within these patterns systems of meaning develop, including the definition of collective goals and values, and the available methods to pursue objectives (Scott, 1983). Normative contexts also exist, varying from the competitive to the cooperative, with cooperation ranging from contingent on the demands of the collectivity to a more mandated cooperation

(Laumann, Galaskiewicz, & Marsden, 1978). This mandated cooperation has led others to suggest that due to the technical interdependence within these interorganisational patterns, coordinating agencies emerge to regulate behaviour by communicating pertinent information, adjudicating areas of dispute, providing standards of behaviour, and by promoting the common interest (Litwak & Hylton, 1962). However, despite the valuable focus on relations and cognitive and normative aspects, the interorganisational field model is limited in its usefulness through an analytic concentration on the horizontal linkages between organisations, and on connections between organisation within a restricted, usually local, geographical area (Scott & Meyer, 1983).

The *organisational collectivity* of Van De Ven et al. (1974) also concentrates on horizontal linkages between organisations, but is not limited to a restricted geographical area. Viewing the environment as a social system, the unit of analysis here is the collectivity of primary productive organisations that are technically dependent upon one another. The collective's orientation is towards the attainment of goals that are unattainable by the organisations independently, and require coordinated action by the member organisations in the collectivity. Introducing normative elements, they suggest that constituent organisations take on specialised roles and develop behavioural expectations of each other regarding the rights and obligations of membership within the collective.

The *interorganisational network* of Benson (1975), also taking the unit of analysis as the network, moves beyond concerns of technical interdependence to consider social and cultural interdependence, and also begins to reflect network approaches (see for instance Laumann et al., 1978). In addition, it also explicitly includes both vertical and horizontal linkages outside of a limited geographic area. Benson conceptualises the interorganisational network as a political economy concerned with the distribution of the scarce resources of money and authority. These interorganisational networks are emergent and vary widely in structure, ranging from a series of organisations linked by multiple direct ties, or characterised by clustering or centred linkages on one or more mediating or controlling organisations. In the substructure of an interorganisational network, differentially powerful constituent organisations interact in pursuit of scarce resources. Power within this substructure derives from both the network structures and patterns of direct linkages, and through the patterns of linkage between organisations within the substructure and other organisations, officials and publics. The interorganisational superstructure, reflecting social/cultural interdependence considerations, consists of the sentiments and interactions of the participating organisations. It is characterised by domain consensus on the role and scope of the network, ideological consensus, agreement on the appropriate approaches to common or similar tasks, evaluation of quality of work, and the coordination of work through the conduct of joint, cooperative, or articulated activities and programs.

Astley and Van De Ven (1983) take a collective action view of the interorganisational network, conceiving the collectivity as guided and constructed by collective purpose and choice (c.f. Emery &

Trist, 1965). Here the interorganisational network is “a social action system of symbiotically interdependent organisations that, over time, take specialised roles within a framework of normative expectations that define rights and conduct” (p. 251). These semi-autonomous organisations interact to modify their collective environment, working rules and options so as to create a protective social environment that displaces the natural environment as the critical influence. The cohesion in these networks derives from the functional interdependence, or symbiosis, that develops on the basis of complementary differences between the heterogeneous participants. Normative expectations develop through the construction of a social environment that permits the network to act as a unit and make decisions to attain the collective and individual interests of its member organisations. Power begins to play an explicit role as those units responsible for obtaining resources directly from the natural environment are able to regulate the conditions essential to the functioning of other units in the network that only have indirect relations with this environment. As such, although such resource flows may still be characterised as economic exchanges, powerful members of the network are able to define their own terms of exchange and impose these on others. They also note a growing dominance of big business at the core of interorganisational networks, where artificial social environments are created among a community of organisations to ensure immunity from the harsh realities of competition in the natural environment. Thus, similar to Litwak and Hylton (1962) and the organisational set model, they suggest that interorganisational networks develop mutually beneficial structures that support collective survival.

Models of organisational collectivities from resource dependency have some resonance to the ecosystem construct (see Table 2 below).

Table 2 – Organisational collectivities relevance to ecosystem construct

CORE THEORY	NETWORK PERSPECTIVE	VALUE CO-CREATION SUPPORT	NON-LOCALITY BASED	POWERFUL CENTRAL ACTOR	GOVERNANCE SYSTEM	SHARED LOGIC
Resource dependence	Yes	Limited	Yes	Partial	Yes	Partial
Organisational ecology	No	No	Partial	No	No	No
Institutional	Yes	Yes	Yes	Partial	Yes	Yes

As resource dependency theory increased in sophistication, it moved from a focus on a focal organisation to a focus on collections or networks of organisations, better aligning with the system perspective of ecosystems. The conception of interdependence in models of the environment also moved from an early focus on geographical proximity to one that was driven by functional concerns, further aligning with the non-geographic nature of ecosystems. Moreover, the primary understanding of the interdependence between organisations is technical, similar to the focus on technological interdependence in ecosystem research. This is complemented by a well-developed consideration of a governance system based upon regulative and normative elements, well as a partial recognition of a shared logic based upon cognitive aspects. However, models of organisational collectivities in resource

dependency theory only partially consider the role of powerful central actors in the collectivity (c.f. Astley & Van De Ven, 1983; Litwak & Hylton, 1962), one of the defining attributes of an ecosystem. Furthermore, resource dependency theory, with its focus on power relations, is limited in its ability to (although not unable to) address the dynamics of value co-creation that typify ecosystems, although Van De Ven et al. (1974) began to consider this through their notion of collective attainment of goals. These limitations restrict the application of models of organisational collectivities from resource dependency theory to develop an organisation theory approach to ecosystems.

2.2.2 Organisational ecology models

The organisational ecology approach to collectivities entails a shift in the unit of organisational analysis from the network to the population of organisations. Organisational ecology takes a natural selection approach (Aldrich & Pfeffer, 1976; Astley, 1985; Carroll, 1984; Hannan & Freeman, 1977) and is primarily concerned with variation and selection processes where the environment selects optimal combinations of organisations (Hannan & Freeman, 1977). As such the main thrust of the organisational ecology approach to the relationship between organisations in collectivities is on the structure and composition of the environment (Davis & Powell, 1992). The dominant model here is that of the *organisational population*, which considers aggregate collections of organisations similar in form and function (Astley, 1985; Carroll, 1984; Hannan & Freeman, 1977). Taking a technical interdependence view, the adjustment of organisational forms to environmental conditions is presumed to occur primarily through selection rather than adaption processes (Aldrich & Pfeffer, 1976; Hannan & Freeman, 1977). As such population ecology models tend to assume that competitive forces dominate relations among the units comprising the population, giving little or no attention to cooperative and symbiotic relations developing among dissimilar organisations. More recently, given the focus on organisational change shaped by alterations in the environment, there has been a convergence of organisational ecology and institutional theory (Davis & Powell, 1992; DiMaggio & Powell, 1991). In doing so the emphasis of technical interdependence has been complemented with a recognition of isomorphic institutional pressures (DiMaggio & Powell, 1983).

In contrast the ‘community ecology’ approach, with the *interorganisational community* as its model of the organisational collectivity, incorporates both competitive and symbiotic (cooperative) connections between organisations in similar and diverse populations (Astley, 1985; Carroll, 1984). Still utilising variation and selection logic with technical interdependence, the community ecology approach considers the emergence of populations of particular organisational forms. Where functional ties fuse populations into functionally integrated organisational communities, symbiosis emerges based upon the interdependencies between the technologies of different populations (Astley, 1985). As these symbiotic interdependencies emerge between populations, new populations branch out from established ones to fulfil ancillary roles in which they become dependent on, but non-competitive with, their ancestors, and shift resource acquisition from the environment to the community. Thus, echoing

contingency and resource dependency theories, wider environmental conditions are seen as both constraining the community and shaping the community structure as well as placing internal constraints.

Models of organisational collectivities from organisational ecology have only limited resonance to the ecosystem construct (see Table 2). Integration with the organisational population model is conceptually invalid, as the organisational population consists of organisations that are similar in form and function, counter to the notion of the ecosystem consisting of a network of heterogeneous organisations that co-create value. The analytic focus on variance, selection and retention mechanisms within the population also means that governance systems consisting of regulative and normative elements, as well as a shared logic, are not considered. Although an interorganisational community model of organisational collectivities holds more promise, considering heterogeneous populations and their interactions, its applicability is limited by a focus on geographically bounded collection of organisations (c.f. Hawley, 1950; Scott, 1983; Scott & Meyer, 1983). Furthermore, with their focus on the population of organisations (or the community of populations for the interorganisational community), community ecology is not able to theoretically account for the existence of a powerful central actor or hub firm. As a consequence, organisational ecology models of organisational collectivities only have limited resonance with the ecosystem construct.

2.2.3 Institutional models

In contrast to previous theories, institutional theory emphasises cultural rather than technical and economic forces in organisational change. In particular, institutional theory posits that the institutional environment leads to the development of organisational structures that conform to institutional rules (Meyer & Rowan, 1977; Meyer et al., 1981; Scott, 1983). Organisational conformity is reflected in a consonance with relevant social and behavioural norms as well as established rules, laws, and regulations, so that there is a “generalised perception or assumption that the actions of an entity are desirable, property or appropriate within some socially constructed system of norms, values, beliefs and definitions” (Scott, 2008; Suchman, 1995b: 574). Building on the more conventional idea of an industry, these models tended to focus on cultural elements comprising of both normative and cognitive belief systems relevant to the system of organisation, although they also include relational elements (Scott, 1983). As such the models here tend to emphasise shared conceptions and information and compatible structures, and also explicitly emphasise the ‘totality of relevant actors’, including other organisations that critically influence performance, including exchange partners, competitors, funding sources and regulators (Scott, 2008).

The *industry system* of Hirsch (1972, 1985) takes a holistic view of all parties engaged in the development, production, and distribution stages of any product or service, and considers the single, concrete, and stable network of identifiable and interacting components that constitute the system. In doing so the industry system is conceived as an input-output conversion system, and operationally entails taking some organisational resource (or set of resources) that enters the industry’s input

boundary – such as a new product idea – and following it through all the facets of the system until it is either discarded or reaches consumers. Structurally it includes production, innovation, investment, employment, consumer and regulatory organisations, and deliberately forces the specification of interconnections among the sets of institutional, organisational and individual-level variables. In doing so it has a focus more on network and relational dimensions (Scott, 1983).

With a stronger emphasis on cultural elements, the *societal sector* proposed by Scott and Meyer (1983, 1991) consists of the collection of organisations operating in a domain, as identified by the similarity of their services, products or functions, and also those organisations that critically influence the performance of the focal organisations, such as major suppliers, major customers, owners, regulators, funding sources and competitors. The boundaries here are functional, not geographic, with the societal sector comprised of participants that are functionally interrelated. The structure and the behaviour of an organisation depends on the characteristics of the sector in which it operates, such as the dominance of technical or institutional processes, the structure of decision making, and the nature of the inter-level controls.

The *business system* of Whitley (1992a, b) considers the social modelling of organisations and markets. Operating at the level of the nation-state, business systems are concerned with the nature of economic activities that are coordinated through managerial hierarchies and how these hierarchies organise their cooperative and competitive relations through markets. A business system is thus a collection of hierarchy-market relations that become institutionalised in different market economies in different ways through the varieties of dominant institutions. They reflect successful patterns of business behaviour and understandings of how to achieve economic success that are reproduced and reinforced by crucial institutions.

The *interorganisational domain* of Trist (1983) is a functional social system that occupies a position in social space between society as a whole and the single organisation. It emerges when an organisational population engages with a common societal problem in order to insulate themselves from the environment turbulence this problem domain causes (Emery & Trist, 1965; Westley & Vredenburg, 1991). The analytic focus is on collaboration rather than competition (Hardy & Phillips, 1998; Trist, 1977; Westley & Vredenburg, 1991), emphasising the cooperative relationships among organisations that rely on neither market nor hierarchical mechanisms of control (Phillips, Lawrence, & Hardy, 2000). Underlying much of the work on interorganisational domains is negotiated order theory, which considers the processes whereby organisations jointly determine the terms of their future interactions with one another (Gray, 1989; Hardy & Phillips, 1998; Nathan & Mitroff, 1991; Strauss, Schatzman, Bucher, Ehrlich, & Satshin, 1963). In an organisational domain a population of organisations agrees on the meaning and scope of the problem domain, and then uses various cooperative devices such as informal agreements, joint ventures, trade associations and collaboration as mechanisms to shape an internal structure that accommodates their partially conflicting interests while securing the common

ground of participants (Nathan & Mitroff, 1991; Trist, 1983). As such an interorganisational domain is a cognitive as well as an organisational structure. More recently, Hardy and Phillips (1998) have emphasised notions of power and legitimacy, noting that formal power, scarce or critical resources and discursive legitimacy all influence the dynamics of an interorganisational domain. These can be particularly relevant when a domain is under-organised due to a lack of convergence around key values or the exclusion of relevant stakeholders, or both (Hardy, 1994; Nathan & Mitroff, 1991). In such domains exist ‘referent organisations’, which enable purposeful action to be taken in the name of the domain through the provision of regulation, a long term view and supporting infrastructure (Trist, 1983). A related concept is the ‘bridging organisation’ which spans the social gaps among organisations and constituencies to enable coordinated action (Westley & Vredenburg, 1991). The referent organisation must provide appropriate leadership, finding mechanisms to integrate organisations that are widely disparate in wealth, power, culture, language, values, interests and structural characteristics, without usurping the functions of the constituent organisations (Trist, 1983; Westley & Vredenburg, 1991). Phillips et al. (2000) have explicitly linked the interorganisational domain with the organisational field, pointing out institutionalisation and collaboration are interdependent, as institutional fields provide the rules and resources upon which collaboration is constructed, while collaboration provides a context for the on-going processes of structuration that sustain the organisational fields of the participants.

The most common model of an organisational collectivity in institutional theory, and perhaps organisation theory in general, is the *organisational field* of DiMaggio and Powell (1983).⁴ The organisational field builds upon both the ‘life space’ concept of Lewin (1951), emphasising the mutual interdependence of the elements and forces surrounding an individual, and the ‘field’ of Bourdieu (1977), which considers “both the totality of actors and organisations involved in an arena of social or cultural production and the dynamic relationships among them” (DiMaggio, 1979:p. 1463). In their seminal paper DiMaggio and Powell (1983) defined the organisational field as “those organisations that, in the aggregate, constitute a recognised area of institutional life: key suppliers, resource and product consumers, regulatory agencies and other organisations that produce the similar services or products” (p. 148). Thus the organisational field has much similarity with both the industry system, societal sector and interorganisational domain in terms of composition – it includes the totality of relevant actors, both those who compete for the same resources as well as those who interact with the producer organisations, such as exchange partners, customers, competitors, intermediary actors, regulators, funding agents (Scott, 2008). An organisational field is agnostic as to whether it is

⁴ Although the term ‘institutional field’ has also been used in the past, it has been replaced by the term ‘organisational field’ (Wooten & Hoffman, 2008); following Davis and Marquis (2005) I consider the two terms interchangeable.

constituted by organisations, individuals or other combinations of actors (Anand & Jones, 2008; Davis & Marquis, 2005).

An organisational field consists of a relational space, a meaning system and a set of rules (Hardy & Maguire, 2010). Put differently, an organisational field has “two constitutive elements: a set of institutions, including practices, understandings, and rules; and, a network of organisations” (Lawrence & Phillips, 2004: 692). More generally, the institutional element can be considered having regulatory, normative and cognitive dimensions (Scott, 2008). The regulative and normative dimensions are reflected in a governance system that consists of the established rules, role and assumptions that govern the interaction among participants of the field (Garud et al., 2002; Scott, 2008). These governance systems are composed of a combination of public and private actors that coordinate the relations between actors (Scott, 2008). For the cognitive dimension, DiMaggio and Powell (1983) originally noted that within organisational fields there develops “a mutual awareness among participants in a set of organisations that they are involved in a common enterprise” (p. 148). This was elaborated by Friedland and Alford (1991) who, introducing the symbolic element to institutional theory, noted institutions have a central logic – a set of material practices and symbols – which constitutes its organising principles and which is available to organisations and individuals to elaborate. Institutional logics are hence the belief systems and associated practices that predominate in an organisational field (Scott, Ruef, Mendel, & Caronna, 2000). Put differently, an institutional logic is a field’s shared understanding of the goals to be pursued and how they are to be pursued (Battilana, Leca, & Boxenbaum, 2009). Closely related to discursive practices (Levy & Scully, 2007; Phillips et al., 2004), institutional logics are symbolically grounded, organisationally structured, politically defended, and technically and materially constrained (Friedland & Alford, 1991). As such they define and stabilise the identities and interactions of the institutional actors (Scott, 2008). Complementing this approach has been the application of the cultural frame, adopted from social movement theory (Benford & Snow, 2000; Snow, Rochford, Worden, & Benford, 1986). Thus Fligstein (2001) notes that an organisational field refers to situations where organised groups of actors gather and frame their actions with respect to each other, emphasising the linkage to social movements. Others have introduced the notion of ‘field-level frames’ where networks of organisations collectively mobilise to create interweaving structures of meaning and resources into their wider cultural and political context (Lounsbury et al., 2003). Frames are thus closely related to the institutional logic of how things are interpreted and represented, and connects to considerations of how things are to be done (Scott, 2008).

The second constitutive element of an organisational field is a network of organisations. DiMaggio and Powell (1983) emphasise that the relations between organisations in an organisational field reflect both direct and indirect ties, as well as positional similarity, leading to “interorganisational structures of dominance and patterns of coalition” (p. 148). These interorganisational structures influence the power of an organisation or set of organisations to capture or direct the actions of the

organisational field (Fligstein, 1991). Fields are therefore comprised of the specific structures of social networks that create power differences between firms and status hierarchies (Beckert, 2010). Taking the institutional and network elements together, organisational fields can be viewed as a network of actors within a contingently stable alignment of material, organisational and discursive forces (Levy & Scully, 2007).

Institutional theory-based models of organisational collectivities, and the organisational field in particular, resonate with the ecosystem construct (see Table 2). Specifically, the organisational field considers the network of actors that are not geographically bounded, and also has a governance system consisting of regulative and normative elements, as well as a shared logic, that describes the interaction of the actors in the field. As an organisational field refers to situations where organised groups of actors gather and frame their actions with respect to each other (Fligstein, 2001), theoretically the organisational field is able to support notions of value co-creation. Institutional theory also acknowledges the role of powerful central actors in the field (see for instance Scott & Meyer, 1983; Trist, 1983), however the organisational field in general has tended to dwell on the relative power of different actors in a field as distinct to the dominant actors themselves (see for instance Beckert, 2010; Brint & Karabel, 1991; Fligstein, 1991; Hardy & Phillips, 1998). Thus, although dominant central actors are not central to theorising in the organisational field, this model of organisational collectivities has the potential to consider powerful central actors.

Above I have reviewed the models of organisational collectivities in organisation theory in the context of the main theories of organisation, outlining how organisational ecology has a limited resonance with the ecosystem construct, resource dependency theory some resonance, and institutional theory the most resonance. As such, institutional theory, and the organisational field in particular, provides useful models of organisational collectivities and their interdependencies, which can be used to develop an organisation theory approach to ecosystems.

2.3 The ecosystem as a fifth facet

Moving beyond the identification of institutional models of organisational collectivities as the most applicable to the ecosystem construct, I now argue that an ecosystem is a type of organisational field as it also consists of those same network and institutional elements that are the defining characteristics of an organisational field (Lawrence & Phillips, 2004). By introducing institutional theory to our understanding of ecosystems, I am not arguing that an ecosystem should be considered an institution, although in some cases a hub firm has become institutionalised – consider the iconic status that Apple Inc has achieved.⁵

⁵ Although even in this case one cannot be certain if it is Apple as a hub firm or its ecosystem that is the institution.

Emphasising the alignment between the organisation field and the ecosystem construct are the constituent participants, with both comprising of the ‘totality’ of actors, including suppliers, complementors, customers, competitors, universities, regulators, judiciary, and standard setting bodies (see DiMaggio & Powell, 1983; Iansiti & Levien, 2004a; Scott, 2008; Teece, 2007). Moreover, for both constructs these participants are viewed as being embedded in a network which influences the power of each participant to capture or direct the actions of the organisational field or ecosystem (see Adner & Kapoor, 2010; Beckert, 2010; DiMaggio & Powell, 1983; Fligstein, 1991; Iansiti & Levien, 2004a). Similarly, both ecosystems and organisational fields have governance systems which consist of regulative and normative elements (see Adner, 2012; Garud et al., 2002; Gulati et al., 2012; Iansiti & Levien, 2004a; Nambisan & Sawhney, 2011; Scott, 2008). Both the ecosystem construct and the organisational field construct also have a cognitive element – a central logic which constitutes its organising principles and which is available to organisations and individuals to elaborate (see Friedland & Alford, 1991; Gulati et al., 2012; Scott et al., 2000). Put differently, both the ecosystem construct and the organisational field construct emphasise a shared understanding of the goals to be pursued and how they are to be pursued (see Adner, 2012; Battilana et al., 2009; Gulati et al., 2012). In summary, an ecosystem is a type of organisational field in that it has the same network, governance and institutional logics characteristics as an organisational field.

An important point of differentiation is the analytic focus of the ecosystem construct, in that an ecosystem is a dynamic and purposive value-creating network in which the participants co-create value. In contrast, theorisations of the organisational field have not developed the notion of co-creation of value. Instead, in its initial formulation, the analytic focus of the organisational field construct (and also for the industry system and societal sector) has been on a common industry: ‘those organisations that in the aggregate ... *produce similar services or products*’ (DiMaggio & Powell, 1983: p. 148; emphasis added). As theorisations of the organisational field have developed (Wooten & Hoffman, 2008), this analytic focus has extended to include those organisations that share common technologies (Garud et al., 2002), social issues (Hoffman, 1999), and markets (Beckert, 2010).

Importantly, this analytic focus underpins the recognised area of institutional life to which the organisational field relates, and which demarcates its boundary (DiMaggio & Powell, 1983). As an organisational field only exists to the extent that it is institutionally defined by its constituent members (Fligstein, 2001; Friedland & Alford, 1991; Lounsbury et al., 2003; Scott, 2008), to be a *recognised* area of institutional life a domain must be acknowledged as such by the constituent actors. This acknowledgment is not an objective recognition by an impartial observer but instead a subjective recognition by the field participants. Consequently, the formulation of an institutional field does not exclude the possibility that other areas of institutional life can be considered organisational fields, so long as the constituent members recognise it as such. Each of the analytic foci identified above – common industry, common technologies, issues and markets – considers that organisational fields are

networks of organisations which share a set of institutions; however, for each the participants have differing subjective recognised areas of institutional life. Therefore, rather than consider these as different types of organisational fields, these extensions should be considered as different facets (or aspects), with each aspect addressing a different recognised area of institutional life. Put differently, an organisational field is a multi-faceted construct that applies to heterogeneous recognised areas of institutional life. Each facet is detailed below:

- The first facet of the organisational field has a common industry as its recognised area of institutional life, and is perhaps the most common within institutional theory. This facet requires little elaboration as it is the founding conception of the organisation field, and encompasses the “key suppliers, resource and product consumers, regulatory agencies and other organisations that produce the similar services or products” (DiMaggio & Powell, 1983:p. 148).
- The second facet considers common technologies as its recognised area of institutional life (Garud et al., 2002; Garud & Karnoe, 2001). No technology exists in a vacuum; instead for successful adoption a technology requires a defined institutional space with rules that govern the production, distribution, and consumption of associated artefacts (DiMaggio & Powell, 1991; Dosi, 1982; Garud et al., 2002; Rosenberg, 1982; Van De Ven & Garud, 1994). The technological facet considers an organisational field to be the pattern between humans and technological artefacts related to a given product-market domain, and which provide the institutional environment for the production, use, and interaction among human and organisational agents and technological artefacts (Garud et al., 2002). In doing so this facet explicitly introduces the notions of the technological trajectory (Dosi, 1982) and dominant design (Abernathy & Utterback, 1978; Anderson & Tushman, 1990), where networks of organisations institutionalise design choices and standards of value (Kaplan & Murray, 2010; Rosenkopf & Tushman, 1994) which shape the broad direction of technological progress.
- The third facet of the organisational field has social issues as its recognised area of institutional life. Hoffman (1999) introduced this facet in their study of environmentalism and the U.S. chemical industry, specifically noting that an organisational field is “the centre of common channels of dialogue and discussion” (p. 352), and more than just common industries or common technologies. More recently Glynn (2008) has argued that in Olympic host cities, given that the Olympics are an event that needs to be understood, managed, strategised, resolved and realised, institutionalised meanings can fortify and change the relationships within a field. With its focus on issues, this facet explicitly recognises the enabling and constraining attributes of the organisational field in social movement theory (McAdam & Scott, 2005; Rao et al., 2000), viewing the organisational field as an ‘arena of power relations’ (Brint & Karabel, 1991). In particular, Rao et al. (2000) point out that

organisational fields define the nature of the social contention. For instance, if a social movement arises in an interstice between two fields, movements are able to produce new organisational forms by bundling together particular sets of practices. If instead the social movement arises within a hierarchical field characterised by a distinct dominance order, the movement will generally assume a ‘conflict orientation’ as it is an organised attempt to modify the existing order. Finally, if a movement emerges within a fragmented field where the elites are disorganised and there is no centre of power, then it will meet with support rather than contention.

- A fourth facet includes the market as its recognised area of institutional life (Anand & Peterson, 2000; Beckert, 2010). This facet considers that in competitive fields the market serves as a magnet around which groups of actors consolidate, and that cognition occurs through the creation, distribution, and interpretation of a web of information about the ‘market’ (Anand & Peterson, 2000). As such markets are here understood as arenas of social interaction for the exchange of goods and services, comprising of specific social network structures that create power differences between firms and status hierarchies (Beckert, 2010). The network structure positions organisations and individual actors in a structural space, institutional rules anchor the relative force of actors supporting certain types of behaviour while discouraging others, and cognitive frames provide the mental organisation of the social environment and thereby contribute to the order of market fields.

Recognising each of these four facets, I argue that the ecosystem should be considered a fifth facet of the organisational field construct, where value co-creation acts as the fifth recognised area of institutional life. As the review of the ecosystem literature above outlines (see Section 2.1), ecosystem participants explicitly recognise that they are members of an ecosystem. Furthermore, there is a distinctive institutional logic and collective identity based around value co-creation, meaning that an ecosystem can also be considered as having a discrete recognised area of institutional life – that of value co-creation. The emphasis on value co-creation and the recognition of all participants that together they are co-creating value means that the ecosystem area of institutional life differs from each of the four already identified facets. Although the ecosystem differs markedly from the third facet, a common social issue as the recognised area of institutional life, it has similarities for each of the others that require more explanation.

The first facet encompasses the totality of participants that produce similar services or products (or a common industry). In contrast, an emphasis on value co-creation requires that an ecosystem encompass a cross-industry network of producers of many different types of goods and services that can be combined into different combinations. Furthermore, as multiple ecosystems can exist within the same industry (for example the Apple iOS, Blackberry OS, Google Android and Microsoft Windows Phone ecosystems), it does not include all the organisations that create the common good or service,

only those that are within a particular ecosystem. As such, the ecosystem has a recognised area of institutional life that is both narrower than the recognised area of institutional life of a common industry, as it may only contain a subset of the population of the organisations that make a particular good or service, yet simultaneously broader in that it contains organisations from the heterogeneous industries that create completely different goods and services that are required for value co-creation. Although the ecosystem could be considered as a subset of the first facet, the focus on value co-creation means that the ecosystem requires that it be considered a distinct area of institutional life – the participants recognise that they are partaking in a domain that is different to an industry – and consequently a new facet.

The second facet has common technologies as its recognised area of institutional life, where there is an interdependency between participating organisations, technology and institutions (Garud et al., 2002). An ecosystem also incorporates technological elements, as value co-creation requires complementarity and co-specialisation of the operating and technological assets of the participating organisations. In a similar fashion to a technological field, ecosystem participants are jointly interdependent on the underlying technology and institutions that coordinate their action. However, to consider the ecosystem as an exemplar of the technological facet would over-emphasise the technological aspects of the ecosystem, obscuring both the emphasis on value co-creation and the market dynamics. In contrast, by considering the ecosystem as a fifth facet, the emphasis on value co-creation moves analytic attention from the relationship of the organisations to the technology to broader considerations of product and service co-delivery, and to customer and system level value co-creation.

The fourth facet has a common market as the recognised area of institutional life, where there is an interdependency between social actors, institutions and market-specific cultural frames (Beckert, 2010). In ecosystems the transactional relationships between participants are often undertaken through market transactions, with the ecosystem often consisting of a multi-sided market. However, although an ecosystem has market dynamics, the logic of mutual exchange operates differently from that of markets and hierarchies, as value co-creation is driven by collaboration (Phillips et al., 2000) where there are investments in relation-specific assets, substantial knowledge exchange, and non-market governance mechanisms (Dyer & Singh, 1998). Furthermore, to consider the ecosystem an exemplar of the market facet would obscure the dynamics of value co-creation and the technological interdependencies that characterise the ecosystem. By considering the ecosystem as a fifth facet, the emphasis on value co-creation moves analytic attention from the market relationships of the organisations to broader considerations of organisational interdependence.

Summarising, the existence of a value-creating network, a governance system and a shared logic suggest that the ecosystem should be considered an organisational field. Furthermore, as participants of an ecosystem explicitly recognise that they are members of an ecosystem, where there is a distinctive institutional logic and collective identity based around value co-creation, an ecosystem can be

considered a fifth facet of the organisational field with a discrete and distinguishable recognised area of institutional life. The emphasis on value co-creation and the recognition of all participants that together they are co-creating value means that the ecosystem area of institutional life differs from each of the other four facets.

2.4 Conclusion

This chapter first reviewed the characteristics of the ecosystem construct, deriving six attributes that are relevant to an evaluation of the models of organisational collectivities and the subsequent selection of an appropriate organisational theory approach to ecosystems. I reviewed models of organisational collectivities utilised within resource dependency theory, organisational ecology and institutional theory, and assessed their resonance with the ecosystem construct. Culminating in the review of the organisational field, I argued that models of organisational collectivities within institutional theory have the most relevance to the ecosystem construct. I then argued that an ecosystem can be considered an organisational field, as it consists of a network of organisations, a governance system and institutional logic. Considering the analytic focus of the organisational field construct, I identified four facets of the organisational field, where each facet is based upon a different recognised area of institutional life, and argued that the ecosystem is a fifth facet which has value co-creation as the recognised area of institutional life.

The next chapter develops this theoretical perspective further, synthesising insights from dominant design, social movement and institutional entrepreneurship theories to derive four activities that drive ecosystem emergence.

3 ACTIVITIES OF ECOSYSTEM EMERGENCE

This chapter synthesises the institutional formation and change literatures of dominant design theory, social movement theory, and institutional entrepreneurship theory to propose four activities of ecosystem emergence. I first review each of the three literatures, emphasising their relevance to the analysis of ecosystem emergence, and then detail the four activities – resource, technological, institutional and contextual.

Very early on Meyer and Rowan (1977) defined ‘institutionalisation’ as the means by which social processes, obligations and actualities come to take on a rule-like status in social thought and action. More specifically related to organisational fields, institutionalisation can be understood as the process by which rules move from being abstractions to being constitutive of repeated patterns of interaction (Fligstein, 2001). These institutionalisation processes include the origins, reproduction and erosion of institutional practices and organisational forms (DiMaggio, 1988; Jepperson, 1991). It is arbitrary to distinguish between the processes that create institutions and those that change them, as institutions do not emerge from a vacuum but always challenge, replace or borrow from existing ones (Holm, 1995; Scott, 2008). The difference is in the focus – if attention is addressed to the formation of new rules, understandings and associated practices, then it is institutional formation (Scott, 2008). As this thesis investigates the emergence processes of ecosystems, the focus is upon institutional formation rather than change.

There is remarkably little literature on organisational field formation and the mechanisms which bring together the actors and relationships (Anand & Jones, 2008; Powell, White, Koput, & Owen-Smith, 2005). DiMaggio and Powell (1983) have proposed a four step process that leads to the emergence of mutual awareness of participants, focusing on the emergence of a collective rationality. First there is an increase in the extent of interaction among organisations in the field, which is followed by the emergence of sharply defined interorganisational structures of domination and patterns of coalition. As a consequence, the third stage consists of an increase in the informational load with which organisations must contend, which then results in the fourth stage, the development of a mutual awareness among participants in a set of organisations that they are involved in a common enterprise. In contrast, Bourdieu (1993) focuses on conflict as the driving principle of emergence, where the competitive forces arise due to the resource limitations in any field (DiMaggio, 1979). Field participants are in a constant struggle to secure and improve upon their social position, through the acquisition of economic, cultural, social or symbolic capital to overcome the constraints of their social position (Anand & Jones, 2008; Battilana et al., 2009). Together these two approaches suggest that the processes of field formation involve increased interaction and communication, development of a sense of interested in common issues, facilitate systems of dominance, and allow for the acquisition of economic, cultural, social or symbolic capital of the participating actors (Anand & Jones, 2008).

Organisational field formation can either be naturalistic or agent-based (Scott, 2008). Naturalistic institutionalisation derives from the work of Berger and Luckmann (1966) who stressed the unconscious ways in which activities are habitualised and reciprocally interpreted, as a natural and undirected process. Examples of this naturalistic approach is organisational ecology, where increasing organisation density as a function of increasing legitimacy (Hannan & Freeman, 1977), and the studies of diffusion processes of institutional reforms (Tolbert & Zucker, 1983). More recently, Dorado (2005) has proposed uncoordinated collective action as ‘institutional partaking’, where institutional change results as the autonomous actions of countless agents converging over time, where no single individual or organisation can be responsible for the change.

In contrast, an agent-based view stresses the importance of particular actors or groups of actors as causal agents. Van De Ven and Hargrave (2004) differentiate between collective action (for groups of actors) and institutional design (for individual actors) in the emergence of an organisational field. Collective action, based on a dialectical motor and recently called ‘institutional conflict’ by Zietsma and Lawrence (2010), focuses on the social and political processes that facilitate and constrain the development of a technological innovation or social movement through the institutions that emerge. In contrast, institutional design is concerned with the actions that an individual actor can take to create or change institutional arrangements. Termed ‘institutional innovation’ by Zietsma and Lawrence (2010), institutional design views institutional formation as driven by a teleological motor. Here, the actors are generally called ‘institutional entrepreneurs’ (DiMaggio, 1988; Scott, 2008).

One theory of collective action driven institutional formation and change is *dominant design theory*, which addresses the technological elements and stability of an ecosystem, vital to digital services. Dominant design theory provides a theoretical logic that argues that the characteristics of a dominant technical design are rarely determined on technological grounds alone but instead are socially and institutionally constructed (Kaplan & Tripsas, 2008; Tushman & Murmann, 1998; Tushman & Rosenkopf, 1992; Van De Ven & Garud, 1993). A second theory of collective action driven institutional formation and change is *social movement theory*, which provides the means to understand how the actions of groups of individuals can create and change institutions (Davis & McAdam, 2000; McAdam & Scott, 2005). A third theoretical approach, instead focused on individual driven institutional formation and change is *institutional entrepreneurship* (DiMaggio, 1988; Garud et al., 2002). Institutional entrepreneurship enables specific consideration of the actions of a particular agent, and provides insight into the discursive and legitimation processes that occur in institutional formation.

Each of these theories is applicable to the entrepreneurial activities involved in ecosystem emergence. For instance, in dominant design theory a technological discontinuity is often triggered by new entrepreneurial organisations and associated with increased environmental turbulence (Henderson & Clark, 1990; Tushman & Anderson, 1986). In addition, entrepreneurs in nascent industries and ecosystem emergence contexts need to gain cognitive and socio-political legitimacy (Rao, 1994), and

in attempting to obtain this, the interactions between firms take on a social movement-like character (Swaminathan & Wade, 2001). An entrepreneur can also act in the role of an institutional entrepreneur – i.e., as an agent who purposefully introduces changes into the institutional setup (Battilana et al., 2009). Not all entrepreneurs take on this role, however, as entrepreneurs can either imitate existing business models or generate new ones (Aldrich & Fiol, 1994). It is only when an entrepreneur introduces a new business model whose ‘institutional logic’ diverges from the existing institutional setup that he or she can be considered an institutional entrepreneur. In a similar vein, entrepreneurs can also act as institutional entrepreneurs when the commercialisation of a technology requires the introduction of new economic logics and institutional set-ups (Kaplan & Murray, 2010). Key here is not that parts of the technology itself are socially constructed (e.g., when it comes to defining the meanings and uses of the technology), but also, that many economic factors too are socially constructed, and consequently, entrepreneurs introducing novel business models also seek to instantiate novel institutional logics to the ecosystem.

Given the applicability of each theory to discerning the activities that underpin ecosystem emergence, each is now reviewed below.

3.1 Dominant design theory

Dominant design theory is primarily concerned with industry and technological evolution and its effect on firm performance. There are two main questions that are considered generally in the literature: what are the factors that influence a dominant design? And, will a dominant design emerge? Originally discussing technological innovations (in particular product and process innovation), as dominant design theory has developed it has explicitly included economic, strategic and institutional determinants and causality in its explanations.

The notion of the dominant design is well established in the literature, and is generally considered applicable to a wide range of technology, from non-assembled to simple assembled products, and closed and open assembled systems (Anderson & Tushman, 1990; Tushman & Rosenkopf, 1992). Although others have limited the use of the dominant design concept to more complex production processes (Abernathy & Utterback, 1978), complex assembled products (Suarez & Utterback, 1995), and complex systemic technologies (Nelson, 1994), the concept is currently considered applicable to virtually any technology. The dominant design concept itself has been used at a variety of levels of analysis, such as product, component or subsystem (Murmman & Frenken, 2006; Tushman & Murmann, 1998). At the product level, dominant designs are ‘a single bundle package of innovations’ (Tushman & Murmann, 1998), such as the DC-3 airplane (Abernathy & Utterback, 1978), container glass (Tushman & Anderson, 1986) and typewriters, calculators and TV sets (Suarez & Utterback, 1995). At the component level, dominant designs can be microprocessors (Anderson & Tushman, 1990), transistors (Suarez & Utterback, 1995) and hard drives (Christensen, Suarez, & Utterback, 1998). With increasing

interest in modularity and system architectures, the unit of analysis has also been sub-systems, linkages and design hierarchies (Baldwin & Clark, 1997; Clark, 1985; Henderson & Clark, 1990). Murmann and Frenken (2006) also identified some studies that span different levels of analysis, and others have identified multiple level dominant design strategies (Funk, 2003). To reconcile these multiple-levels of analysis, technology has been considered as a system with a nested hierarchy of technology cycles (Tushman & Murmann, 1998), incorporating both modularity and design hierarchies (Baldwin & Clark, 1997; Clark, 1985). Emphasis has also shifted to a consideration of core and peripheral subsystems, where core components are those components that affect many functions by their changes (Murmann & Frenken, 2006; Tushman & Murmann, 1998). This consideration of core and peripheral subsystems reflects notions of platform-centric ecosystems, where the system is partitioned into low- and high-variety components (Baldwin & Woodard, 2009).

Dominant design emergence is an evolutionary process (Anderson & Tushman, 1990). Initiated by a technological discontinuity, there is an era of intense technical variation and selection culminating in a single dominant design, which is then followed by a period of incremental progress until the next technological discontinuity (Abernathy & Utterback, 1978; Anderson & Tushman, 1990; Dosi, 1982; Sahal, 1981; Utterback & Abernathy, 1975). A technological discontinuity may either forward the performance frontier along the parameter of interest by a significant amount or change the product or process design rather than merely enlarging the scale of existing designs (Anderson & Tushman, 1990). Technological discontinuities are often based upon a different set of engineering and scientific principles, which lead to major product and process technological breakthroughs that open up an entire new market (Dess & Beard, 1984; Dewar & Dutton, 1986; Ettlie, Bridges, & O'Keefe, 1984; Henderson & Clark, 1990). Tushman and Anderson (1986) differentiate between technological discontinuities that are either competence-enhancing or competence-destroying. Competence-enhancing discontinuities are order-of-magnitude improvements that build upon existing know-how, and are generally initiated by existing firms. A competence-destroying discontinuity is fundamentally different to the existing technology so that the existing skills, production process and competences of the organisation are generally initiated by new firms. For instance, an architectural innovation destroys the usefulness of architectural knowledge, and since architectural knowledge tends to become embedded in the structure and information-processing procedures of firms, this destruction is difficult for existing firms to recognise and correct (Christensen et al., 1998; Henderson & Clark, 1990).

With the arrival of a technological discontinuity, there is environmental turbulence and resource munificence (Henderson & Clark, 1990; Tushman & Anderson, 1986), leading to an era of variation, during which time there is uncoordinated process and product performance maximisation, reflected in multiple competing product designs, non-standardised manufacturing processes, and generalised production capital. Competition between firms at this point is between designs of the products. As the technology matures, product performance stabilises around a particular product design and process

innovation is at its greatest. The stabilisation around a particular product design is influenced by a wide range of institutional, technological and economic factors such as the rate of technological change (Lee, O'Neal, Pruett, & Thomas, 1995), nature of the technological field (Suarez, 2004), appropriability regime (Hariharan & Prahalad, 1991; Lee et al., 1995; Suarez, 2004), regulation (Anderson & Tushman, 1990; Lee et al., 1995; Suarez, 2004; Tushman & Rosenkopf, 1992), product radicalness (Srinivasan, Lilien, & Rangaswamt, 2006), availability of complementary assets (Schilling, 2009; Teece, 1986), participation in coalitions (Cusumano, Mylonadis, & Rosenbloom, 1992; Smith, 1996; Soh, 2010), installed base and switching costs (Hariharan & Prahalad, 1991; Schilling, 2009; Suarez, 2004), economies of scale (Abernathy & Utterback, 1978; Christensen et al., 1998; Lee et al., 1995; Tushman & Anderson, 1986), network externalities (Lee et al., 1995; Murmann & Frenken, 2006; Suarez, 2004), firm resources (Hariharan & Prahalad, 1991; Schilling, 2009; Smith, 1996), firm capabilities (Lee et al., 1995; Schilling, 2009), and firm reputation and credibility (Cusumano et al., 1992; Hariharan & Prahalad, 1991; Khazam & Mowery, 1994; Suarez, 2004). Taken together, each of these factors has an influence on one design being selected over another.

An aspect of design selection is the functional characteristics of the technology and how it meets the required dimensions of merit (Abernathy & Utterback, 1978; Christensen et al., 1998; Suarez & Utterback, 1995). This aspect considers how effective a particular design is as compared to others for a given parameter of interest. However, a product design that meets all the required dimensions of merit is generally a compromise, as a single technical design rarely dominates others on all dimensions of merit (Anderson & Tushman, 1990). As such the selection of the dominant design becomes a function of both the dimensions of merit of the technology, as well as a negotiated socio-political and institutional process, as competing technical communities debate between the feasible technical and economic options (Anderson & Tushman, 1990; Tushman & Rosenkopf, 1992). This is particularly salient where the product is complex with many technological uncertainties (Tushman & Rosenkopf, 1992), or where there are network externalities at work (Wade, 1995).

A synthesis of Rosenkopf & Tushman (1994) and Tushman & Murmann (1998) provides a non-formal descriptive account of the social construction logic. The social construction of a dominant design begins when a technological discontinuity affects the dimensions of merit, as well as the mechanism for measuring these dimensions of merit. This dissolution of the dimension identification and measurement mechanism spurs the introduction of new firms, inter-organisational relationships, and affiliations that span industry boundaries. More specifically, the movement of new members enables the reformation of the old interorganisational networks. These organisational, inter-organisational and institutional activities hence create a context within which competing technologies are selected, such as developing the markets and matching technological variants to them. Thus, accompanying emergence of new technological variants and actors, is the development of a social system within which these actors interact. As technological variants compete, the social system evolves clusters around competing

variants, and this interorganisational action drives technological competition and eventually defines the selection event. This occurs through the determination of the appropriate dimensions of merit as well as the mechanism to measure the technological variants along these dimensions. This convergence on a set of technical attributes is matched by an interorganisational convergence of the technical community. Put differently, the selection of dominant design has not only technical level effects but also social system level effects: critical problems are defined, legitimate procedures are developed, technical puzzles are solved and social system norms and values emerge (Rosenkopf & Tushman, 1998; Van De Ven & Garud, 1989).

These technological communities adjudicate on the process of technological evolution by selecting the critical dimensions of merit, driving the standardisation of the design, and creating legitimacy and promoting stability through the consensus building (Rosenkopf & Tushman, 1994, 1998; Tushman & Murmann, 1998). During this adjudication process there is a reciprocal interaction between beliefs, the technological artefacts and evaluation routines of the individual participants and the group as the community alights upon the design (Garud & Rappa, 1994). This reciprocal interaction between the frame of reference and the collective frame influences the technological choices of the actors, such as user adoption, producer investment or institutional support (Kaplan & Tripsas, 2008). As such a dominant design emerges as part of a negotiated collective frame, where a negotiation process, consisting of the interactions of the interpretive processes of producers, users and institutions, shapes the emergence of a collective technological frame (Kaplan & Tripsas, 2008). Thus a dominant design reflects a set of technical, social and political constraints (Anderson & Tushman, 1990; Tushman & Murmann, 1998).

The selection and retention of a standard technical design is the ‘dominant design’ (Abernathy & Utterback, 1978) or a ‘technological guidepost’ (Sahal, 1981). A key transition point between the era of ferment and the era of incremental change, once a dominant design emerges, the uncertainty associated with competing design approaches disappears and the subsequent technical progress elaborates on the selected design, shaping the broad general direction of technical advances. Processes become systemic, and production variety and costs are minimised through economies of scale. These, and any network externalities, mean that the design that initially acquires a lead in the market will emerge as the dominant design through an inexorable economic logic (Klepper, 1997; Murmann & Frenken, 2006; Utterback & Abernathy, 1975; Wade, 1995). A similar notion of technological trajectories was introduced by Dosi (1982), which are broader in scale in that they represent the whole technology rather than a design, better echoing the broader scale of scientific paradigms introduced by Kuhn (1962). There is thus a cycle of variation, selection and retention, initiated by a technological discontinuity, where the dominant design selected provides the operational principles for a product or service (Murmann & Frenken, 2006).

Overall, the emergence of a dominant design represents a key transition point in the evolution of a technological field, where the industry moves from high variety in product designs to an industry that has coalesced around a particular architecture of a set of core components. In the process technical communities adjudicate on the dimensions of merit and collectively negotiate a standard technical design, legitimate processes and a cognitive frame for future incremental innovation. As ecosystems are complex value co-creation systems, characterised by technological interdependence, dominant design theory provides insight into the determinants and processes of the technological aspects of ecosystems. This approach is reinforced by the similar scope of the participants involved in dominant design emergence and ecosystems, including suppliers, complementors, distributors, users, government and educational bodies (Iansiti & Levien, 2004b; Teece, 2007; Tushman & Murmann, 1998). Moreover, the recognition of the reciprocal interplay between technology, frames and routines in the community that results in dominant design selection suggests a variety of technological, economic and social activities of ecosystem emergence. As such dominant design provides insight into the technological design, delivery and operation of value co-creation and the product(s) or service(s) around which the ecosystem is organised.

3.2 Social movement theory

Social movement theory is primarily concerned with understanding the origins and processes of collective action in society, and has a long tradition within sociology that focuses on social process (McAdam & Scott, 2005). In general social movement research has focused on two questions: what is the mix of factors that gives rise to a movement? And, what form will the movement take? Beginning from an early focus on the motivations of an individual participant, social movement theory has subsequently developed to include institutional, political, structural, organisational, and cognitive elements.

As a sociological theory of institutional change, social movement theory has examined large, society-wide movements aimed at affecting politics, in particular those change efforts that require the conscious mobilisation of marginalised and disenfranchised constituents (McAdam & Scott, 2005). Social movements can be differentiated into identity and instrumental movements (Rao, Monin, & Durand, 2003). Instrumental movements seek to redress injustices, challenge economic and political structures, and strive for policy impact in the form of new laws or governance structures. By contrast, identity movements seek autonomy rather than justice, and arise in opposition to the dominant cultural codes. They consist of a 'we-feeling' sustained through interactions among participants, expressed through cultural materials such as names, narratives, symbols and rituals.

Key factors considered within social movement theory include the source of political opportunity (Tilly, 1978), the mobilisation of people and resources (McCarthy & Zald, 1977), the construction and reconstruction of purposes and identities (Benford & Snow, 2000; Cohen, 1985), and the crafting of

ideologies and cultural frames to support and sustain collective action (Snow et al., 1986). These have been incorporated into three broad interrelated factors that make up social movements and collective action in general. These are known as political opportunity structure, mobilising structures, and framing processes.

The political opportunity structure consists of the political opportunities and constraints facing the movement, which generally emerge through shifts in external political structure (Davis & McAdam, 2000; McAdam, McCarthy, & Zald, 1996). For a political opportunity to be salient and provide a stimulus, people need at least to feel aggrieved and/or threatened by some aspect of their life, and at least minimally optimistic that acting collectively they can address the problem (McAdam et al., 1996). The political opportunity structure also constrains potential collective action, as it acts as a moderating factor of the success of the social movement by restricting the types of activities and actions that can be conducted (Schneiberg, King, & Smith, 2008).

Mobilising structures are formal and informal structures available to the movement (Davis & McAdam, 2000; McAdam et al., 1996). Consisting of groups, formal organisations and/or information networks (McAdam et al., 1996; Tilly, 1978), these mobilising structures are considered to be the 'building blocks' of social movements (McAdam & Scott, 2005), in that they provide the original social structures, social capital and context for the mobilising parties. In particular, mobilising structures provide the availability and deployment of tangible resources (Snow & Benford, 1988), such as volunteer labour, revenue and membership (McCarthy & Wolfson, 1996), as the resources controlled prior to mobilisation are key to movement mobilisation success (Jenkins, 1983).

Framing processes are the collective processes of interpretation, attribution and social construction that mediate between the political opportunity and action (Davis & McAdam, 2000; McAdam et al., 1996). Originally proposed by Snow et al. (1986), who introduced the concept of frame alignment to provide the cognitive link between the individual and the social movement, over time framing processes have been deepened to encompass the link between the political opportunity structure and the mobilising structure. Frames themselves are a 'schemata of interpretation' that enables individuals to locate, perceive, identify and label occurrences within their life space and in the world at large (Goffman, 1974). A collective action frame is the ideological tool that organises experience, by serving as an accenting device to either underscore and embellish the seriousness and injustice of a social condition or redefine it as unjust and immoral; diagnosing problems; and prescribing solutions for the constituents of social movements (Babb, 1996; Snow & Benford, 1992). It is through collective action frames that a social movement socially constructs the contours of contention and protest (Klandermans, 1992). Collective action frames can have variable potency, influenced by such factors as the salience of its problem identification to the target audience, the level of flexibility the frame has to adjust to changing circumstances, and when it occurs within the protest cycle (Benford & Snow, 2000). Also relevant to the potency of a collective action frames is its credibility, salience and alignment

to the master frame in which it is situated, as alignment with the master frame influences the resonance any particular frame will have (Benford & Snow, 2000). A master frame is a collective action frame that is sufficiently inclusive and flexible to encompass a whole ideological tradition (Benford & Snow, 2000; Snow & Benford, 1992).

The processes of framing include the generation and dissemination of the symbolic and discursive elements that mediate between the social movement and the social actors (Benford & Snow, 2000; Snow & McAdam, 2000). Framing activity is an active, processual phenomenon which is constantly ongoing as targeted audiences interact (Benford & Snow, 2000). Snow and Benford (1988) identify the three core framing tasks that lead to the construction of meaning and legitimacy. Participation in a social movement is contingent upon these three framing tasks which act as prods to action, which can additionally be enhanced with a range of incentives such as material, status, solitary and moral inducements. Diagnostic framing involves the identification of injustice or problems and the attribution of causality, blame and/or culpable agents. Prognosis framing involves the articulation of a proposed solution to the problem or a plan of attack, and the identification of the appropriate strategies, tactics and targets. Motivational framing is the elaboration of a call to arms or rationale for action that goes beyond the diagnosis and prognosis, including the construction of appropriate vocabularies or motives. Gamson and Meyer (1996) point out that movements often exaggerate opportunities and underestimate constraints, and assess an opportunity with a systematically optimistic bias.

Closely related to the framing process is a collective identity, which is constructed as part of the motivational framing (Polletta & Jasper, 2001). Participation in a social movement frequently involves an enlargement of personal identity for participants, as well as offering fulfilment and realisation of the self (Gamson, 1992). Taking the pre-existing collective beliefs and identities of individuals, framing processes result in a collective identity which defines the cognitive, moral and emotional connection of participants with a broader community, category, practice or institution (Klandermans, 1992; Polletta & Jasper, 2001). The development of a collective identity increases the ability of a movement to translate common interests into mobilisation towards a common objective (Davis & Thompson, 1995), and is often key to the success of a social movement (Polletta & Jasper, 2001).

McAdam et al. (1996) suggest that a social movement generally begins with a political opportunity, followed by an organising structure, both of which are pulled together by framing processes. In contrast Davis and McAdam (2000) suggest that a social movement begins with a political opportunity, followed by framing processes which then lead to the adoption of an organisation structure, followed by more framing. Whatever the specific sequence, the creation of a political opportunity alone is not sufficient for collective action, nor is the availability of a structure with which to mobilise, and no matter how momentous a change appears in retrospect, it only becomes an opportunity when defined as such by a group of actors sufficiently well organised. Put differently, when the cognitive and affective by-products of these framing processes are combined with the political opportunity/threat and sufficient

organisational processes, chances are that collective action will develop (Davis & McAdam, 2000). The specific form of the movement is also an output of the interaction of the three factors. Although the nature of the political opportunity may dictate the broad category of movement, the formal and ideological properties of the movement are more directly influenced by the cognitive frames that were available at mobilisation, and these in turn are largely a product of the initial mobilising structures (McAdam et al., 1996). Thus the form of the movement is both a product of the interaction of framing with mobilising structures and the initiating political opportunity (Clemens, 1993; McAdam et al., 1996; McAdam & Scott, 2005).

Social movements can lead to new forms of organisations and new markets (Rao et al., 2000; Schneiberg et al., 2008; Swaminathan & Wade, 2001), as the creation of new organisational forms is an institutionalisation project consisting of the active definition, justification and diffusion of the theory underpinning the new form (Clemens, 1993; DiMaggio, 1988). Here social movements play a double edged role as they both de-institutionalise existing beliefs, norms and values embodied in existing organisational forms, and they establish new forms that instantiate new beliefs, norms and values (Rao et al., 2000). The socio-political and constitutive legitimacy of the new organisational form are key to the success of the social movement, as the new organisational form must be validated if they are to get resources (Rao et al., 2000). Beyond organisational forms, social movements can also provide the social infrastructure necessary for new markets to be created (Fligstein, 1996; Schneiberg et al., 2008). By contesting existing arrangements and providing entrepreneurs with political support, field frames, standards and organising templates, social movements can carve out space for new markets, generate institutional support for industry development, and populate the market with new organisational forms (Schneiberg et al., 2008). In doing so social movements enable the construction and propagation of cognitive frameworks, norms, values, and regulatory structures (Sine & Lee, 2009). Moreover, as social infrastructures, social movements can help to institutionalise key forms and market supports, buffering them from adverse of short-term economic forces.

Beyond providing insight into how social movements can create new organisational forms and markets, social movement theory can also be adopted as a theoretical framework within organisation theory. For instance, Davis and McAdam (2000) suggest that there is a strong analogy between processes of mobilisation for collective action in social movements and those for building momentum for contemporary business organisations, as the underlying assumptions are the same: boundaries around organisations are difficult to define, interests and grievances are socially constructed rather than transparent, and organisational structures are emergent and path dependent. More specifically, Swaminathan and Wade (2001) argue that interactions between firms in emerging markets take on a social-movement like character as firms attempt to obtain socio-political and cognitive legitimacy. They emphasise that, similar to social movements, new organisational forms need collective action to mobilise resources to survive and grow, to establish legitimacy, form a distinct and inimitable collective

identity, and to replace the dominant incumbent organisational form. Similarly, Campbell (2005) suggests that there is a strong similarity between processes of change and development between social movements and organisations. He links political opportunity structures with external environment mechanisms, mobilising structure with the organisation, and highlights that framing as a cognitive mechanism is congruent with the logic of appropriateness utilised in organisational structure and strategy. Furthermore, he emphasises common cognitive processes such as diffusion (the spread of practices through actors), translation (the process by which practices travel from site to site), and bricolage (the innovative recombination of elements).

Social movement theory can also be adopted to understand market creation. Fligstein (1996) argues that in new markets, politics resembles social movements, as actors in different firms try to convince other firms to go along with their conception of the market. In addition to institutions, property rights, rules of exchange and governance structures, he introduces the notion of ‘conceptions of control’ that structure how a market works and that allow actors to interpret their world and act to control situations. A conception of control is similar to the collective frame, as it is simultaneously a worldview and also a reflection of how market is structured, consisting of the market specific agreements between firms on principles of internal organisation, the tactics for competition and cooperation, and the hierarchy and status of organisations. A conception of control is also a kind of collective identity to which many groups adopt to create successful market. Firms take advantage of a market opportunity in the same way organisations in social movements take advantage of political opportunity – they can invade a market and transform the conception of control – looking like a social movement in the sense that trying to establish a new conception of control and ally themselves with challengers and existing incumbents.

Summarising, social movement theory considers the processes of collective action that result in institutional change, specifically identifying the political opportunity structure, mobilising structure and framing processes. As ecosystems consist of a heterogeneous collection of independent entities that interact to co-create value, social movement theory provides insight into the collective action processes and factors that drive institutional formation from the perspective of the ecosystem participants. Indeed one can argue that ecosystem creation is a process of institutional change driven by collective action. This approach is buttressed by the more recent work in social movement theory that explicitly adopts social movement theory in organisation theory, such as Fligstein (1996), Swaminathan and Wade (2001), and Campbell (2005). This has the benefit of not assuming that the participants of the ecosystem are a social movement, but instead that they have collective action processes that are theoretically analogous to those of social movements. As such, social movement theory provides insight into the collective actions of ecosystem participants and their effect on both ecosystem emergence and the environment in which the ecosystem resides.

3.3 Institutional entrepreneurship

Institutional entrepreneurship literature considers how individuals change the institutional context in which they reside. Institutional change moments occur when groups of social actors confront one another in some set of social interactions that is contentious and inherently political, as those who benefit from the existing regime will almost invariably arise to defend existing beliefs and practices (DiMaggio, 1988; DiMaggio & Powell, 1983). Agent-driven institutional change generally takes place in the context of powerful actors attempting to produce roles of interaction to stabilise their situation vis-a-vis other powerful and less powerful actors (Fligstein, 2001). However, the underlying interest in institutional entrepreneurship is the ‘paradox of embedded agency’ (Holm, 1995; Seo & Creed, 2002): how actors can change institutions if their actions, intentions and rationality are all conditioned by the very institution they wish to change? As an attempt to address this paradox, institutional entrepreneurship literature generally considers the enabling conditions for institutional entrepreneurship and how divergent change is implemented (Battilana et al., 2009). In doing so, the concept of institutional entrepreneurship reintroduces agency, interests and power into institutional analyses of organisations (Garud, Hardy, & Maguire, 2007).

Institutional entrepreneurship was introduced to institutional theory by DiMaggio (1988), who utilised an earlier conception of institutional entrepreneurship by Eisenstadt (1980). An institutional entrepreneur is an actor who leverages resources to create new institutions or transform existing institutions (DiMaggio, 1988; Garud et al., 2007; Maguire, Hardy, & Lawrence, 2004). The most comprehensive definition to date is that of Battilana et al. (2009):

Institutional entrepreneurs, whether organisations or individuals, are agents who initiate, and actively participate in the implementation of, changes that diverge from existing institutions, independent of whether the initial intent was to change the institutional environment and whether the changes were successfully implemented. Such changes might be initiated within the boundaries of an organisation or within a broader institutional context, within which the actor is embedded. (p. 72)

Institutional entrepreneurship can spring from either or both field and actor level sources. These field level sources enable institutional change by blocking the activation of reproductive procedures or by thwarting their successful completion (Jepperson, 1991). Field level sources include external jolts (Fligstein, 1997, 2001; Greenwood, Suddaby, & Hinings, 2002; Holm, 1995; Rao et al., 2000), the presence of multiple institutional orders (Clemens & Cook, 1999; Jepperson, 1991), degree of institutionalisation (DiMaggio, 1988; Fligstein, 1997; Phillips et al., 2000; Rao et al., 2000; Reay, Golden-Biddle, & Germann, 2006), and the presence of internal contradictions (Clemens & Cook, 1999; Greenwood & Suddaby, 2006; Seo & Creed, 2002). Actor level sources influence institutional change as an actor is required with the relevant skills and motivation to be able to execute the change (Zietsma & Lawrence, 2010). Actor level sources include the level of embeddedness of actors (Garud et al., 2002;

Greenwood & Suddaby, 2006; Leblebici, Salancik, Copay, & King, 1991; Reay et al., 2006), the capabilities and characteristics of the individual actor (Fligstein, 1997), and network location, such as at the intersection of fields (Greenwood & Suddaby, 2006; Phillips et al., 2000; Rao et al., 2000).

Although these enabling conditions provide the impetus for institutional change, they do not lead deterministically to that change (Seo & Creed, 2002). Nor do all conditions necessarily need to be present, nor is one source necessarily sufficient on its own, nor is there indication that any of these sources are sufficient to predict when institutional entrepreneurship will occur (Battilana et al., 2009). To add complexity, these differing enabling conditions of institutional entrepreneurship also influence and mediate the actions of sources (Battilana et al., 2009; Clemens & Cook, 1999; Mutch, 2007). For institutional entrepreneurship to occur, these enabling conditions need to result in the creation of alternative practices, ideas and/or organisational forms that counter the existing practices (Barley & Tolbert, 1997; Hinings, Greenwood, Reay, & Suddaby, 2004; Leblebici et al., 1991). Practically speaking, these new practices, ideas or forms need to be in place before actors are able to begin to assemble resources and rationales (Barley & Tolbert, 1997). In addition, these practices, ideas and forms need to be recognised as anomalies in order to effect institutional change (Lounsbury & Crumley, 2007).

The widespread adoption of such innovations depends upon successfully presenting them to a wide range of potential adopters where they are seen as more compelling than existing practices (Maguire et al., 2004; Strang & Meyer, 1993). This is accomplished through theorisation – the development and specification of abstract categories and the elaboration of chains of cause and effect; that is, building both a model of how new practices and organisational forms work, and providing a justification for them in current and future contexts (Greenwood et al., 2002; Hinings et al., 2004; Lawrence & Suddaby, 2006; Strang & Meyer, 1993). Theorisation informs wider audiences of the new localised practices (Hinings et al., 2004), specifies general organisational failings (Tolbert & Zucker, 1996), and justifies abandoning old practices in favour of new ones (Hinings et al., 2004; Tolbert & Zucker, 1996). Theorisation essentially promotes the innovation that emerged in response to the enabling condition, and provides a general story about how they are relevant to, and appropriate for, wider audiences.

A concomitant and interacting process is legitimisation, the process of linking the alternative idea, practice or form to sets of values and logics that are held in esteem by field actors and by the surrounding societal context (Hinings et al., 2004). This is vital as the innovations need to be seen as plausible due to the absence of information and evidence regarding their activities (Aldrich & Fiol, 1994; DiMaggio, 1988). At its most basic, an institutional entrepreneur can conform to a certain extent in a particular institutional environment to gain legitimacy, however more commonly the institutional entrepreneur will need to manipulate the institutional environment (Suchman, 1995b). Legitimation can occur through discursive actions (Battilana et al., 2009; Phillips et al., 2004) such as the use of rhetorical strategies (Suddaby & Greenwood, 2005), stories (Lounsbury & Glynn, 2001; Zilber, 2007) and

analogies (Etzion & Ferraro, 2010). The construction of collective identities can also lead to legitimation (Creed, Scully, & Austin, 2002). In particular, building an identity is important for making the unfamiliar familiar, understandable, acceptable, and thus more legitimate (Lounsbury & Glynn, 2001). More recently, Navis and Glynn (2011) have introduced the concept of the ‘entrepreneurial identity’ as the constellation of claims that gives meaning to the questions ‘who we are’ and ‘what we do’. More substantive actions include establishing a standard (Aldrich & Fiol, 1994; Garud et al., 2002; Kaplan & Murray, 2010; Lawrence, 1999), having a robust design (Hargadon & Douglas, 2001), performing symbolic actions (Zott & Huy, 2007) and proving the value of the innovation (Kaplan & Murray, 2010; Reay et al., 2006; Sine, David, & Mitsunashi, 2007; Suchman, 1995b; Tolbert & Zucker, 1983). Legitimation can also occur through the social position of the actor (Battilana et al., 2009; Maguire et al., 2004) and through the mobilisation of resources, both financial (DiMaggio, 1988; Greenwood et al., 2002; Hinings et al., 2004; Misangyi, Weaver, & Elms, 2008) and number of followers (DiMaggio, 1988; Hinings et al., 2004; Lawrence, 1999). Together these legitimating actions lead to cognitive, social and material endorsement and support that is integral for institutional change (Battilana et al., 2009; Dorado, 2005).

Some have argued that the notion of ‘framing’ (Snow & Benford, 1992; Snow et al., 1986) from social movement theory provides insights into the processes of theorisation and legitimation (Battilana et al., 2009; Fligstein, 1997, 2001; Rao et al., 2000). Battilana et al. (2009) helpfully develop framing as part of the key process of ‘creating a vision’, or those activities undertaken to make the case for change. To develop a vision, the institutional entrepreneur locates the change project, first, in terms of the problem it helps to resolve, secondly, as preferred to existing arrangements, and thirdly, as motivated by compelling reasons (Battilana et al., 2009; Rao et al., 2000; Snow & Benford, 1992). As a frame begins to cohere to organise the field, actors then act to propagate that frame and the social order it implies (Fligstein, 1997).

The processes of theorisation, legitimation and framing can be challenging. As the promoted changes will differ with those that are taken for granted by people in the field, the institutional entrepreneur needs to be aware of and sensitive to the discursive and cultural contexts in which they are embedded (Battilana et al., 2009; Fligstein, 1997). The processes of theorisation, legitimation and framing will also differ in substance depending on the characteristics of the field in which the change is occurring (Battilana et al., 2009). In fields with high levels of institutionalisation and which are quite homogenous, entrepreneurs need to frame discourses which resonate with the interests and values of members of the dominant coalition (Greenwood & Suddaby, 2006; Greenwood et al., 2002). However when the field is institutionalised but fragmented, there are no dominant actors and the institutional entrepreneur must unite the divergent actors and find stable sets of agreements in ways that meet the interests of diverse stakeholders without access to the taken-for-granted symbolic and material resources and institutional channels of diffusion that are normally available (Fligstein, 1997; Fligstein

& Mara-Drita, 1996; Maguire et al., 2004). In less institutionalised fields, particularly those which are fragmented (often called emerging fields) little existing coordination exists between members, and there is less relevance of isomorphic pressures, no widely shared values, and diffuse power making coercion difficult (Lawrence & Phillips, 2004; Maguire et al., 2004). As such the institutional entrepreneur has considerable scope to be strategic and opportunistic, such as attaching new practices to existing routines, using discursive strategies, political tactics such as bargaining, negotiation and compromise, or by crafting an attractive social identity that appeals to potential field members (Battilana et al., 2009; Fligstein, 1997; Lawrence & Suddaby, 2006; Maguire et al., 2004).

Finally, the new institutional practices that have been theorised and legitimated also need to be diffused to other actors. This can occur through the processes of coercive, normative and mimetic isomorphism, particularly in more established fields (Hinings et al., 2004). However, Greenwood and Hinings (1996) suggest that in a less mature, less tightly coupled and more permeable field, more ideas can be theorised, and as a result dissemination will be more difficult because of the lack of enabling mechanisms (Hinings et al., 2004). Lawrence, Hardy, and Phillips (2002) have suggested ‘proto-institutions’ as new practices, rules and technologies that are narrowly diffused and only weakly entrenched. Proto-institutions can become new institutions if they evolve from their particular collaborative context and diffuse sufficiently through social processes.

Summarising, institutional entrepreneurship literature considers the enabling conditions and processes of agency in institutional contexts. As an ecosystem has been argued to represent one facet of an organisational field, institutional entrepreneurship provides insight into the processes and factors that drive institutional change from the perspective of the hub firm. In particular, the recognition of the resources, material and substantive strategies that need to be deployed for theorising, legitimation and framing provide insight into the key activities of ecosystem emergence.

3.4 Four activities of ecosystem emergence

From the above review, it is apparent that each is a theory of institutional change that considers institutional formation from a different vantage point. Dominant design literature considers the institutional formation from the context of technological standardisation, social movement theory considers institutional formation as the outcome of collective action, and institutional entrepreneurship literature considers institutional formation as driven by individual actors. Together, and broadly stated, dominant design theory considers the activities concerned with the technological development of the underlying technologies in an ecosystem; social movement theory considers the collective action activities of the ecosystem participants; and institutional entrepreneurship theory considers activities undertaken taken by the hub firm.

There are areas of commonality between the three theories that provide the foundations for the identification of the four factors below. For instance, each theory highlights legitimising processes as

integral to the success of the institutional formation (DiMaggio, 1988; Hargrave & Van De Ven, 2006; Rao et al., 2000; Rosenkopf & Tushman, 1998; Suchman, 1995b; Swaminathan & Wade, 2001; Van De Ven & Garud, 1989). Legitimacy is the “generalised perception or assumption that the actions of an entity are desirable, property or appropriate within some socially constructed system of norms, values, beliefs and definitions” (Suchman, 1995b: 574). In particular it is “possessed objectively, yet created subjectively” (p. 574). As such, legitimacy is a condition reflecting perceived consonance with relevant rules and laws, normative support, or alignment with cultural-cognitive frameworks, which are displayed in a way that is visible to outsiders (Scott, 2008). One source of legitimacy is socio-political, in that key stakeholders, the general public, key opinion leaders or government officials accept a venture as appropriate and right (Aldrich & Fiol, 1994; Sine et al., 2007). Legitimacy can be pragmatic, based upon audience self-interest, as well as moral, based upon positive normative approval (Suchman, 1995b). Legitimacy can also be cognitive, based on comprehensibility and taken for grantedness, and where a status hierarchy is created along with reputations of organisations (Aldrich & Fiol, 1994; Rao, 1994; Suchman, 1995b). Ecosystems and the participating organisations require social acceptability, plausibility and credibility beyond their material resources, technical information and capabilities to survive (DiMaggio, 1988; Scott et al., 2000). In emergence contexts, the absence of information and evidence regarding their activities reinforces the importance of legitimacy (Aldrich & Fiol, 1994). Furthermore, gaining legitimacy for the new ways of organising, such as an ecosystem, will confer the authority for a hub firm to control existing and future processes (Hinings et al., 2004).

For dominant design theory, the legitimacy of the sponsoring firm signals to other participants in the technological field that the firm and its technology is viable and worthwhile considering (Cusumano et al., 1992; Hariharan & Prahalad, 1991; Khazam & Mowery, 1994; Suarez, 2004). Relatedly, the reputation and credibility of an organisation provides an advantage over others when manoeuvring strategically (Cusumano et al., 1992; Khazam & Mowery, 1994; Klepper & Simons, 2000). For social movement theory, socio-political and cognitive legitimacy are key to the success of a social movement, as the movement must be validated if they are to get resources (Rao et al., 2000). As a social movement gains legitimacy, there is decreasing amounts of collective action as the goals of the movement become institutionalised (Davis & McAdam, 2000; McAdam et al., 1996; Swaminathan & Wade, 2001). For institutional entrepreneurship, claims to legitimacy are often made to a variety of audiences by linking changes to broader social values – in doing so the discourse of legitimacy aligns (or claims to align) the values and attributes of new ideas, forms, and practices to those held in society at large, that is to broader values beyond the particular organisational field (Battilana et al., 2009; Phillips et al., 2004). For instance, in technology contexts, it is not necessarily the nature of the technology that is important in determining how disruptive the technology will be, but the degree to which institutional entrepreneurs manage the meaning of the technology and its level of embeddedness in everyday lives for potential consumers (Munir & Phillips, 2005).

Another commonality is the role of collective action. Institutional entrepreneurship and dominant design theories both cover collective dimensions, each introducing collective action from social movement theory. This explicit recognition of collective action has occurred as scholars have begun to realise the importance of the mobilisation processes in order to gain legitimacy (Battilana et al., 2009). Institutional formation in dominant design contexts puts emphasis on the technological communities that collectively standardise the design through a process of compromise and accommodation (Tushman & Murmann, 1998). Here the collective action of the technological communities builds legitimacy for both themselves as the adjudicator within the emerging technological field, but also on their selection of the standards of merit and value that drive the measurement of technological performance (Kaplan & Murray, 2010; Kaplan & Tripsas, 2008). For institutional formation driven by institutional entrepreneurship there needs to be some type of multilateral or collective action that reconstructs both the existing social arrangements and the actors themselves (Seo & Creed, 2002). Others have introduced the concept of ‘collective institutional entrepreneurship’, defined as the process of overcoming collection inaction and achieving sustained collaboration among numerous dispersed actors to create new institutions or transform existing ones (Wijen & Ansari, 2007). Underscoring the importance of collective action in institutional formation and change, McAdam and Scott (2005) have proposed deeper integration between social movement theory and institutional theory with institutional actors and mobilising structures, governance structures with political opportunities, and institutional logics with framing processes.

A further commonality is that all theories recognise the importance of cognitive processes and framing contests – the generation of shared meanings through framing processes (Hargrave & Van De Ven, 2006). Central to social movement theory, they have been explicitly integrated into institutional entrepreneurship (Battilana et al., 2009; Fligstein, 1997, 2001; Rao et al., 2000) and are beginning to be considered within technology innovation management (Kaplan & Tripsas, 2008). As a consequence Hargrave and Van De Ven (2006) have explicitly linked social movement theory with dominant design. Similarly, collective action coordinated through social movements has been explicitly called out as institutional entrepreneurship (Fligstein & Mara-Drita, 1996; Hargrave & Van De Ven, 2006; Rao, 1998; Rao et al., 2003; Rao et al., 2000; Van De Ven & Hargrave, 2004).

The commonalities between each of these theories in the context of institutional formation provide insight into the activities of ecosystem emergence (see Figure 1 below). Taken together, these three frameworks suggest that there are four types of activity of ecosystem emergence – resource activities, technological activities, institutional activities and contextual activities.

Figure 1 – Theoretical derivation of the activities of ecosystem emergence

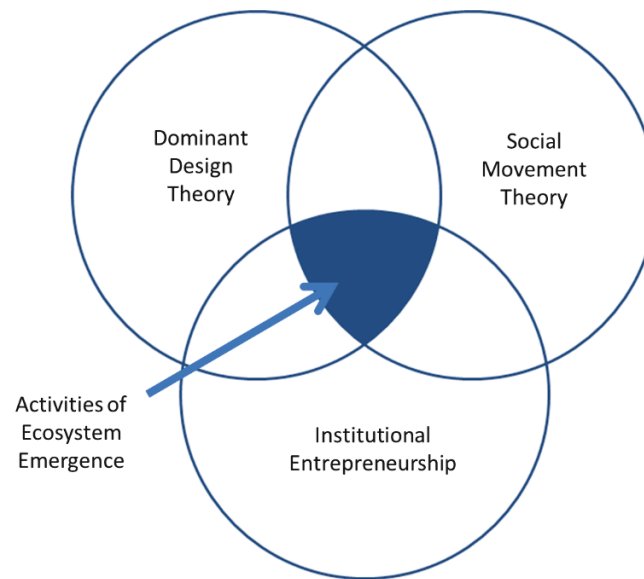


Table 3 below outlines the source theories for each of the activities and details the specific sub-types of activities which are drawn from each theory.

Table 3 – Overview of source theories for activities and sub-activities

ACTIVITY	DOMINANT DESIGN THEORY	SOCIAL MOVEMENT THEORY	INSTITUTIONAL ENTREPRENEURSHIP THEORY
Resource	Finance Coalitions Skills and competences	Finance Coalitions Skills and competences Organisational form	Finance Coalition Skills and competences
Technological	Design Delivery Support	-	Support
Institutional	Rule making Framing Discourse	Framing Identity construction	Rule making Framing Discourse Identity construction
Contextual	Initial conditions Regulation Competitors	Initial conditions Regulation Competitors	Initial conditions Regulation Competitors Discourse

3.4.1 Resource activities

Resource activities are those concerned with the procurement and management of resources by the hub firm in an ecosystem. All three theories emphasise the importance of resources as influencing institutional formation processes. Salient resource activities include corporate activities, financial activities, coalition and competence building activities.

The activities involved in the establishment and maintenance of the *organisational form* of the hub firm underpin the emergence of an ecosystem, as the structure and processes of the initiating

organisational form are an important early resource (Zald & Ash, 1966). For instance, social movement theory emphasises the importance of the mobilising structure that provide the initial social capital for movements (Tilly, 1978), as it constitutes the ‘building blocks’ of collective action (McAdam & Scott, 2005). In addition, the likelihood of mobilisation is largely determined by the organisational vehicles utilised (Jenkins, 1983; Tilly, 1978). The form of the organisation can be informal or formal, and includes groups, formal organisations and information networks (Davis & McAdam, 2000; McAdam et al., 1996; Tilly, 1978). Different organisational forms are effective for different tasks (Zald & Ash, 1966), and as a consequence the choice of organisational form influences the hub firm’s ability to respond to environmental stimuli (Davis & McAdam, 2000; Lounsbury et al., 2003; McAdam et al., 1996). The organisational form also influences the range of frames and meanings that are available (Clemens, 1996). The organisational form can also influence the availability and deployment of tangible resources (Jenkins, 1983; Snow & Benford, 1988), such as financial resources, ability to enter into coalitions, and capability development through the professionalism of staff and membership (McCarthy & Wolfson, 1996; McCarthy & Zald, 1977). The particular organisational form of the hub firm can either be created or adopted from one already existing. The acquisition of complementary asset providers can develop the ecosystem by appropriating existing organisational forms and restructuring them into something more appropriate (Davis & McAdam, 2000; McAdam, Tarrow, & Tilly, 2001). Alternatively, through investment in an organisation others can be encouraged to participate (Garud et al., 2002) or encourage stakeholders to favour the ecosystem (Battilana et al., 2009).

Another resource activity is the acquisition and management of *financial resources*, such as initial seed investments, venture capital investments, loans, initial public offerings (IPOs), and stock issuance. Financial resources are important as sufficient resources are required in order for an ecosystem to be created (DiMaggio, 1988; Schilling, 2009; Smith, 1996; Swaminathan & Wade, 2001). Financial resources can also act as a legitimating factor, as actors need sufficient resources in order to realise the opportunity that they can see (DiMaggio, 1988). In particular, developing an ecosystem and the resulting institutional change is likely to be costly (Misangyi et al., 2008), as incumbents may try and resist the change (Fligstein, 2001). For instance, financial assets can be used during the early stages to bypass sanctions likely to be imposed by opponents of the change (Greenwood et al., 2002), or ride out the negative costs of the transitional period during which the new digital service and related ideas are likely to be unknown (Greenwood & Suddaby, 2006). Financial assets are also useful to bring others into the coalition, such as by providing a service or product for free as distinct to the charged offering of the incumbent (Garud et al., 2002). In addition financial resources can be used to get stakeholders to favour a project (Battilana et al., 2009). Thus institutional entrepreneurs can devise appropriate incentive structures (Wijen & Ansari, 2007) and create rule structures that also confer property rights (Lawrence & Suddaby, 2006).

A further resource activity is the *establishment and maintenance of coalitions*, such as joint ventures, strategic agreements, licensing, and marketing and technology agreements (Cusumano et al., 1992; Khazam & Mowery, 1994; Smith, 1996; Soh, 2010; Suarez, 2004). Ecosystem success springs not just from technological superiority, but also from the level of organisational support from the surrounding technological community (Wade, 1995) and from alliances in the existing institutional apparatus (McAdam et al., 1996). These coalitions form a network of complementary players that collectively possess the skills and resources needed to achieve success (Hargrave & Van De Ven, 2006). As complementary assets underlie the ability of the hub firm to profit from the ecosystem (Lee et al., 1995; Teece, 1986), once the ecosystem begins to take off, then access to and use of complementary assets become critical (Schilling, 2009; Teece, 1986). The linkages created through coalitions represent some of the interdependencies between the participants in the ecosystem (Adner & Kapoor, 2010; Iansiti & Levien, 2004a), and can be between individual actors, and at other times between multiple individual actors, such as consortia and trade associations (Rosenkopf & Tushman, 1994). These coalition building activities can mobilise elite allies (McAdam et al., 1996), legitimating the ecosystem (DiMaggio, 1988; Fligstein, 1997; Greenwood et al., 2002) and granting access to resources (Tilly, 1978). This access and the strength and status of individual partners (Hariharan & Prahalad, 1991) generally creates a qualitative improvement in the returns to the ecosystem. Greater firm centrality within in the ecosystem leads to informational advantages due to improved knowledge acquisition and sharing (Funk, 2003) as well as enhanced embedding of texts in the wider discourse (Phillips et al., 2004).

Coalition building activities directly affect the number of participants in the ecosystem, which can have an influence on ecosystem emergence. For instance, the number of users of a technology is associated with higher rates of adoption for that technology, providing ‘extra’ momentum (Schilling, 2009; Suarez, 2004). Relatedly the composition of the early members of the ecosystem can have an influence, as the more homogenous the interests and the more dense the social network, the greater the resource mobilisation for further growth (Davis & Thompson, 1995). The number of users in an ecosystem also enables the process of mimetic isomorphism to drive the legitimation of ecosystem wide value co-creation practices and structures (Hinings et al., 2004). Together these have a virtuous cycle effect, as a greater number of participants leads to more rapid adoption of the ecosystem by those participants, (both customers and both supplier and complementary asset providers), leading in turn to a greater number of participants.

Another resource activity is the *development of the appropriate skills and competences*, as relevant capabilities, competences and skills are required to be able to execute the institutional formation project (Zietsma & Lawrence, 2010). For instance, strong organisational linking capabilities are required to develop partnerships and alliances (Tushman & Murmann, 1998), as some competences may come from suppliers external to the hub firm, such as advertising, while others will be within the

hub firm itself. Similarly, learning capabilities, both within and between organisations (Lee et al., 1995), and of the market (Hariharan & Prahalad, 1991), are also vital, as learning-curve advantages can result in more efficient and effective technology that underpins the ecosystem (Schilling, 2009). Furthermore, both production capacities and marketing capabilities are vital resources that will influence the emergence of an ecosystem (Hariharan & Prahalad, 1991; Schilling, 2009; Smith, 1996). A hub firm should also have the production capabilities available to take advantage of the market opportunities (Hariharan & Prahalad, 1991). The capabilities and characteristics of specific individual actors may also influence the emergence of an ecosystem. For instance, Fligstein (1997) and Wijen and Ansari (2007) have identified a collection of social skills that the successful institutional entrepreneur requires. The quality of leadership is also particularly important, as the hub firm will only be as good as the leaders that guide it (Snow & Benford, 1988; Swaminathan and Wade (2001)). In particular, having prior experience and expertise can be a factor in success (Swaminathan & Wade, 2001). The quality of the leadership can also influence other resource activities, such as financial resource acquisition, quality of the coalitions and membership.

Intimately involved in the development of the relevant capabilities is the social position of the hub firm, including formal positions that that the firm may hold, as well as the available socially constructed and legitimated identities that enable influence (Dorado, 2005; Maguire et al., 2004; Tushman & Rosenkopf, 1992). Social position mediates the relationship between the hub firm and the environment in which they are embedded and hence their capability to act (Emirbayer & Mische, 1998). It reflects the perceptions of that actor to the potential for ecosystem emergence (Bourdieu, 1977) and provides ongoing differential access to resources (Lawrence, 1999). Alternatively, the social capital from a social position may provide legitimacy with respect to diverse stakeholders, as well as the ability to build bridges between them to access dispersed sets of resources (Maguire et al., 2004). It can also act as a source of legitimacy if it provides access to information and political support (Battilana et al., 2009). Social position can also enable the capability to influence tactics, set agenda, and to leverage power (Fligstein, 1997; Maguire et al., 2004). Social position may change over time, with social status accruing to some ecosystem participants more than others, and as a consequence ecosystem participants may differ in their ability to shape and influence ecosystem emergence (Lee et al., 1995; Rosenkopf & Tushman, 1994).

Summarising, the activities of resource acquisition, development and maintenance are salient in ecosystem emergence contexts. In particular, the establishment (or adoption) and management of a corporate form, the acquisition of financial assets, the establishment and maintenance of agreements and strategic alliances with other participations, the development of relevant capabilities, and the hiring and development of personnel are key to providing the requisite resource endowments upon which to build an ecosystem.

3.4.2 Technological activities

Technology activities are those related to the design and provision of the underlying technologies in the ecosystem that enable value co-creation. Salient technological activities include the design and delivery of the underlying technologies and the establishment and operation of supporting services for ecosystem participants.

Activities concerning the *design and functionality* of the underlying technologies are important in ecosystem emergence contexts, as they can have economic, cognitive and social impacts. When a technology or offering is superior to competing technologies on the dimension of merit, *ceteris paribus*, it is more likely to be adopted over others (Suarez, 2004). As such technological design can often be the key factor in successful value co-creation and ecosystem emergence (Abernathy & Utterback, 1978; Christensen et al., 1998; Murmann & Frenken, 2006; Suarez & Utterback, 1995), although others have noted that the characteristics of the technology only have a strong influence (Schilling, 2009). Similarly, Gawer and Cusumano (2002) noted that technological design has a strong influence on platform and ecosystem success. A technological design can provide a means through which people can understand, appreciate, interact and adopt an innovation (Hargadon & Douglas, 2001). The type of design that is required is 'robust', where its arrangement of concrete details are immediately effective in locating the novel product or process within the familiar world, by involving valued schemas and scripts, yet preserve the flexibility for future evolution, by not constraining the potential evolution of understanding and action that follows use. Related technological activities include those day-to-day routines that facilitate the operation of the service. For instance, the availability of a technology – whether the system is down or running slow – is vital to its success.

The level of radicalness of the design and functionality can influence ecosystem emergence, as new technologies that offer significant advances in both technology and consumer benefits can often have low initial performance-to-price ratio and face limited market acceptance (Christensen, 1997; Srinivasan et al., 2006). The design and functionality of the underlying technology can also influence the relevant complementary assets that are required for value co-creation within the ecosystem. Access to and use of complementary assets is vital for building market momentum, and a better set of complementary assets will be associated with a higher likelihood of dominance, all other things being equal (Suarez, 2004). Although complementary assets do not loom large in early stages of ecosystem emergence when there is little to gain from specialised assets (Teece, 1986), once the ecosystem begins to gain momentum then access to and use of complementary assets become critical (Schilling, 2009; Teece, 1986). As complementary assets underlie the ability of a firm to profit from an innovation (Lee et al., 1995; Teece, 1986), the design of the technology can subsequently influence value sharing within the ecosystems. In addition, the design and functionality offered will be influenced by the overall rate of technological change, as it affects the number of service alternatives available, the nature of the dimensions of merit against which it will be measured, and likelihood of obsolescence (Lee et al., 1995).

The design and functionality of the technology, particularly the level of standardisation, can also have significant economic impacts on the emergence of the ecosystem. For instance, as the ability to scale up quickly is vital to ecosystem emergence, the standardisation of design and functionality can influence the availability and size of any economies of scale and scope (Abernathy & Utterback, 1978; Christensen et al., 1998; Lee et al., 1995; Tushman & Anderson, 1986). The technological design can also impact network externalities, where the customer value of a product increases through its adoption by other customers (Lee et al., 1995; Murmann & Frenken, 2006; Suarez, 2004). Network externalities can be either direct or indirect, where a direct network externality relates to increased value from other customers, and an indirect network externality relates to increased value from complementary assets (Katz & Shapiro, 1985, 1986). A network externality can act as a strong force in driving participant adoption to an ecosystem, as similar to that of economies of scale, so that a small lead (either random or through first mover advantage) will inexorably drive more users to the ecosystem through increasing returns (Murmann & Frenken, 2006). The design and functionality of the underlying technology can also impact switching costs, influencing the ability to attract customers and to build or maintain existing participants (Lee et al., 1995; Suarez, 2004). Although switching costs can increase the perceptions of riskiness of an ecosystem, through fear of lock-in (Lee et al., 1995), switching costs can also influence on network externalities by making existing participants more ‘loyal’ (Suarez, 2004). Technological functionalities, the level of openness of the technology, the installed base and the availability of complementary goods all interact to drive the emergence of an ecosystem (Schilling, 2009).

A related technological activity to technological design and functionality are the *supporting services* that enable ecosystem participants to enhance their performance. These include technological features such as toolkits, as well as the technology specific support programs and training. The maintenance of group communications, the development of formal alliance programs, and the involvement of users in testing, and the development of linkages with educational curricula (Aldrich & Fiol, 1994; Lawrence & Suddaby, 2006) serve as useful mobilisation mechanisms in ecosystem contexts. By easing the burden of joining the ecosystem, participants can be motivated and subsequently provide legitimacy through their provision of resources (DiMaggio, 1988).

Summarising, technological activities that enhance the design and provision of the core services within the ecosystem can be important for ecosystem emergence and momentum building. In particular, the design and delivery of the core technological services and the provision of supporting services to assist ecosystem participants in their operations can influence ecosystem emergence.

3.4.3 Institutional activities

A third collection of activities are those related to the institutional structure and operation of the ecosystem, as distinct from the resource and technological activities. These factors are internal to the ecosystem and include actions by both the hub firm and ecosystem participants. Salient institutional activities include rule-making and enforcement, framing, discourse, and identity construction.

The first institutional activity relates to the *establishment and application of rules*, including those efforts to establish norms of behaviour and procedures within the ecosystem. These rules and norms govern action in the ecosystem and outline the ways of working together (Hargrave & Van De Ven, 2006; Lee et al., 1995; Rosenkopf & Tushman, 1998; Van De Ven & Garud, 1989). The rules of engagement, such as coordination, behaviour and operation, have implications for the ability of ecosystem participants to co-create value (Garud & Rappa, 1994; Suarez, 2004). Furthermore, the rules of engagement, such as information sharing practice, and structure of the value system, have implications for value co-creation (Garud & Rappa, 1994; Suarez, 2004). For instance, if ecosystem participants are in opposition (as contrary to their values) to the level of ‘openness’ in value co-creation activities, then value co-creation and subsequent ecosystem emergence will be restricted (Schilling, 2009). Similarly, the norms of cooperation versus competition affect dynamics of value co-creation (Suarez, 2004). Relatedly, the rules and activities around governance are also a mechanism for manipulating ecosystem dynamics and the right of the hub firm to control existing and future processes (Hinings et al., 2004). A more tangible activity is the establishment of technical, legal or market standards that define ‘normal’ processes involved in the production of a good or a service (Aldrich & Fiol, 1994; Lawrence, 1999). These standardisation processes are inherently fragile, and social and political skills are required for their maintenance and legitimacy (Garud et al., 2002).

As ecosystems encompass many members, activities around the establishment and maintenance of the rules and criteria for membership are important as they outline who can make rules, what attributes participants should possess and the degree of redundancy between them, and the degree of exclusivity and duration (Gulati et al., 2012). Membership strategies, such as those that involve the definition of the rules of membership and their meaning for an institutional community, can also drive legitimacy (Lawrence, 1999; McCarthy & Wolfson, 1996). Membership strategies also enable collaboration activities through providing the boundaries of the problem domain (Phillips et al., 2000), and in doing so indirectly affect the level of stability in the ecosystem (Zietsma & Lawrence, 2010). Membership strategies are often tied to appropriate incentive structures (Wijen & Ansari, 2007), such as conferring property rights (Lawrence & Suddaby, 2006), so as to encourage stakeholders to participate in the ecosystem (Battilana et al., 2009). Rule-setting activity can also include pricing, which can be varied in order to encourage adoption (Armstrong, 2006; Eisenmann et al., 2006; Murmann & Frenken, 2006; Rochet & Tirole, 2006; Suarez, 2004).

Central to processes of institutional formation is the generation of shared meanings through *framing* (Hargrave & Van De Ven, 2006). Implying reality construction (Snow & McAdam, 2000), framing is important in building legitimacy and the institutional logic of the value co-creation in the ecosystem. As ecosystem participants and the hub firm interact, frames are being constantly modified depending on the challenges that it faces (Benford & Snow, 2000). Benford and Snow (2000) identify three overlapping framing processes which enable the development, generation and elaboration of

meaning. Discursive processes consist of the talk, conversation and written material that occur in conjunction with ecosystem emergence. Strategic processes are those deliberately utilitarian processes, often including collective identity construction (Polletta & Jasper, 2001), which connect frames to the ecosystem purpose and goals. Contested processes are those that contest the identity and discursive processes, underlining that collective action frames are contested processes. Within such framing process two institutional activities are salient to the creation of meaning and legitimacy in ecosystem emergence: discourse and identity construction.

Discursive activity includes the talk, conversation and written material that occurs in conjunction with ecosystem emergence (Benford & Snow, 2000), as well as generation and dissemination of the symbolic elements that mediate between the participants and the ecosystems. Discursive activities are those activities and practices that motivate and convince others to accept and participate in the ecosystem, as well as building a shared understanding (Battilana et al., 2009; Benford & Snow, 2000; Phillips et al., 2004). Active, sometimes controversial, discourse is essential for the hub firm to validate their role in the centre of emerging ecosystem and to provide legitimacy (Aldrich & Fiol, 1994; Munir & Phillips, 2005; Phillips et al., 2004; Suddaby & Greenwood, 2005). This discursive activity is complemented by intense sensemaking, experimentation and search for good practices as participants seek to adopt, adapt and utilise the new technologies in the emerging ecosystem (Garud & Rappa, 1994; Kaplan & Murray, 2010; Kaplan & Tripsas, 2008; Tushman & Rosenkopf, 1992). The discursive activity often consists of shared narratives, rhetoric and analogies, through white papers, speeches, conferences and industry award ceremonies, that shape participants' shared understanding of the ecosystem (Anand & Jones, 2008; Anand & Watson, 2004; Etzion & Ferraro, 2010; Garud, 2008; Suddaby & Greenwood, 2005; Zilber, 2007), as do promotional and sales activities set expectations and encourage participation (Suarez, 2004). Actions that draw attention to the meaning of an object that goes beyond its functional use are also vital to drawing participants to the ecosystem (Zott & Huy, 2007). Together these generate justified accounts – narratives that describe the way value co-creation in the field should be done – and persuade the ecosystem participants to adopt them (McInerney, 2008).

A final institutional activity relates to the *construction of a collective identity* among the participants, as identity construction is an inherent feature of the framing process (Benford & Snow, 2000; Klandermans, 1992; Snow & McAdam, 2000). At the early stages of ecosystem emergence a generally recognised mobilising identity can make the claims of the hub firm and ecosystem more salient (Polletta & Jasper, 2001). However, the construction of ecosystem-level collective identities – defined here as the participants' cognitive, moral and emotional connection with the ecosystem (Polletta & Jasper, 2001) – can underpin the successful emergence of an ecosystem (Creed et al., 2002; Gawer & Phillips, forthcoming). The development of collective identities increases the ability of an ecosystem and the hub firm to translate common interests into mobilisation towards a co-creation (Davis & Thompson, 1995). Collective identities can emerge through differing narratives, such as those that

valorise or demonise particular actors or practices, others that idealise particular attributes or practices, those that authorise particular practices, and also some that problematise issues or actors (Hardy & Maguire, 2010). The formation of a distinct and inimitable collective identity also increases the legitimacy of the ecosystem, as legitimating accounts are often intertwined with the construction of social identities (Davis & Thompson, 1995; Gawer & Phillips, forthcoming; Polletta & Jasper, 2001; Swaminathan & Wade, 2001). In particular, a collective identity can be shaped so as to enhance the ecosystem's interpretations of and claims to the logics in an attempt to create the conditions for the collective, on-going social construction of the institutional logic (Creed et al., 2002). This subsequently both legitimates participation and mobilises others and crucial audiences. This collective identity can be shaped through field-configuring events such as conference, award ceremonies and tradeshow (Anand & Jones, 2008; Garud, 2008; Lampel & Meyer, 2008), as well as through activities that develop endogenously amongst the participants, such as specific routines and practices. Together these embed the identity into the institutional logic (Barley & Tolbert, 1997; Hinings et al., 2004; Polletta & Jasper, 2001).

Summarising, institutional activities shape the successful operation, perceived legitimacy, and sense of belonging of the participants in the ecosystem. In particular, rule-setting and enforcement, and framing activities, discursive activities and identity construction are all salient to the emergence of ecosystems.

3.4.4 Contextual activities

Contextual activities also drive the emergence of an ecosystem, as wider technological, political and economic environment changes can influence the conditions in which the ecosystem emerges (Anderson & Tushman, 1990; McAdam et al., 1996; Oliver, 1992; Rao et al., 2000). For instance, Rao et al. (2000) emphasise that the initiating context influences the level of competition initially faced by an ecosystem entrepreneur. If the ecosystem emerges within a fragmented context which is disorganised and where there is no pre-existing dominant competitor, it will generally be met with support; however if the ecosystem emerges in an interstice between two dominant competitors, or in a context characterised by a distinct dominance order, there will be resistance and competition from existing competitors. This restricts the likelihood of ecosystem emergence, and hub firm entrepreneurs often switch fields to take advantage of new emerging fields (Perkmann & Spicer, 2007), although early competition does not preclude ecosystem emergence (Barley, 1986; Beckert, 1999; Greenwood & Suddaby, 2006; Reay et al., 2006).

External events are a common enabling condition for ecosystem emergence and which shape the activities required for ecosystem emergence. These external events disturb the existing socially constructed, field-level consensus and invite the introduction of new ideas (Fligstein, 1997, 2001; Greenwood et al., 2002; Holm, 1995; Jenkins, 1983; Rao et al., 2000; Reay et al., 2006). These external events can consist of social upheaval, technological disruption, resource disruption, competitive

discontinuity, and regulatory changes (Anderson & Tushman, 1990; Battilana et al., 2009; Fligstein & Mara-Drita, 1996; Hinings et al., 2004; Jepperson, 1991; Thornton, 2002), and may happen gradually or abruptly (Gamson & Meyer, 1996). However they occur, they shape the strategic landscape which the hub firm and emerging ecosystem must navigate. Similarly, internal contradictions in existing markets, ecosystems or organisational fields (Clemens & Cook, 1999; Friedland & Alford, 1991; Greenwood & Suddaby, 2006; Seo & Creed, 2002) can also influence the initial conditions for emergence. For instance, the levels of inefficiency, lack of adaptability and levels of divergent interests can create the conditions for emergence (Greenwood & Suddaby, 2006; Seo & Creed, 2002). Indeed these contradictions may provide the alternative logics of value co-creation, as well as the cognitive and physical resources to be mobilised, appropriated and transposed in the process of ecosystem emergence (Seo & Creed, 2002). As the hub firm and ecosystem also directly interact with the existing political, economic and institutional system, in doing so it can create opportunities (Ingram & Rao, 2004).

As the context can both provide the conditions for ecosystem emergence as well as shape the environment in which emergence occurs, a collection of activities that relate to the actors external to the ecosystem which have an impact on the emergence processes of the ecosystem is suggested. Activities here include the actions of regulators and government, discourse in the press and wider society, and the actions of competitors.

Regulatory activities relate to those regulatory events that occur in the wider context, such as the passing of statutes that relate to the operation of the ecosystem and investigation by regulatory bodies. Governments may have a strong interest in the activities of the ecosystem and hence may regulate (Anderson & Tushman, 1990; Lee et al., 1995; Suarez, 2004; Tushman & Rosenkopf, 1992). By the act of regulating an activity, a government or regulator can not only (de)legitimate the ecosystem, it may also make the market much more (less) favourable (Sine et al., 2007). For instance the introduction of legislation can lead to altered alliances between participants, changing power relations, and hence threatening established resource flows in the ecosystem (Holm, 1995). In particular they can change the regime of appropriability that governs the ability to capture profits (Hariharan & Prahalad, 1991; Lee et al., 1995; Suarez, 2004; Teece, 1986). Appropriability is an influence on the ecosystem emergence, as a strong regime of appropriability will favour ecosystems and hub firms with superior technology (Suarez, 2004), or will give them time to improve their technology (Teece, 1986). An example is the selection of the GSM (Global System for Mobile Communications) mobile phone standard in Europe. However, an adverse appropriability regime can be worked around by encouraging imitation and market acceptance of a particular design through an 'open architecture' (Schilling, 2009). Institutional intervention, such as government purchases of a product (Suarez, 2004) or through large and powerful users requesting a particular product design (Tushman & Rosenkopf, 1992) can also influence ecosystem emergence. In these circumstances the sheer volume of production required will be sufficient to ensure success through scale economies or through legitimacy signals. Similarly, private institutions

such as industry associations or standards making bodies can influence which technology can enter the market initially providing first mover advantages to particular hub firms and ecosystems (Suarez, 2004; Tushman & Rosenkopf, 1992).

The second context activity relates to the *discursive actions of the press, analysts and other actors* in wider society. Here press activities include any written or spoken actions that discuss the ecosystem in a substantive manner (Phillips et al., 2004). Societal discursive activities are the dialogue that occurs in wider society, such as entering the general lexicon, referencing in art, winning awards, and the release books, magazines, academic or medical research that addresses the ecosystem. These activities have the effect of legitimating the ecosystem (Phillips et al., 2004), as can winning a certification competition which highlights the ‘best’ service or product (Rao, 1994). Signals of leadership are also important in the construction of markets and the shaping of boundaries (Santos & Eisenhardt, 2009), as they build legitimacy both for ecosystem participants on the viability of value co-creation, as well as for the ecosystem within wider society. Discourse external to the ecosystem can also lead to fragmentation of views of the participants within an ecosystem, an imposition of values from outside the ecosystem, or changing opinions of participation about their involvement (Hinings et al., 2004). For instance, Haveman and Rao (1997) point how the changing nature of society led to changing concepts of the nature of thrift, and Greenwood et al. (2002) show how new external views of the monopoly position of professions altered the organisational field of accounting. In both these cases wider societal changes affected the institutional logics within the field.

The activity of *competitors* within the ecosystem can also influence ecosystem emergence, as successful ecosystems and hub firms will generate spin-offs and motivate other organisations to compete for the same resources (Fligstein, 2001; Rao et al., 2000). Thus the entry of competitors as well as their actions are relevant to sales-take off, technological improvement and ecosystem emergence (Agarwal & Bayus, 2002). At times the contest between the ecosystem and competitors will focus on meaning construction (Benford & Snow, 2000; Ryan, 1991) and at other times related more directly to the core product or service, such as through price wars or functional improvements (Garud et al., 2002). A competitor can also generate conditions for wider institutional change, including acting in such a way that foster opportunities that other organisations can take advantage of (Battilana et al., 2009; Delbridge & Edwards, 2008). Moreover, a competitor, in its zeal for competitive success could deliberately compromise the boundaries of the ecosystem, disembedding some previously embedded participants, as well as exposing the ecosystem to new actors who have never been embedded (Zietsma & Lawrence, 2010).

Summarising, context activities are those external to the ecosystem that impact on the emergence of the ecosystem. In particular these activities include actions by regulators and government, discursive actions of the press, analysts and wider society, and the actions of competitors.

3.5 Conclusion

To conclude, this chapter has synthesised the institution formation and change literatures of dominant design theory, social movement theory, and institutional entrepreneurship theory to propose four activities of ecosystem emergence. Resource activities are those concerned with the procurement and management of resources by the hub firm in an ecosystem, including corporate activities, financial activities, coalition building activities and competence building activities. Technology activities are those related to the design and provision of the underlying technologies, including the design and delivery of the underlying technologies and the establishment and operation of supporting services for ecosystem participants. Institutional activities are those related to the institutional structure and operation of the ecosystem, including actions by both the hub firm and ecosystem participants. These include rule-making and enforcement, framing, discourse, and identity construction. Contextual factors that both provide the conditions for ecosystem emergence as well as shape the environment in which emergence occurs include the actions of regulators and government, discourse in the press and wider society, and the actions of competitors.

The next chapter outlines the process methodology adopted to empirically investigate the emergence processes of ecosystems.

4 METHOD, DATA AND EMPIRICAL SETTING

This chapter outlines the process methodology relevant to addressing the third research question: *do ecosystem emergence processes exhibit similarities across cases?* I first specify the key assumptions of the process methodology adopted: narrative explanation. I then detail the research design, the empirical setting, the empirical cases, as well as the methods employed for the generation and analysis of the sequence data, including data collection, event colligation, phasic analysis and statistical bootstrapping.

4.1 Narrative explanation

The process methodology adopted employs narrative explanation, which takes the contribution that actions and events make to a particular outcome and then configures these contributions into a complete episode (Polkinghorne, 1988). Put differently, narrative explanation conceptualises development and change processes as a sequence of events which have unity and coherence over time. Outcomes are explained as the result of the order in which the events unfold and of particular conjunctions of events and contextual conditions. Ideally, narrative explanation provides an account of how and why a sequence of events unfolds that is sufficiently flexible to encompass a range of observed cases, yet sufficiently powerful to help researchers discern the operation of a generative mechanism in a collection of sequences (Poole et al., 2000). This generative mechanism is located in the particular progression of events and their conjunctions with other events and conditions, and is a sequence or cycle of prototypical events that enact the change path through space and time (Van De Ven & Poole, 1995).

That outcomes are explained as a result of the order in which they unfold indicates that the underlying assumptions of narrative explanation differ with respect to those methods based upon variance methodological approaches (Abbott, 1983, 1988, 1990a; Poole et al., 2000). The first assumption is that the *entities* that are the subject of interest may change over time (Abbott, 1988; Poole et al., 2000). No degree of similarity between earlier and later stages in development is required so long as this development is spatio-temporally continuous (Hull, 1975). This is in sharp distinction to methodologies based upon variance models, where the entity is assumed to be fixed with changing attributes (Abbott, 1988, 1992). As a consequence discerning a central subject and the types of events and characteristics that mark changes in the subject underpins the methodology. Central subjects are individual entities (groups, people, organisations, machines and other material artefacts) around which the narrative is woven. Also distinct from the variance approach, an entity, attribute, or event may change in causal meaning over time (Abbott, 1988, 1992; Poole et al., 2000).

Because of the inherent complexity of developmental processes, narrative explanation explicitly focuses on events rather than variables which indicate attributes of the entity. Events naturally simplify the complex flow of incidents (Abbott, 1990b). As such, *events* are the natural unit of the process in

that they are what happens to the central subject or what the central subject does (Abbott, 1990b; Poole et al., 2000). In contrast to variance approaches where, for instance, a survey contains indicators of the underlying constructs, a narrative text contains the indicators for an underlying process theory (Pentland, 1999). Furthermore, the *temporal sequence* of events is critical (Pentland, 1999; Poole et al., 2000). For variance theories there is an assumption of independence between entities, attributes and time periods, so that the order of things does not influence the way things turn out (Abbott, 1988, 1992). For narrative explanation, the order in which events occur determines when causality come into play, while the duration of events and the continuity across events determines how long these causes operate (Abbott, 1988; Poole et al., 2000). This means that unlike variance approaches, establishing the minimum time unit is relatively unimportant as process theories have to be able to expand and contract their windows for event recognition (Poole et al., 2000).

Narrative explanation also incorporates multiple *layers of explanation* ranging from the immediate to the past (Poole et al., 2000). In distinction to variance theories which are ‘causally shallow’ where history is encapsulated in the immediate past state of the entity, process theories are ‘causally deep’ as they explain the state of development at any point in terms of the prior history of events and associated causal influences (Abbott, 1988). The importance of considering both the immediate past and the distant past is underpinned by the fact that the history of an individual case can cause different paths with differing outcomes, and that events can have differing time horizons (Poole et al., 2000).

Narrative explanation is also based upon a different *logic of causality* to variance approaches. Necessary causality requires that only the entire set of forces that influence the change process, in the particular order and combinations in which they occur, are necessary and sufficient to explain a narrative (Poole et al., 2000). This is in distinction from variance approaches which attempt to cut through a variety of variables to find the relevant few that are both necessary and sufficient (Mohr, 1982; Poole et al., 2000). As causal influences come through one or more events, it is rare for a single cause to be sufficient in narrative explanation, and hence, unlike variance models, main effects are not more important than interaction effects (Abbott, 1988, 1992). Also in contrast to variance models, a given attribute can have more than one effect on another attribute within a given study (Abbott, 1988). This means that in process research although each causal event will impart a particular direction, the subsequent events, conjunction and confluences also influence the subject and alter the direction imparted by a previous event. Narrative explanation is also based upon final and formal causality, supplemented by efficient causality (Poole et al., 2000), which is the causality utilised within variance explanations, where a force acts upon the unit of analysis to make it what it is in terms of the outcome variable (Mohr, 1982). Efficient causality explains the influence imparted by particular events and explains the mechanics of transitions between events and more macro-level units, such as phases (Poole et al., 2000). Both final and formal causality, not viewed as valid generative mechanisms by variance

approaches, can also be used. Final causality considers explanations where an end or goal guides the unfolding of development and change, while formal causality considers explanation driven by a pattern that guides the change (Poole et al., 2000).

Finally, the generality of narrative explanation depends upon its *versatility* (Poole et al., 2000). For variance theories generality is based upon the domain of cases and contexts in which the explanation operates uniformly and consistently (Abbott, 1988, 1990a). In narrative explanation generality stems from the degree to which it can encompass a broad domain of developmental patterns without modification of its essential character (Poole et al., 2000). Thus rather than categorise the cases that do not fit the explanation within the error term, the goal is to incorporate all cases into the explanation. In order to achieve this versatility, process researchers are required to pursue a strategy of simplification, where events and event sequences are categorised in such a way as to identify qualitatively similar events and sequences (Abbott, 1990a).

Summarising, narrative explanation explains outcomes as a result of the order in which they unfold. To do so narrative explanation has a range of assumptions which differ from those of variance studies. In particular, narrative explanation allows the subject of interest to change over time, focuses on the temporal sequence of events, utilises various layers of explanation, has differing logics of causality, and aims to be generalisable through the versatility of its explanations.

4.2 Research design

Having noted that the overall empirical approach adopts narrative explanation, I now outline the research design, which is a logical plan for getting from the research question to the answers (Yin, 1984). A research design needs to explicitly describe the key methodological decisions taken in order to answer the research question. Together these methodological decisions constitute the framework that is used to empirically investigate the research question.

The first methodological decision was to adopt a case study based approach. Case studies are particularly useful when the research question focuses on an area that is currently understudied and where there is limited theory (Edmondson & McManus, 2007; Eisenhardt, 1989; Siggelkow, 2007). Furthermore, case studies are generally preferred when the research question is focused on a contemporary phenomenon in a real-life context and where the researcher will have little control over the events being researched (Yin, 1984). For narrative explanation and process studies such as this, case studies provide rich detail (Langley, 1999; Van De Ven, 1992; Weick, 2007), capture multiple levels of context and recurrent patterns in process data (Pettigrew, 1992), and contain the same narratives that organisations use to plan, enact, interpret and evaluate their own actions and those of others (Pentland, 1999). The narrative data that constitutes the source material for case study research can also be easily manipulated and codifiable using standard methodological techniques.

In seeking to understand if there is similarity in the processes of ecosystem emergence across cases, the unit of analysis here is the process of emergence. This is congruent with the synthetic approach to sensemaking of process data and theory development which takes the full process as the unit of analysis and attempts to construct global measures from the detailed event data to describe it (Langley, 1999).

With the process as the unit of analysis, multiple case studies are required to generate enough processes for comparison. In this way the research takes the event sequences and conducts a type of variance analysis to determine similarities. Furthermore, the greater the number of cases utilised in the analysis the greater the potential generalisability of the results, as case studies are subject to limitations in generalisability and open to biases (Eisenhardt, 1989; Yin, 1984). The generalisability of narrative explanation also depends upon its versatility, as outlined above (Poole et al., 2000). Multiple case studies also typically enable the emergence of more robust and parsimonious theory than single case studies (Eisenhardt & Graebner, 2007; Yin, 1984). Multiple cases also permit a replication logic in which each case is treated as an experiment, with each serving to confirm or disconfirm inferences drawn from the others (Yin, 1984). A further natural advantage that comparative case studies have over other comparative approaches is the opportunity to explore holistic explanations within and between cases (Pettigrew, 1992).

A further methodological decision was to not only extract incidents from the raw case narratives, but also to construct events from the incidents. An incident differs from an event in that it is an empirical observation, while an event is not directly observed but is a construct that explains a pattern of incidents (Abbott, 1984). As events act as a simplifying tool for analysis of complex change processes, methods of incident extraction and event identification are vital to the construction of event sequences (Abbott, 1990b; Pentland, 1999; Poole et al., 2000). Incident extraction uses standard methods of reviewing raw qualitative data and recording each incident. To construct events, the method of colligation is adopted, a procedure where any number of incidents are selected as indicators of an event (Abbott, 1984, 1990a; McCullagh, 1978; Walsh, 1958; Whewell, 1847). This creates a temporal sequence of events that explains an observed stream of incidents (Poole et al., 2000). This process of incident extraction and event colligation is in stark contrast to non-process oriented case study research which takes case data and applies qualitative methodologies such as grounded theory (for instance, Corbin & Strauss, 1990; Eisenhardt, 1989).

Having created event sequences for each case study, the next methodological decision was to code each event with the four activities of ecosystem emergence – resource, technological, institutional, and contextual – previously identified in Chapter 3. As these activities describe the underlying types of events that occur in ecosystem emergence contexts, the coding of each event sequence creates an activity sequence that captures a sample of activities that occurred in the emergence processes of each case. This also organises each event sequence into a format conducive for process analysis. A related

decision was to apply the codes multi-functionally, meaning that multiple codes are applied to a single event, aligning with the concept of processes as multiple, intertwining narratives (Abbott, 1990a).

With the activity sequences for each case created, the penultimate methodological decision was to adopt phasic analysis as the tool to analyse the activity sequences. Phasic analysis attempts to capture the overall coherency of development and change at a higher level than fine-grained micro-level structure (Poole et al., 2000). Three different phasic analysis techniques were selected. Optimal matching compares whether any two sequences have similarities in their code patterns. Direct inspection, a qualitative technique, enables the determination of phases through interrogation of the case narratives and the manual discernment and sorting of pattern sequences into higher level sequences. Frequency analysis is the quantitative analysis of the occurrences of codes, such as code counts per period or within a moving window.

The final methodological decision was to bootstrap statistical significance for the phasic analysis technique of optimal matching. Optimal matching is a technique that is not normally utilised alone, but is paired with cluster analysis so that groups of sequences could be identified (see for instance Biemann, Fasang, & Grunow, 2011; Huang, El-Khoury, Johansson, Lindroth, & Sverke, 2007; Joseph, Boh, Ang, & Slaughter, 2012; Saberwhal & Robey, 1993; Salvato, 2009; Shi & Prescott, 2011). This is necessary because although a single distance provides a numerical value of the dissimilarity between any two sequences, the real meaning of this value is obscure (Poole et al., 2000). As a consequence optimal matching is usually only viable when there is a large enough sample of sequences that can provide statistically significant results from cluster analysis. As there are only a limited number of cases within this research, the optimal matching technique needs to be enhanced so as to provide meaningful statistical information. The details of the statistical bootstrapping technique to address this shortcoming of the optimal matching technique are discussed in more depth in Section 4.11.1.

Together, this framework provides the necessary methodological steps that are required to investigate whether there are similarities in the processes across differing cases of ecosystem emergence.

4.3 Empirical setting

The research setting is digital services. Broadly stated, a digital service is the electronic provision of a service that was previously delivered either as analogue service or as a physical product. From this perspective the introduction of accounting software, word processing and computerisation of production control equipment can be considered digital services. Although the emergence of such services is fundamental to understanding the emergence of the post-industrial economy (Castells, 2000), particularly in relation to productivity increases and the shift from manufacturing to services, digital

services relate to an upgrading of an information transfer activity that already existed in the industrial economy, and also to activities that are usually internal to an economic entity, such as an organisation.

A more comprehensive approach to digital services is to focus on transfers of information that did not exist in the industrial economy, such as those that relate to the provision of data and information between economic entities beyond traditional telephony or paper. An early example of digital services is provision of digital data between parties, such as Electronic Data Interchange (EDI), and the early, non-interactive internet. A unique element of information technology is that in contrast to previous general purpose technologies, information technology can be used to improve itself (Castells, 2000). As a consequence, over time the resources made available as digital services have increasingly exposed the underlying technology which provides the information and data. Digital services have evolved from mere data and information interchange to the manipulation of it, such that the capabilities of software, previously hidden ‘behind’ the service, have become available as a service. As such digital services are defined as *informational resources available for consumption where the consumers do not own the physical or informational infrastructure*.

Digital services are an attractive setting for studying the emergence of ecosystems as they are not necessary consumed directly or alone. Digital services are normally consumed by other services or jointly consumed in a network setting. This is due to the fact that many digital services are designed as incomplete systems (Garud et al., 2008), necessitating their inclusion in a network of other complementary services. As such they are designed with value co-creation in mind, and it is through the ecosystem that the combination of heterogeneous digital services provides utility to the ultimate economic entity that consumes the service. This is enabled by ‘loosely coupled’ integration methodologies, with ‘just-sufficient’ protocols of interoperability and extensibility, which are a good design for widely distributed systems and networks (Orton & Weick, 1990). Digital services also exhibit many of the characteristics of a high velocity environment, in that there are rapid changes in demand, competition, and technology (Bourgeois & Eisenhardt, 1988).

In sum, digital services provide an ideal setting to observe ecosystem emergence processes.

4.4 Empirical cases

Six successful digital service ecosystem emergence processes are investigated – Amazon, eBay, Facebook, Google, Salesforce, Wikipedia. Each of these cases is a well-known digital service. See Table 4 for an overview of each case.

Table 4 – Case overviews

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Year founded	1994	1995	2004	1998	1999	2001
Years of study	1994 - 2003	1994 – 2001	2002 - 2009	1996 – 2005	1996 – 2006	1999 – 2008
Founder	Jeff Bezos	Pierre Omidyar	Mark Zuckerberg	Sergei Brin & Larry Page	Marc Benioff	Jimmy Wales
Founder background	Hedge Fund executive	Software engineer	Undergraduate student	Doctoral students	Software executive	Bank trader
Founding ideal	Commercial success	Create the perfect market	Make the world more open	Make all the world's information freely accessible and available	Free the business from enterprise software	Free access to the world's knowledge
Competitors at founding	Books.com; clbooks.com	None	MySpace.com; Friendster.com;	Yahoo!; Altavista; Excite	None	Encyclopaedias
Initial Funding	Founder & Family	Founder	Founders	Founder	Founder & angel investors	Founder
IPO	1997	1998	2012	2004	2003	Not Applicable
Year became profitable	2001	1995	TBD	TBD	2002	Not Applicable
Business Model	Retail	Brokerage	Social advertising	Search advertising	Subscription	Open source
Marketing Approach	Word of mouth	Word of mouth	Word of mouth	Word of mouth	Guerrilla	Word of mouth
Major Crisis Event	Dotcom crash	Technology failure	Privacy	Privacy	Technology failure	Quality
Effect of dotcom crash	Major; potential for bankruptcy	Minor; slump in listings	Not Applicable	None	Mid; cash-flow issue solved through fee	Not applicable
Ecosystem participants	Customer, wholesaler suppliers, distributors, partner websites, associate websites, marketplace vendors	Customer, escrow services, insurance services, information services, software, packaging materials,	User, app developers, advertisers, Connect enabled websites, 'Like' enabled websites	Customer, advertisers, advertising affiliates, search affiliates, app developers	Customer, consultancies, solution developers, AppExchange developers, software	Users, editors, bot developers, add-on developers

These six cases are heterogeneous within the context of digital services. They illuminate the phenomenon of interest and cover a range of polar types (Pettigrew, 1990; Yin, 1984). More specifically, each digital service case has a different logic of value co-creation, and the cases collectively exemplify the main logics of value co-creation in digital service contexts. Amazon is an online retailer, eBay an online auction service, Facebook a social networking service, Google a search engine, Salesforce an online customer relationship management service, and Wikipedia an open source encyclopaedia. A second source of heterogeneity are the participants in each ecosystem; Amazon is business to consumer service, while the services of eBay and Wikipedia link consumers. Facebook and Google link businesses to consumers through advertising (and Facebook consumers to consumers for socially motivated reasons) and Salesforce is a business to business service.

Further sources of heterogeneity include the effect of the dot-com crash, major crisis events, founder backgrounds and motivations, and early stage funding activities. The dot-com crash had a major impact on the business of Amazon, leading to lay-offs and a reduction in scope of strategic ambition, and also caused severe cash flow difficulties at Salesforce. eBay had a slump in listings, but as the digital service had been profitable from the beginning, the dot-com crash had little effect on its operation. Google was at too nascent a stage to be affected by the dot-com crash; both Facebook and Wikipedia had not yet been founded. In terms of major crisis events, all cases experienced an event which shook their ecosystem's confidence in the viability of the digital service and ecosystem, with corresponding widespread media coverage. Both Facebook and Google suffered significant issues with privacy, eBay and Salesforce issues with service availability, Amazon the dot-com crash, and Wikipedia the quality of the articles.

The founders and their motivations in each of the cases also vary widely. Jeff Bezos, originally a hedge fund executive, founded Amazon with the explicit goal of commercial success. In contrast Pierre Omidyar was a software engineer who founded eBay with the idealistic goal of creating the perfect market after experiencing what he felt were unfair practices in the stock market. Facebook, Google, Salesforce, and Wikipedia all adopted founding ideals which reflected the altruistic and open nature of the internet. Mark Zuckerberg was an undergraduate student at the founding of Facebook, and founded the digital service with the goal of making the world more open through enabling easier connections and communication between people. Sergei Brin and Larry Page of Google were both doctoral students who founded the digital service to make the world's information freely accessible and available. Marc Benioff was a senior software executive at Oracle, and founded Salesforce to free the business from the travails of enterprise software. Jimmy Wales, the founder of a moderately successful early web company that, among other things, sold access to soft-core porn, founded Wikipedia to enable free access to the world's knowledge after being influenced by the open source movement.

The early stage funding of these digital services is also heterogeneous. Prior to venture capital (VC) investment, all empirical cases were initially seeded by their founders, although Salesforce was

also seeded by some angel investors, and Amazon and Facebook acquired early capital from the families of the founders. eBay, uniquely, was profitable from the very beginning and only acquired VC funds as a means of signalling viability. In contrast to all the other cases, Wikipedia has always been supported by philanthropic means, either from Bomis which initially established the service, or through direct outreach to corporate and individual donors after their establishment as a foundation.

Together, these six cases are heterogeneous along a number of different dimensions within the context of digital services. As well as illustrating the phenomenon of interest, this should potentially provide a level of generalisability beyond their context (Leonard-Barton, 1990).

4.5 Data sources

Narrative explanation is based upon stories, because they help explain the relationships between events in a process or narrative (Pentland, 1999). Narrative data can be collected from many sources, as most forms of data embody, to a greater or lesser extent, some aspect of narrative structure (Pentland, 1999).

Data was collected from a variety of archival sources, including critical histories authored by independent journalists, websites, press releases, Wikipedia, and news articles. Each data source presents its story, more or less, in the form of a narrative, and in doing so gives a surface view of the deep structure of the underlying process. Table 5 details the data sources for each case.

Table 5 – Data sources utilised for each case

	Book	Corporate Milestones	Press Releases	Blog/ Newsletter	Wikipedia Criticisms	Other
Amazon	Brandt (2011)	Y	Y	N	Y	N
	Spector (2000)					
eBay	Cohen (2002a)	Y	Y	N	Y	N
	Lewis (2008)					
Facebook	Kirkpatrick (2010)	Y	Y	Y	Y	N
Google	Vise (2005)	Y	Y	Y	Y	N
Salesforce	Benioff and Adler (2009)	Y	Y	N	Y	N
Wikipedia	Lih (2009)	Y	Y	Y	Y	Trophies
	Sanger (2005)					

For each case, at least one book that covered the early period of operation was included. For Amazon and eBay two books were reviewed, and for Wikipedia a book chapter that specifically covered the early years was included. All of these books, with the exception of the one used for Salesforce, were authored from a critical perspective by independent journalists. A chapter authored by Larry Sanger on the early history of Wikipedia was also included. Corporate milestones and all press releases were available on the public websites for all cases. In addition, Facebook, Google and Wikipedia, due to their later founding, had a body conversational-style archival material, such as newsletters and blogs that

were available online. Given the potential for biased narrative to be generated from these hub firm-centric archival materials, the criticisms or controversy page or section on Wikipedia was also included as a data source. Only data verified through a citation was extracted from such Wikipedia pages. In addition, the trophies page was included for Wikipedia, which lists the awards that the digital service received.

Beyond the core archival texts listed above, to cross check data, such as dates, Dow Jones Factiva was consulted as required. This enabled a deeper triangulation logic between differing sources to ensure additional reliability (Jick, 1979; Yin, 1984).

4.6 Central subject identification

In narrative explanation, the identification of the central subject is vital as they are the entity around which the narrative is woven. A central subject can take many forms, including groups, people, organisations (such as social movements), machines, material artefacts, and genetic lineages (Hull, 1975). The discernment of the events and characteristics that qualitatively change this unit of analysis provides the raw data for analysis. So long as the central subject can be described, and has spatio-temporal unity and continuity over time, then it can be a central subject. In addition, because they are primary and give the narrative its basic unity and continuity, central subjects must be identified independent of the events in which they figure (Poole et al., 2000).

Narratives with multiple central subjects are possible, however they may become quite tangled and complicated as multiple strands of narrative are tracked (Poole et al., 2000). Rather than consider multiple narratives, an approach similar to Garud and Van De Ven (1989) is taken, which looked at the development of cochlear implants. For them their central subject was the business unit within 3M which revolved around a technology based product. As the central subject and the technology were intertwined, anything that was relevant to either was included. In the case of the research here, the central subject is the ecosystem, as well as the digital service and hub organisation that lie at the centre of the ecosystem. As such, anything that is relevant to the organisation, digital service or ecosystem is considered. Similarly, following Garud and Van De Ven (1989), data concerning the wider contextual environment, such as competing digital services, regulators and press, were also considered relevant. The inclusion of this wider contextual environment is congruent with definitions of ecosystems which include regulators, competitors and educational bodies, such as Teece (2007). This wide range of levels of analysis overcomes issues with difficulty in isolating the central subject in an unambiguous way which naturally consist of multiple levels of analysis (Langley, 1999).

4.7 Time frame

In process research such as this establishing the time frame is also vital, as it sets a reference for what changes are seen and how the changes are explained (Pettigrew, 1990). Here the time frame ranged from the initial idea of the digital service, to the time when the success of the digital service and

ecosystem are commonly acknowledged. Thus data collection often began before the digital service or hub firm was launched, and finished a number of years later; for completeness an additional year was added after the commonly acknowledged (discussed more below) success date.

Table 6 – Empirical cases key dates

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
First Idea	08/04/1994	20/05/1994	12/12/2003	10/12/1996	Approx. 1997	18/08/1999
First (Beta) Availability	04/04/1995	04/09/1995	04/02/2004	08/10/1997	06/04/1999	23/02/2000 (Nupedia)
Full (Open) Availability	16/07/1995	04/09/1995	26/09/2006	03/02/1999	07/02/2000	15/01/2001
First Paying Customer	07/06/1995	05/02/1996	27/05/2004	17/03/1999	12/11/1999	Not Applicable
First Internationalisation	15/10/1998	04/07/1999	07/02/2008	09/05/2000	09/04/2001	15/03/2001
First Press Release	04/10/1995	20/01/1998	19/04/2006	18/08/2004	06/12/1999	25/02/2004
First Investment (non-seed)	13/12/1995	17/06/1997	24/08/2004	27/08/1998	06/12/1999	Not Applicable
First VC Investment	07/06/1996	17/06/1997	06/04/2005	07/06/1999	08/05/2000	Not Applicable
IPO	14/05/1997	24/09/1998	Not Applicable	19/08/2004	23/06/2004	Not Applicable
First Profit	2001	1995	2009	2000	2002	Not Applicable
First Employee Hired	17/10/1994	06/05/1996	06/03/2004	14/09/1998	14/11/1998	03/01/2000

Table 6 above details the years of study for each case, as well as key dates. The years of study for Amazon range from 1994 to 2003; 2003 was selected because by this year Amazon had reached general profitability and was by far the dominant retailer on the internet. The years of study for eBay range from 1994 to 2001, as although eBay was the undoubted market leader by late 1999, given the effect of the dot-com crash it was considered prudent to include its effect in the years of study. For Facebook the range is from 2003 to 2009, as by 2009 Facebook was the undoubted market leader for personal social networking, having not only surpassed MySpace a couple of years earlier, but also surpassing Orkut and Friendster globally. The years of study for Google range from 1996 to 2005, as Google was not only the undoubted market leader by this year, but it also won a court case in 2005 that ensured its dominance in search driven advertising. The years of study for Salesforce are from 1996 to 2006, as by 2006 its ecosystem was finally completely opened and monetised. Prior to this year, Salesforce only progressively opened its ecosystem because it was not fully developed. Finally, the years of study for Wikipedia range from 1999 to 2008, from the first idea of an online encyclopaedia (then called Nupedia) to when its philanthropic underpinnings achieved long term viability, both of the regularity and amount of donations as well as the operation and staffing of the Wikipedia Foundation.

4.8 Incident extraction

In process research, it is important to distinguish between an incident as raw datum, and an event as a theoretical construct (Abbott, 1984). Whereas an incident is an empirical observation, an event is not directly observed; it is a construct in a model that explains a pattern of incidents. An incident is the basic element of information. As explicated by Poole et al. (2000), an incident is empirical qualitative datum consisting of these characteristics: (1) a bracketed string of words capturing the basic elements of information, (2) about a discrete incident or occurrence, (3) that happened on a specific date, which is (4) entered as a unique record (or case) in a qualitative data file, and (5) is subsequently coded and classified as an indicator of a theoretical event.

In order to identify incidents consistently across the differing empirical cases, explicit decision rules are required.⁶ The decision rule used here is based upon the definition of an ecosystem. Adapting Autio and Thomas (forthcoming), and also following Poole et al. (2000), a relevant incident is defined as *a major recurrent activity or whenever changes were observed to occur in or to a network of production and use side participants as well as the hub firm or platform*. In addition, incidents relating to the wider contextual environment were also considered as relevant to the emergence process.

Following Garud and Van De Ven (1989), a discrete view of time was taken with the day as the temporal measurement unit. This means that events take place at a particular time and incidents are using the DD/MM/YYYY format. The decision rules listed in Table 7 were applied to the application of the unit of time.

Table 7 – Unit of time decision rules

- Unclear exact date – When exact dates cannot be ascertained, they were estimated based upon the information obtained, entered in the incident date field, and flagged as ‘approximate’.
- Unknown date – Where the specific day, month or year of an incident was not known, this was flagged as an ‘unknown’ and the date left empty.
- Short incidents – Where incidents were less than one unit of measurement, they were specified at the level of the unit of measurement.
- Long incidents – Where an incident took longer than one unit of measurement, it was said to have duration. In this case the dates and incidents that started and concluded the event were specified, as well as flagged as having duration.
- Quantity incidents – Where an incident refers to a quantity (such as revenue or number of users) that was gathered over a defined time duration (such as ‘over January’ or ‘through Q1’), the date is specified as the final day of the duration and the marked as ‘final date’.

Due to the nature of the source material, and the fact that the raw data has been gathered from a number of sources, not all incidents extracted from the raw narratives are relevant to the case of study.

⁶ It is also necessary to ensure the validity of the bracketing procedures (Poole et al, 2000), something that has not been carried out in this research. This requires testing of whether the list of incidents is consistent with the common perceptions of the phenomenon investigated. There are two main techniques here: the first is to use a second researcher to ensure that the decision rules are consistently interpreted; the second is to have the resulting list of incidents reviewed by key informants.

In order to identify incidents consistently across the differing empirical cases, explicit decision rules ensure that only incidents relevant to the creation process were included. Table 8 below outlines the incident relevance decision rules.

Table 8 – Incident relevance decision rules

- Solely quantitative – An incident is coded as quantitative when it is not a press release or other promotional activity, and only details purely numeric achievements, such as revenue, number of users, or size of database.
- Subjective observations – An incident is coded as an observation when judgements or interpretative statements are made by stakeholders about events. Coding incidents as observations requires a referencing of the event (by number) on which interpretive statements are made, the stakeholders making the observation, and what the statement is about (that is, about the ecosystem core concepts).
- Out of date range – An incident is coded as out of range when it occurs prior to either the establishment of the initial organisational form or the initial idea for the digital service, or occurs after the range of interest. The range of interest is determined as when an ecosystem is considered fully created.

Each incident was incorporated into a Microsoft Access database with core metadata associated for identification, management and manipulation. These metadata were applied univocally, in that an only single item for each metadata category was applied to each incident (Poole et al., 2000). See Table 9 for the core incident metadata.

Table 9 – Core incident metadata

Metadata	Description
ID	A unique ID to identify the incident.
Incident date	The starting date of the incident. If the incident occurred over a period of time then the finish date can be added and the incident_range field selected.
Date approximate	Denotes if the exact date is used, or an approximation.
Incident title	A short sentence that pithily describes the incident
Incident description	The long form text which describes the incident in more depth
Source	The source from which the incident was extracted.
Source reference	The reference from within the source, such as a page number.

For data sources that came from electronic sources (such as press releases, newsletters and corporate milestones), these were directly imported into the Microsoft Access database and the core metadata automatically associated with each incident. For data sources that required manual extraction of data, such as books, any action or incident that occurs was manually entered into the database.

Table 10 below details incident counts for each case by each data source. As can be observed, the volumes of incidents from each data source vary, as does the overall count for each case. This variability is to be expected given the range of data sources. In addition, as emphasised by Poole et al. (2000), it is important to recognise that the resulting list of incidents is only a sample. Put differently, the list of incidents for each case represents a sample of indicators of events.

Table 10 – Case incident count

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Books	Brandt - 261 Spector - 449	Cohen - 476 Lewis - 87	Kirkpatrick - 601	Vise - 318	Benioff - 259	Lih – 179 Sanger - 80
Press Releases	440	205	64	16	635	47
Corporate Milestones	80	25	54	102	47	143
Blog / Newsletter	-	-	114	466	-	450
Wikipedia Criticisms	16	3	55	16	-	78
Other	-	-	-	-	-	28
Total	1246	796	888	918	941	1005

Note: N/A signifies no incidents available or relevant for extraction from data source.

At this stage a case narrative and timeline are also completed for each case in order to gain a holistic overview of its emergence process.

4.9 Event colligation

The next step is to identify theoretically meaningful events from the incident data. There is a particular kind of relationship between incidents and events. As noted above, incidents are descriptions of happenings, documentary records of occurrences, and are raw data. In contrast, an event is a theoretical construct (Abbott, 1984), built upon a systematic interpretation of what is relevant to the process. As such the stream of incidents, a first order construction, needs to be translated into a sequence of events, a second-order construction (Poole et al., 2000).

However, events may vary in several respects, as they may differ in temporal duration, may overlap or nest, and may also differ in spatial extension (Poole et al., 2000). That events may differ in temporal and spatial scope suggests that incidents may well indicate more than one overlapping event. Events may be embedded within other different types of events of larger scope. Here both event levels may be important for understanding the change process, because interleaving narratives may clarify the emergence process better than either narrative could on its own. Another complication is that the event-incident relationship may change over time (Abbott, 1984). Just as the significance of events may change as a process unfolds, so can the relationship between an incident and event change. As a consequence, incident indicators can correspond to a theoretical construct in a variety of ways: some are better representatives than others, and some are easier to measure or detect (Poole et al., 2000).

To identify events from a collection of incidents requires *colligation*, which can be formally defined as the combination of incidents into an emergent whole (Abbott, 1984; McCullagh, 1978;

Walsh, 1958; Whewell, 1847). The task of colligation involves three essential parts (Abbott, 1984, 1990b).⁷

The first part of colligation involves identifying the *levels of analysis* within which a coherent story can be told. Each level of analysis is a social level-of-action on which the story events for that level occur (Abbott, 1990b). These levels of analysis are also those where one can conceive of coherent cases for the stories (Abbott, 1984). Based upon our identification above of the central subject, relevant levels of analysis include the ecosystem, the digital service, the organisation that provides that service, and the wider contextual environment, such as competitors and wider societal institutional events. The level of incident was applied univocally; for an incident to act as an indicator of an event requires the incident to be applicable at a single level (Abbott, 1984). The decision rules for the classification of an incident into a level are detailed in Table 11 on the following page.

The second part of colligation is *substantive colligation*, or deciding the substantive story at each of those levels (Abbott, 1984). This consists of assembling the narrative by deciding its essential events at each of those levels and ensuring the same event granularity at each level (Abbott, 1984, 1990a). There are a number of approaches to formally map indicators to events, including giving all indicators an equal weight, considering each indicator on a case-by-case basis, or using some measure of central tendency (Abbott, 1984). Following Poole et al. (2000) the first and third strategies were adopted for initial classification, and the second strategy then used to adjust the initial classification to one that was meaningful within the context of the case. This means that conceptual and practical reasoning are used to correct the bluntness of the objective rules.

In order to construct an event from a set of incidents, clear and rigorous decision rules are required so that high construct validity can be achieved. Table 12, also on the following page, details the decision rules that govern the indication of an event. These rules utilise a triangulation logic between differing indicators to ensure additional reliability (Jick, 1979; Yin, 1984).

⁷ The reliability of the colligation process should also be tested (Poole et al, 2000), something that has not been carried out in this research. This requires testing the unitising reliability, or the consistency in dividing the stream of activity into units. The main technique is to use a second researcher to ensure that decision rules are consistently interpreted.

Table 11 – Decision rules for levels of incidents

Level	Organisation	Service	Ecosystem	Context
Definition	An incident that relates to the organisation that controls the digital service	An incident that relates to the digital service	An incident that relates to the participants that interact with both the digital service and company both on the production and use side	An incident that occurs in the wider environment in which the case study is occurring
Examples	• Promotion and marketing related to company and unrelated products and services (such as email blasts, holiday related press releases, competitions, sponsorships, etc.) • Philanthropic activities (such as scholarships, charitable giving, charitable assistance, etc.) • Acquisitions of other organisations • Patents and trademarks awarded • Office openings, moves and refurbishments • Firm founding, bank account opening, bank loans, etc. • IPO and related activity • Election of personnel to operating committees and board • Hiring (and departures) of personnel • Decisions, realisations and other actions of managers • Staff training • Restructuring • Performance (such as revenue, profits, number of employees, etc.)	• Release of new features (including related hardware elements) • Changes to existing features • Change of name, visual layout, design and logos • Release of supporting programs and sites • Standard setting • Rule and policy setting • Price setting (including making something free of charge) • Sales activities • Promotion and marketing activities related to digital service (such as advertising, email blasts, holiday related press releases, competitions, sponsorships, charitable auctions, etc.) • Outgoing communications specifically relating to digital service • Initial ideas and R&D • Technology selection and deployment • System performance issues or system down • Performance (for example, number of entities that the service delivers, such as searches, items listed, articles; or number of languages supported)	• Partnership agreements and alliances • Licensing agreements • Integration of the service into other services and products • Entry and/or exit of participants • Participant activity, such as word of mouth marketing, promotions, projects, polls, surveys, competitions, etc. that support the service • Participant responses to service changes, new features, or organisational actions • Emergence of related industry in which ecosystem participants partake • Attendance at conferences • Investor and funding activity (including actual investment, offers and fundraising) • Investment in and funding of participants • Performance (such as numbers of users, number of partners/affiliates, number of apps, number of edits, etc.)	• Activities of competitors • Acquisition activity (from non-ecosystem members) • Press and news articles, including participation in interviews • Market and industry analyst reports • Actions of regulators and government • Actions of NGOs and other pressure groups • Honours and prizes awarded • Enters society discourse (books written, service name becomes a verb, etc.) • Court cases brought (when the organisation is sued) • Court case resolutions (for both when sued and suing) • Visit of dignitary to company • Participation in high profile non ecosystem event (such as attendance at Davos, or meeting President) • Performance (such as surpassing a rival or Alexa rankings)

Table 12 – Event colligation indication decision rules

- When an incident was deemed worthy of a press release, newsletter or some other public broadcast or publication by the hub firm, then there is an indicator of an event.
- When an incident is named as critical by an ecosystem participant, then there is an indicator of an event.
- When an incident is named as a ‘milestone’ by a participant, then there is an indicator of an event.
- Where there is a change in the functionality of the digital service, the capability of the hub firm or the environment in which the ecosystem resides, then there is an indicator of an event.
- When an incident is mentioned more than once from differing data sources, then there is an indicator of an event.

As the goal is to create a series of events which all have the same approximate granularity, additional decision rules are required when there are multiple indicators that occur on a given day. The following rules described in Table 13 below apply in the decision to construct an event from a single incident or multiple incidents.

Table 13 – Event colligation multiple indicator decision rules

- When multiple indicators occur on the same day, if these are the same incident then they are joined together into the same event.
- When multiple indicators occur on the same day which are not exactly the same but are closely related, where logical, these should be joined together into the same event. For instance, if three new technical features are released on the same day, then these can be colligated into the same event. However, if there is a technical feature and a new pricing policy on the same day, then these should be considered separate events.
- When there is a series of indicators over differing dates that can be better considered as a single event, then these should also be joined into a single event. Here the decision rule is “do these indicators together cover a single event in relation to ecosystem emergence?” In general these incidents should not run over a long time period, say 4 months, but should be clustered around a number of closely spaced days. The date assigned should correspond to the emphasis of the event. For instance, a series of articles in the press over a couple of days can be reduced to a single press event. Here the date of the event would be the publication of the first article. Similarly a series of meetings and activities which result in a failed or successful funding or acquisition can be considered the one event, however here the date should be that which concludes the incident as all other lead to that date.

The third part of colligation concerns the analysis of the *formal qualities* of each event (Abbott, 1984). The first formal quality is duration, which has been discussed earlier, and is obviously an issue when there are events occurring at differing levels. The second formal quality is dispersion, where an event propagates from one level of analysis to another, and need to be carefully noted. However this is done, Abbott (1984) points out that the final colligation should be coherent in both its limitation to the level of analysis and by extension to the participants in the event, and the pattern of links between events must be closed, although external antecedent events may be allowed. Here event duration was noted on each event.

Table 14 below details the number of events colligated for each case.

Table 14 – Event and incident counts

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Incidents	1246	796	888	918	941	1005
Events	674	483	520	568	721	710

As can be observed, the dispersion between the numbers of events for each case has decreased as compared to the dispersion for incidents. Again, it is important to emphasise that the list of events is only a sample of the events that can be identified.

4.10 Event coding

To organise these event sequences into a format conducive for process analysis, they need to be categorised to describe the emergence process.⁸ These category systems provide the ‘measurement’ necessary to construct theoretical models of change with empirical events (Abbott, 1984). Classifying an event or a sequence into a type is fundamentally different from measuring its variable attributes, as the change processes being classified are too complex to decompose into variables (Poole et al., 2000).

The coding scheme consists of the four conceptual categories derived in the theoretical development – resource, technological, institutional, and contextual. To recap, resource activities are those concerned with the procurement and management of resources by the hub firm in an ecosystem, including corporate activities, financial activities, coalition building activities and competence building activities. Technology activities are those related to the design and provision of the underlying technologies, including the design and delivery of the underlying technologies and the establishment and operation of supporting services for ecosystem participants. Institutional activities are those related to the institutional structure and operation of the ecosystem, including actions by both the hub firm and ecosystem participants. Salient institutional activities include rule-making and enforcement, framing, discourse, and identity construction. Contextual factors that both provide the conditions for ecosystem emergence as well as shape the environment in which emergence occurs include the actions of regulators and government, discourse in the press and wider society, and the actions of competitors.

Coding was conducted with a focus on pragmatism and utility, where rules and codes were devised in order for the coder to recognise and distinguish the categories. These rules were made easier by the archival data sources used, as by definition these were observer privileged and had little-to-no subjective influence. For each code a number of sub-categories emerged which aided application of the higher codes, enabling a more granular and accurate application of the codes. These sub-categories were developed retroductively, combining both inductive and deductive approaches (Poole et al., 2000). Taking the top level categories derived within Chapter 3, each the sub-categorisation was developed and then adjusted in view of what is workable and informative after trying out on the data. This is consistent with the observation of Poole et al. (2000) that when the study of organisational change process is at an embryonic stage, initial categories emerge as ‘sensitising constructs’ for conducting exploratory research. Appendix A outlines the codes, sub-categories and examples utilised.

The codes were applied multi-functionally, meaning that multiple codes were applied to a single event, aligning with the concept of processes as multiple, intertwining narratives (Abbott, 1990a). For instance, a strategic partnership between a hub firm and a complementary asset provider which also

⁸ For coding, both reliability and validity need to be tested (Poole et al, 2000), but this has not been performed here. Here classificatory reliability, referring to the consistency in assigning units to classification, and interpretive validity, the accuracy of interpretation, are salient. The main technique is to use a second researcher to ensure that there is consistency of interpretation about the decision rules.

involved a functional improvement to the digital service would be coded two times: once for the resource acquisition and once for the technological improvement.

The following Table 15 presents some descriptive statistics of the code frequency. The total code counts differ to the total event count due to the multifunctional coding.

Table 15 – Case descriptive statistics for activity codes

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Resource	27.55%	25.25%	18.29%	22.45%	15.18%	7.05%
	(197)	(126)	(182)	(134)	(114)	(52)
Technological	25.03%	18.31%	34.67%	33.33%	11.98%	29.54%
	(179)	(91)	(182)	(199)	(90)	(218)
Institutional	30.77%	43.06%	23.62%	22.61%	52.60%	40.51%
	(220)	(214)	(124)	(135)	(395)	(299)
Contextual	16.64%	13.28%	23.43%	21.61%	20.24%	22.90%
	(119)	(66)	(123)	(129)	(152)	(169)
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
	(715)	(497)	(525)	(597)	(751)	(738)

Note: The number in parentheses represents actual code count.

Following the application of codes to the events, the data consists of six sequences of activity codes. For example, a subset of the code sequence could appear as follows, R-T-C-T-R-I-C, with ‘R’ signifying a resource activity, ‘T’ a technology activity, ‘I’ an institutional activity and ‘C’ a context activity. From this basis analysis can proceed.

4.11 Phasic Analysis

Phasic analysis attempts to capture the overall coherence of development and change at a higher level than fine-grained micro-level structure (Poole et al., 2000). The fundamental assumption of phasic analysis is that the overall process can be described in units larger than the underlying events. A number of phasic analysis techniques were applied to these coded sequences: optimal matching, direct inspection and frequency analysis. Analysis was conducted using the R open source statistical software (R Core Team, 2012) with the TraMineR package for optimal matching (Gabadinho, Ritschard, Muller, & Studer, 2011).

4.11.1 Optimal matching

Optimal matching is a technique that compares whether two sequences have similarities in the pattern of the codes, and requires that each sequence is represented by well-defined elements drawn from an alphabet of relatively small set of (repeating) event types (Abbott, 1990b; Poole et al., 2000). Optimal matching produces an index of the relative ‘distance’ between any two sequences, and can be utilised on sequences of differing lengths. This index, known as the Levenshtein distance, is the smallest possible cost of insertion, substitution and deletion operations required to align the two sequences. Put differently, this index represents the effort required to transform one sequence into another. As an

example below demonstrates,⁹ the Levenshtein distance between “R-T-R-T-C-R” and “T-T-R-T-I-R-C” is 3, since the following edits change one into the other, and there is no way of doing it in less than three edits.

1. Substitution of “T” for “R” in position 1: “R-T-R-T-C-R” → “T-T-R-T-C-R”
2. Substitution of “I” for “C” in position 5: “T-T-R-T-C-R” → “T-T-R-T-I-R”
3. Insertion of “C” at end: “T-T-R-T-I-R” → “T-T-R-T-I-R-C”

A cost matrix determines the effort required for each insertion, substitution or deletion of a sequence element. In the example above, the cost of each insertion, substitution or deletion is costed at a value of 1, in what is called a constant cost matrix. As such the higher number returned in the distance, the more different the sequences. Where sequences have varying lengths, this distance can be normalised to a number between zero and one – where zero represents perfect similarity.

I use a constant cost matrix within this thesis; there is a value of one to each insertion, substitution and deletion. An alternative costing method, called TRATE, is based upon the probabilities of the transition of one code to another calculated from an analysis of the two sequences. This approach was not adopted as it results in differing costs of each insertion, substitution and deletion for each sequence comparison, making comparisons across differing sequence-pairs difficult to interpret.

The optimal matching algorithm always computes a distance measure for any pair of event sequences. However, because real-life event sequences are influenced by random events, it is very rare for any two event sequences to be perfectly matched. The challenge therefore remains to determine the meaning of the distance measure. For example, if the optimal matching algorithm indicates a distance of 0.459 for two sequences, a procedure is required to determine whether this is indicative of meaningful difference or similarity between the two sequences. This is further complicated by the varying number of events within each case. For instance, the distance between Amazon-eBay is between 715 and 497 events, Amazon-Facebook is between 715 and 525 events, and eBay-Facebook is between 497 and 525 events. Given the influence of the number of insertions required to calculate the distance between each case-pair, the distances of each case-pair are not directly comparable. To explore the meaning of distance measures calculated from a dataset, clustering procedures are often used with optimal matching (Abbott, 1990b; Poole et al., 2000). Clustering procedures help identify clusters where event sequences share a higher similarity with one another than with event sequences from other clusters (see for instance Biemann et al., 2011; Huang et al., 2007; Joseph et al., 2012; Saberwhal & Robey, 1993; Salvato, 2009; Shi & Prescott, 2011). Clustering allows the identification of a ‘most typical’ sequence by finding the sequence that minimises some (possibly weighted) function of the distances to all other sequences

⁹ Example adapted from “Levenshtein distance”, Wikipedia (retrieved on 20/07/2013).

(Abbott, 1990b). However, a clustering procedure is not possible here, as there are only six cases, and hence fifteen event sequence pairs in the dataset.

For this reason, I developed a randomisation procedure to establish statistical benchmarks that could be used to compare the distance measures against.

1. For each case I first create an event set that was of equal length and contained the same frequency of codes as the actual event sequence (to use Amazon as an example, this would consist of a length of 715, of which 197 are resource codes, 179 technological codes, 220 institutional codes and 119 contextual codes). See Table 14 above for total length and code frequencies for each case. This is repeated for each case.
2. Using the 'SAMPLE' randomisation algorithm in R and the respective event sets as a basis, I create 10,000 event sequences for each case where the ordering of events is randomised but the frequencies of the codes remain the same. In practice, this simply means that there was a different order in which the underlying activities occurred. This creates a sample of the population of the code ordering permutations that could exist for each case.
3. For each case-pair comparison, I compute the distance of the 10,000 randomised event sequences of the first case to 10,000 randomised event sequences of the second. This procedure creates a database of 10,000 distance measures where 10,000 randomised event sequences of the first case sequence length and code frequency are compared against 10,000 randomised event sequences of the second case event sequence and code frequency. These 10,000 distances are a sample of the population of distances that would be created by calculating the distance between the populations of the code ordering permutations of each case-pair.
4. I then compare the actual distance measure computed for the actual sequences of the case-pair against the distance measure database. This enabled me to establish how the actual case-pair distance measured compared against the frequency distribution in the distance measure database. For example, if the mean distance was 0.5, and 95% of the random distances were within the range from 0.4 to 0.6 and the actual distance computed for the pair was 0.61, then this distance was equal to or greater than 95% of all distances in the database. Thus, the statistical significance of 0.11* indicates that the case-pair event sequences are statistically dissimilar with 95% confidence level ($p < 0.05$).
5. The meaning of this difference can be interpreted as indicating that the first case event sequence is substantially different to the second case event sequence. A distance measure of 0.39, where 0.39 is *smaller* than 95% of the values in the database would have indicated that the event sequence of the first case is statistically distinguishable and substantially similar to the second case.

Summarising, optimal matching enables the comparison of two sequences to determine the distance (or the amount of similarity) between the two sequences. I have complemented this method through ‘statistical bootstrapping’, a technique that enables the comparison of limited numbers of sequences.

4.11.2 Direct inspection

A second technique utilised is direct inspection to determine if phases are suggested in the activity sequences. Direct inspection, a qualitative technique, enables the determination of phases through interrogation of the case narratives and the manual discernment and sorting of pattern sequences into higher level sequences. In doing so direct inspection capitalises on the background knowledge of the researcher and allows the modelling of sequence phases in a more discerning fashion than is possible by using algorithmic techniques (Poole et al., 2000). It is particularly useful when there are not many phases in the change sequence (Poole et al., 2000), something that the process models from ecosystems (see for instance, Moore, 1993), dominant design (see for instance, Hargrave & Van De Ven, 2006; Suarez, 2004), social movement theory (see for instance, Davis & McAdam, 2000) and institutional entrepreneurship (see for instance, Greenwood et al., 2002; Hinings et al., 2004) literatures suggest. The results from direct inspection are investigated further through frequency analysis and validated through optimal matching.

4.11.3 Frequency analysis

The third technique utilised is frequency analysis of the activity codes. In addition to standard frequency techniques such as code counts per period, two original techniques have been developed. One frequency measure is the count of the occurrence of codes over a moving window (of a size of a set number of events, say 25) that progresses along the sequence. As a code occurs within the window the code count increases by one, and as the moving window moves past the code, the count decreases by one. Differing smoothing techniques were also applied, including symmetrical smoothing where the smoothed value includes values on both sides of the value and lagging value. This technique provides a visual aid that provides the relative frequency of codes at any point within the sequence and also implies rates of change.

A second frequency measure examines the variance of code frequencies within a phase from a mean. This approach bootstraps statistical significance into the code frequency analysis. To produce a random mean for each code in a phase, 10,000 random sequences are generated for each case maintaining the same frequency of codes as the actual sequence (in the same manner as the statistical bootstrapping technique described above in Section 4.11.1 for optimal matching). Phase markers are then added at the same location in the random sequence as they occur in the actual sequence. The phase marker location is calculated by counting of the number of events in each phase (from the actual event sequence) as the phase duration. For instance, for a particular case, if a complete event sequence consists of 650 events, with the first phase consisting of 100 events, the second of 400 events and the third of

150 events, then for each randomised sequence for that case the first 100 events in the sequence is removed to form Phase I, the next 400 removed to form Phase II, and the remainder (150 events) forms Phase III. This is repeated to all 10,000 random event sequences for that case, as well as for the other case with their specific phase durations. This splits each randomised sequence into its constituent phases.

The code frequency in each phase of the randomised sequence is then calculated, resulting in 10,000 different frequencies for each phase. The mean frequency and standard deviation for each code can then be calculated for each phase. This mean frequency is identical (if not very close) to the code frequency for that phase if it had been calculated directly from the code counts on the actual event sequences. When comparing with the actual code occurrence for a phase of a case, a positive variance signifies a greater occurrence of that code than would occur by random, given the overall code frequency in the sequence. Similarly, a negative variance signifies a lesser occurrence of that code than would occur by random, given the overall code frequency in the sequence.

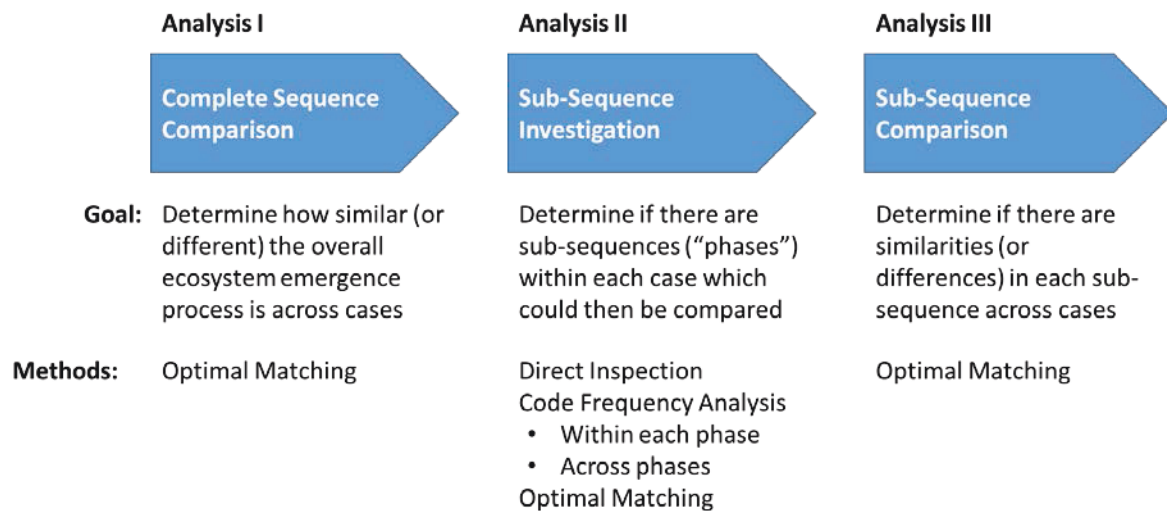
4.12 Conclusion

This chapter has outlined the process methodology relevant to addressing the third research question: *do ecosystem emergence processes exhibit similarities across cases?* The chapter has specified the key assumptions of the process methodology, the research design, empirical setting, as well as detailing the methods employed for the generation and analysis of the sequence data, such as data collection, event colligation, phasic analysis and statistical boot-strapping. It has expounded in more detail the three phasic techniques applied: optimal matching, direction inspection and frequency analysis. The following chapter reports the results of the case comparisons using phasic analysis.

5 PHASIC ANALYSIS RESULTS

This chapter reports the results of the comparison of the six empirical cases using phasic analysis. The objective of this chapter is to address the third research question: *do ecosystem emergence processes exhibit similarities across cases?* To do so this chapter empirically analyses the emergence sequences of the six cases to discern if there are any similarities in their emergence sequences. Figure 2 below details the three different phasic analyses that are conducted.

Figure 2 – Chapter outline of analyses conducted



The first phasic analysis compares the complete sequences of each of the six cases using optimal matching. This analysis provides insight into how similar the overall ecosystem emergence processes are for each case. The second phasic analysis uses direct inspection, frequency analysis and optimal matching to investigate the existence of sub-sequences ('phases') of ecosystem emergence within each of the six empirical cases. Here the goal is to determine if there are sub-sequences within each case. In the third phase I compare each of the individual sub-sequences (as identified in the second comparison) of the six cases using optimal matching. The purpose of this comparison is to determine if there are any similarities (or differences) in the individual sub-sequences across cases.

5.1 Analysis I: Complete sequence comparison

This first analysis considers the similarity of the complete event sequences for all six cases, using optimal matching to determine the pairwise 'distance' of each case, as determined by the similarity of their complete event sequences.

Fifteen case-pair distances are calculated, one for each pair: Amazon-eBay; Amazon-Facebook; Amazon-Google, and so on. To create the mean distance for each case-pair to which the actual case-pair distance could be compared (see Section 4.11.1 in Chapter 4 for rationale and details of the following technique), 10,000 random event sequences for each case were created, using the same frequency of codes as in the actual event sequence. By using the same frequency of codes, each of these

randomisations is a different sequence of events in the complete event sequence – in practice, simply a different order in which the underlying activities occurred. This resulted in 60,000 random event sequences in total – 10,000 for each case. The optimal matching procedure was then run for each random event sequence for each case-pair, so that a database of 150,000 distances was created – 10,000 for each case-pair. As there was a range of distances for each case-pair, the mean and standard deviation were calculated. Following this procedure there were 15 mean distances and 15 standard deviations – one each for each case-pair. The mean distance for each case-pair (hereafter called the ‘random mean’) represents the average distance of 10,000 pairwise distances calculated.

The random mean for a particular case-pair thus provides a measure against which the actual event sequence for a case-pair can be compared. By subtracting the random mean from the actual distance, a measure of the variance from the random mean can be calculated. Thus, a positive variance represents an increased distance and a negative variance represents a lesser distance of the actual distance to the random mean of 10,000 pair-wise random sequences calculated from the same code frequency. These results are detailed in Table 16 below. The mean distance and standard deviations for each case-pair are in Appendix B.

Table 16 – Complete sequence optimal matching cross-case comparison

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	0.019 + (0.643)	0.000 (0.000)				
Facebook	0.029 ** (0.691)	0.013 (0.789)	0.000 (0.000)			
Google	0.044 *** (0.719)	0.037 ** (0.760)	0.036 ** (0.700)	0.000 (0.000)		
Salesforce	0.008 (0.767)	0.043 *** (0.676)	0.022 * (0.778)	0.030 ** (0.815)	0.000 (0.000)	
Wikipedia	0.108 *** (0.855)	0.051 *** (0.717)	0.074 *** (0.738)	0.082 *** (0.785)	0.069 *** (0.768)	0.000 (0.000)

Note: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001; numbers in parentheses are actual distances.

The results indicate that the majority of the case-pairs are significantly different to each other, although with differing levels of significance. Amazon-Google,¹⁰ eBay-Salesforce, Amazon-Wikipedia, eBay-Wikipedia, Facebook-Wikipedia, Google-Wikipedia and Salesforce-Wikipedia are the most significantly different to each other (p<0.001). This means that the distance of the actual event sequences in each case-pair is greater than 99.9% of the 10,000 pairwise distances calculated from their randomly generated sequences. Amazon-Facebook, eBay-Google, eBay-Facebook, Facebook-Google and Google-Salesforce are also significantly different (p<0.01). This means that the distance of the

¹⁰ For clarity and consistency, all case comparisons have the following format *vertical case name* hyphen *horizontal case name*. For example, the comparison between Salesforce and Wikipedia will be denoted Salesforce-Wikipedia.

actual event sequences in each case-pair is greater than 99% of the 10,000 pairwise distances calculated from their randomly generated sequences. Facebook-Salesforce is also almost significantly different, although less so than the others ($p < 0.05$), with Amazon-eBay less so ($p < 0.1$). This means that the distance of the actual event sequences between Salesforce and Google is greater than 95%, and Amazon and eBay greater than 90%, of the 10,000 pairwise distances calculated from their randomly generated sequences. The remaining case-pairs, eBay-Facebook and Amazon-Salesforce are not significantly different to each other. This means that their distances are similar to their respective random means. As the differences are positive, positive this suggests that the event sequence of each case-pair tends towards being different to each other.

These results overwhelmingly suggest that the emergence sequences of the six cases are not similar to one another. In fact they are significantly *dissimilar* to each other. This is an interesting finding. Put another way, a significant positive variance from a random mean indicates that each case in a comparison has a sequence of events that, when compared, are more different than a comparison of 10,000 pair-wise iterations of the same code frequency. This implies that each case has a pattern of events that is non-random in comparison to the pattern of events of the other cases. For those distances which are not significant, this implies that the pattern of events for each case in a comparison is no different than any two random sequences of the same code frequency. As a whole, these results suggest that there are no commonalities in the emergence sequences of the six cases.

The finding that the emergence process of each ecosystem is dissimilar has support within the institutional formation literature. For instance, theorists have noted that the institutional logics and power relationships within a field are unique and that they emerge uniquely (Fligstein, 2001; Scott, 2008). Schilling (2009) suggests that there are multiple pathways to the emergence of a dominant design when the firm is able to adjust the level of ‘openness’ of the technological design. Others have noted that firm level capabilities, such as financial resource acquisition, alliance formation, personnel recruitment, and product design, emerge in different ways although appear similar once created (Eisenhardt & Martin, 2000).

Potentially some of the differences in emergence sequences may be explained through the unique history of each case. For instance, the significant difference between the emergence sequences of Salesforce and eBay could be explained through their very different histories, with eBay launching over a weekend and growing organically, while Salesforce was extensively planned and grew after launch through active and aggressive marketing. More granularly, the non-significant variances of eBay-Facebook and Amazon-Salesforce pairs may reflect some of the similar challenges that these ecosystems faced, and hence some internal patterns of events that are more similar. For example, both Facebook and eBay experienced conflict within their ecosystem over policy changes, and Salesforce and Amazon both undertook extensive marketing and societal outreach in order legitimise their respective ecosystems.

However, more likely, the dissimilarity of each event sequence can be explained through a consideration of the characteristics of each case. For instance, it is not surprising that Wikipedia is significantly different to the other cases, given its non-profit ethos that differed from the other, for-profit ecosystems. The governance of Wikipedia was handed over to ecosystem participants from the beginning, and it relied on donations for its income rather than sales. This would lead one to reasonably expect that Wikipedia's event sequence would be significantly different from that of the other cases due to its distinctive value logic. This heterogeneity in the logics of value co-creation was already embedded in the research design: Amazon is an online retailer, eBay an online auction service, Facebook a social networking service, Google a search engine, Salesforce an online customer relationship management service, and Wikipedia an open source encyclopaedia. Together these ecosystems collectively exemplify the main logics of value co-creation in digital service contexts and are hoped to support a degree of generalisability in my analysis results.

The model of value creation in e-business by Amit and Zott (2001) has the potential to illuminate the level of heterogeneity across the logics of value co-creation of each case in my dataset. Although Amit and Zott (2001) consider value creation at the firm level, they note that their four factor model of value creation – efficiency, complementarity, lock-in and efficiency – applies to the total value created in e-business “regardless of whether it is the firm, the customer, or any other participant in the transaction who appropriates that value” (p. 503). In their model efficiency refers to the cost reductions obtained through digital provision of a service, complementarity refers to the revenue increase through the alignment of ecosystem participants, lock-in refers to the propensity of ecosystem participants to remain in the ecosystem, and novelty refers to the development of a new way of doing business. Table 17 below details how each case differs across these four factors, with an additional factor of mode of value appropriation of the hub-firm.

There is a range of differing efficiency benefits that each ecosystem delivers. Both Amazon and eBay offer similar transaction efficiency benefits through the reduction of search costs and having a wide selection range; however each varies on how they appropriate value – Amazon makes a margin on the sale and shipping of physical products and eBay a commission through brokerage. In contrast, Facebook, Google and Wikipedia, in addition to reducing search costs, also reduce information asymmetry, albeit through different mechanisms. Whereas Facebook and Google appropriate value through advertising, Wikipedia offers their service for free. In a further contrast, Salesforce creates transaction efficiency benefits through simplicity and speed, appropriating value through a subscription model. Each case also has differing complementary asset providers beyond the common complementary assets required for a digital business (servers, software, backup systems, engineers and internet connections).

Table 17 – Case logics of value co-creation heterogeneity

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Efficiency	• Search cost reductions • Wide selection range • Scale economies	• Search cost reductions • Wide selection range	• Search cost reductions • Reduced information asymmetry	• Search cost reductions • Reduced information asymmetry	• Simplicity • Speed • Scale economies	• Search cost reductions • Reduced information asymmetry
Complementarity	• Book (and music) wholesales • Shippers	• Complementary software provision • User base	• Advertisers • Complementary software provision • User base	• Advertisers • User base	• Complementary software provision	• Complementary software provision • User base
Lock-in	• Switching costs, such as loyalty and customisation	• Network effects • Trust	• Network effects	• Network effects	• Switching costs, such as customisation and trust	• Loyalty
Novelty	• Online retailing	• Online brokerage	• Social network supported advertising	• Search supported advertising	• Software as a Service (now known as 'cloud')	• Open and free group authoring
Appropriation	• Margin	• Commission	• Pay-per-click • Cost-per-impression	• Pay-per-click • Cost-per-impression	• Subscription	• None

Amazon relied upon book (and later music) wholesalers and shippers, eBay and Wikipedia relied upon their user base and providers of complementary software, Facebook and Google upon advertisers and users, and Salesforce upon software developers who provided extensions. Similarly, each case exhibits different lock-in mechanisms, with eBay, Facebook, and Google relying on positive network effects and Amazon and Salesforce relying on high switching costs created through customisation, particularly by a personalisation engine and customer history and operational and technological dependencies, respectively. In contrast, Wikipedia employs few lock-in mechanisms beyond user loyalty.

Together, the heterogeneity in these logics of value co-creation suggests differing processes of value co-creation. For instance, the processes involved in online brokerage are different to those of subscription and those that are offered for free. Similarly, the processes involved in the management of complementary asset providers such as shippers is different to managing advertisers, which is different again to managing ecosystem participants who are deeply involved in the governance of the service. More specifically, a logic of value co-creation that has open ecosystem governance is more likely to have a higher frequency dialectical processes of conflict and resolution as rules are debated and agreed (such as Wikipedia and to a lesser extent eBay), than a logic of value co-creation that has a command and control process of governance (such as Google and Salesforce). This is not to say that dialectical processes would not occur in the latter examples – the imposition of rules that participants do not agree with will also result in conflict and resolution – however these processes are likely to be less frequent.

By extension, this implies that the emergence processes of each ecosystem would also be different as these value co-creation processes are established. For instance, the emergence processes required to achieve critical mass for positive network effects to create lock-in, are different to those required to create lock-in through switching costs based on customisation or loyalty. Similarly the

emergence processes required to co-opt software developers into an ecosystem are different to those required to ensure supply of physical goods.

Summarising, the optimal matching analysis of the complete emergence sequences of the six cases suggests that the emergence sequence of each ecosystem are dissimilar. This finding has support within the institutional formation literature, and can potentially be explained through idiosyncratic logics of value co-creation of each case, as well as through the unique challenges each experienced during emergence.

5.2 Analysis II: Three phases of emergence

This second analysis considers whether there are sub-sequences (here called ‘phases’) within each case. Although the complete sequence analysis above indicates that the complete event sequences of each case are significantly different, sub-sequences within each complete event sequences are possible, as each case may have experienced the same sub-sequences, just in different ways.

To investigate whether there are sub-sequences within the complete event sequences, three phasic analyses are applied. The first, direct inspection, is retroductive, combining both inductive and deductive approaches (Poole et al., 2000). Insights and models from existing theories of ecosystem and organisational field emergence are applied to the case narratives and then adjusted in view of what is workable and informative. The analysis of each case narrative is enhanced through descriptive statistics, including a moving average frequency analysis and code frequencies for each case. (See Appendix C for the individual case narratives, and Appendix D for the results of the moving average frequency analysis.) This retroductive approach provides a theoretical basis for the identification of phases and is consistent with the observation of Poole et al. (2000) that initial theoretical models can be used as ‘sensitising constructs’ for conducting exploratory research when the study of change processes are at an embryonic stage.

The second analysis, code frequency variance analysis, is a statistical technique that provides a measure of whether a particular code is more or less prevalent in a phase than the overall occurrence of that code in the complete event sequence. The goal of this analysis is to statistically validate the existence of each phase. Substantial variance of code frequencies within the overall event sequence would be indicative of the existence of distinct phases within the sequence. Taking the phases identified by direct inspection, the variance of each code in a phase is compared to their overall frequency in the event sequence. A positive variance implies that a code is more frequent, and a negative variance that a code is less frequent, than their occurrence in the complete event sequence. A first code frequency analysis considers the code variances within a phase, bootstrapping statistical significance so as to determine the significance of the amount of a variance. The intuition here is that similarities of variances of code frequencies within a phase across cases provides statistical support for the phases. A second code frequency analysis analyses the changes in these variances across phases. The intuition here is that

similarities in changes of code variances across phases provides statistical support for the existence of the three phases.

The third analysis compares the (dis)similarity of a phase with other phases within a case, utilising optimal matching to determine the pairwise ‘distance’ between each phase, as determined by the similarity of the event sequence within each phase. This analysis provides a validity check on the phase identification by determining if the phases in each case are different or similar to each other.

First presented below are the results of the direct inspection analysis. Three phases are proposed. Theoretically, these three phases are derived through a synthesis of the ecosystem, dominant design, social movement theory and institutional entrepreneurship literatures. For instance, Moore (1993) has proposed a four stage model of the ecosystem lifecycle – birth, expansion, leadership and renewal – of which the first three are relevant when considering the emergence of an ecosystem. Suarez (2004) has suggested a five phase model of dominance design emergence - R&D build-up, technical feasibility, creating the market, decisive battle and post dominance – all of which are salient to understanding the emergence of an ecosystem. Hargrave and Van De Ven (2006) have suggested three phases of institutional technological innovation – emergence, development and implementation – as well as identifying the underlying process motors in each. Within social movement theory, Davis and McAdam (2000) have proposed a linear model which emphasises the identification of an opportunity, the gathering of resources to enable change, followed by collective action. From the institutional entrepreneurship literature, Greenwood et al. (2002) have proposed a six stage model – precipitating jolts, deinstitutionalisation, pre-institutionalisation, theorisation, diffusion and re-institutionalisation – which is similar to the five stage model of Hinings et al. (2004).

A synthesis of these emergence models suggests a first phase where there is the early technological development (Hargrave & Van De Ven, 2006; Moore, 1993; Suarez, 2004) as well as activities, such as sense-making and rule-making, that establish the viability of the ecosystem and digital service (Greenwood et al., 2002; Suarez, 2004). There is also resource gathering, including the establishment of an organisation structure for the personnel involved (Davis & McAdam, 2000) and the co-option of complementary asset providers and suppliers (Davis & McAdam, 2000; Moore, 1993; Suarez, 2004). As the ecosystem is nascent there is little competitor activity or wider interest from society (Hargrave & Van De Ven, 2006; Moore, 1993; Suarez, 2004). This phase corresponds to the initial slow growth found by Agarwal and Bayus (2002) in the early stages of market evolution and sales take-off for new products.

A second phase is also suggested through the synthesis of these models. In this phase the ecosystem begins to grow rapidly (Agarwal & Bayus, 2002; Hargrave & Van De Ven, 2006; Moore, 1993; Suarez, 2004), as an installed base is created and network effects drive ecosystem growth (Suarez, 2004). Strategic manoeuvring such as marketing and alliancing activity is undertaken to drive adoption,

as well as to provide the resources to scale up the ecosystem (Moore, 1993; Suarez, 2004). Increasing participant adoption, and marketing and discourse in wider society begins to legitimate the ecosystem and hub firm, complemented by processes of theorisation and dissemination (Greenwood et al., 2002; Hargrave & Van De Ven, 2006). Competitive activity is at its greatest here, as challengers also attempt to seize the opportunity (Agarwal & Bayus, 2002; Davis & McAdam, 2000; Hargrave & Van De Ven, 2006; Moore, 1993; Suarez, 2004).

A further phase is also suggested, where the ecosystem is now dominant and the competitive battles have been won (Greenwood et al., 2002; Moore, 1993; Suarez, 2004). Secure in the power structure it has created (Hinings et al., 2004) and its install base (Suarez, 2004), the ecosystem and hub firm have gained socio-political and cognitive legitimacy (Greenwood et al., 2002; Hinings et al., 2004). The focus of activity moves from growth to control as activities move to interest satisfaction and value appropriation (Hinings et al., 2004; Moore, 1993; Suarez, 2004).

Taken together, these models of ecosystem, organisational field and institutional formation and change suggest that there are three phases of emergence. Phase I consists of the initial idea and digital service development, resource gathering and early operation. In Phase II the ecosystem begins to grow rapidly, characterised by increasing numbers of participants (driven by positive network effects), aggressive marketing, much press and societal interest, as well as competitor activity. In Phase III the focus of activity moves from expansion to control and value appropriation.

The characteristics of each phase are now discussed in three subsequent sub-sections in the context of existing ecosystem and institutional formation theories, including dominant design, social movement theory and institutional entrepreneurship, as well as the case narratives. Appendix F provides an overview of each phase in context with the cases. This emphasises the theoretical support for the identification of each phase. For Phase II and Phase III, the key transition events for each case are also provided, providing further evidence of the existence of each phase.

The direct inspection analysis is followed by the code frequency variance analysis, providing statistical support for the existence of each phase. The existence of each phase within each case is then validated through optimal matching analysis.

5.2.1 Phase I - Initiation

Pre-existing environmental conditions meant that the emergence of an ecosystem was possible in each of the six cases (c.f. Hoffman, 1999). For Amazon, eBay, Salesforce and Wikipedia, the internet, specifically technology and increasing broadband provision, provided the 'jolt' that enabled the founders to successfully launch an ecosystem (Battilana et al., 2009 ; Greenwood et al., 2002; Hinings et al., 2004). For Facebook and Google, the poor performance of existing services (Friendster and Yahoo! respectively) led to efficiency mismatches that enabled the conditions for both services to launch (Seo & Creed, 2002). Attributes of the founders of each ecosystem, such as their network

location and embeddedness, also suggested readiness for emergence (Battilana et al., 2009; Greenwood & Suddaby, 2006). For each case the founders were technically minded and cognisant of the opportunities that the internet provided. These conditions enabled the founders to identify new opportunities, gather resources, and introduce technically viable innovations (Greenwood et al., 2002; Hinings et al., 2004).

In this stage the early ecosystem participants cooperatively work together to co-opt key customers and partners, and define the value logic (Davis & McAdam, 2000; Moore, 1993; Suarez, 2004). The cooperation of key customers and partners was more important for some cases than others. For example, Google's strong relationship with Search Engine Watch and their constant attention to the maintenance of that relationship ensured a source of legitimacy. Similarly Amazon's good relationship with the major book wholesalers ensured the success of the nascent digital service.

Each case cooperatively developed their respective logics of value co-creation with their nascent ecosystems. Each digital service was first developed in isolation, and access (and by implication membership) was then progressively released to beta testers (normally family and friends) until the digital service was released to general access. An exception here is eBay which opened up immediately to general access. However, uniquely among the other cases where there was significant activity within the ecosystem from the beginning, eBay was seeded and tested by the founder himself before activity started in earnest within the ecosystem. In all cases, once there were a small number of active participants within an ecosystem, the rich interaction between beta testers and the hub firm resulted in the co-production of the functionality of the digital service, and the definition of the logics that drove co-creation of value. This intense interaction addressed the technical potentialities for each ecosystem, as the feasibility of the digital service was de facto tested by early participants (Suarez, 2004). For those cases that faced (some little) competition during this phase, such as eBay, Facebook and Wikipedia, each competitor proposed a differing service and ecosystem design, leading to design competition (Hariharan & Prahalad, 1991). In parallel with this, a set of regulative mechanisms was being created that enabled ecosystem emergence (Hoffman, 1999). For instance, very early on in their operation Amazon posted a 'Bill of Rights' for shoppers, and eBay published its 'Ethical Guidelines'. Similarly, Wikipedia participants were releasing a series of policies that enabled the heterogeneous users to be able to create an encyclopaedia. These regulations led to increasing returns so that participation in the ecosystem became viable, highlighting the role of incentives as a motivating force in ecosystem emergence (Hoffman, 1999; Scott, 2008).

Very early on in some ecosystems these early regulative institutions were complemented by the emergence of a normative institution (as first noted by Hoffman, 1999). As examples, on both eBay and Wikipedia, which had handed over much governance to ecosystem participants, particular behaviours of ecosystem participants were soon viewed as either constructive or to be discouraged. In the case of

Wikipedia for instance, the behaviour of ‘trolls’¹¹ was actively discouraged. On Facebook ecosystem participants very quickly developed idiosyncratic behaviours that gained normative significance. These were often beyond the regulative (and technical) control of the service, such as ‘friending competitions’ and the use of a photo to broadcast political affiliation. For those ecosystems which launched early in the history of the Internet, such as Amazon and eBay, much of this sense-making was as much cognitive as technical, as the potential of the internet, and hence the potential capabilities of the service, was not well understood at this time.

Summarising, based upon the insights gained from theory and complemented through the particular histories of each case, Phase I consists of the initial idea and digital service development, resource gathering and early operation. With pre-existing conditions providing a fertile setting for the digital services to emerge, and following the progressive opening of the service to wider groups of participants, intense sense-making resulted in a set of technological attributes for the digital service and agreed-upon regulative, normative, and cognitive structures. Together these shaped the subsequent ecosystem emergence and created the necessary conditions for collective action (Hensmans, 2003; Hoffman, 1999).

5.2.2 Phase II - Momentum

In Phase II the ecosystem begins to grow rapidly, due the improving quality of the digital service and competitors’ entry (Agarwal & Bayus, 2002). Understanding of the ecosystem spreads rapidly as there is diffusion and dissemination of the value logic to potential participants (Greenwood et al., 2002; Hinings et al., 2004; Tolbert & Zucker, 1996). The accumulation of ecosystem participants generates a momentum that harnesses their distributed inputs that drives further adoption ecosystem through the ongoing regulation, evaluation, design, production and use of the digital service (Garud & Karnoe, 2003).

The case narratives (see Appendix C) provide insight into the key transition events that initiated this phase. For Amazon, Phase II commenced in late 1995 with the founder raising approximately \$1 million from local Seattle investors. Following the investment round, the strategy became ‘Get Big Fast’,¹² an explicit change from incremental organic growth to market domination, and business development staff were hired, an advertising agency brought on board, and an aggressive advertising campaign launched. For eBay, Phase II commenced at the beginning of 1997 with increasing numbers of participants, with over 330,000 completed auctions in the first quarter alone, giving rise to the moniker ‘the Great eBay Flood’.¹³ As a result, the service was unable to scale to meet demand and was continually crashing; despite this the number of participants continued to pour in. For Facebook, Phase

¹¹ A person who sows discord on the Internet by starting arguments or upsetting people (Wikipedia, retrieved on 20/07/2013).

¹² Brandt (2011), p. 95.

¹³ Cohen (2002), p. 55.

II started with rapid growth in users after the summer 2004 college recess, aided by an automated process to add universities, as well as a VC investment round. To outflank emerging competitors, a 'surround' strategy was introduced, consisting of opening up access to the service to students at all the local universities where another social network had begun to take root. For Google, Phase II began with VC funding in June 1999, which resulted in extensive news coverage. This fuelled user adoption as the 'Google' brand became familiar to a wider audience beyond the core group of devotees. For Salesforce, Phase II commenced in February 2000 with high profile guerrilla marketing at the main competitor's annual conference, as well as their own uniquely branded launch party. Together these led to a large influx of customer interest and a media firestorm, further inflamed when Siebel responded publically. For Wikipedia, Phase II commenced with escalating main stream media attention (such as the New York Times), rapidly increasing the number of contributors and the arrival of specialised tools and services to assist in editing.

During this stage the ecosystem opens up a large market by scaling up with both suppliers and partners to achieve maximum market coverage (Moore, 1993). Put differently, the nascent market that was created in the first phase is rapidly expanded in this phase through coalitions and outreach such as marketing (Suarez, 2004). In each case during this phase increasing network effects drove market size, to such an extent that eBay, Salesforce and Wikipedia experienced serious technological failures due to the overloading of their service. In these three cases the service outage and the resulting furore within the ecosystem almost destroyed confidence in (and the legitimacy of) the emerging ecosystem. Although Amazon, Facebook and Google also experienced service failures due to the explosive growth each was experiencing, in these cases they did not have the same effect on the legitimacy of the ecosystem. Of particular note here is Facebook which had an explicit policy of slowing growth through the limited opening of the service to new ecosystem participants to ensure service stability.

In all cases there was ongoing technical development of the service. However, the main functional dimensions of the service had already been agreed by this time and were being implemented. Instead, as suggested by social movement theory and institutional entrepreneurship theory, there was increasing introduction of regulative mechanisms to coordinate activity, as well as rising participant commitments as normative aspects developed (Hoffman, 1999; Scott, 2008). In addition, cognitive mechanisms of coordination also began to emerge, through discourse between participants and the hub firm, receipt of awards from commentators, as well as high levels of press and societal interest that established the ecosystem and digital service in society. These provided validation and objectification of the ecosystem and service not only to the participants, but also for wider society (Lampel & Meyer, 2008; Rao, 1994; Scott, 2008). Processes of theorisation, legitimation and dissemination led to the commitment of the participants, as well as to the establishment of a power structure (Greenwood et al., 2002; Hinings et al., 2004). However these processes were contested (c.f. Benford & Snow, 2000). For eBay and Wikipedia, where the governance of the ecosystem had been handed over to participants, any

change in regulative or normative structures was often met with a large push back from the ecosystem participants. For those cases where governance remained more under the control of the hub firm, the nature of the contestation varied. For instance, often the digital service's own tools were used against it when ecosystem participants protested. In the case of Facebook, technological design changes to the service sometimes led to protests which were collectively organised through service functionality, such as groups. For those cases that remained tightly controlled, such as Google and Salesforce, the contestation often originated outside the ecosystem, but implicitly supported by ecosystem participants.

This process of socio-cognitive construction was aided by the aggressive use of marketing and public relations, and technical tools which further raised the profile of the ecosystems. In particular, as each ecosystem was finding themselves in a favourable position with respect to the emerging systemic power relations, they acted to mobilise a bias in their favour to conquer the field (Hensmans, 2003). Much of this framing activity (Benford & Snow, 2000; Snow & McAdam, 2000) was undertaken with the goal of actor mobilisation and collective action (Battilana et al., 2009; Seo & Creed, 2002). For instance, both Amazon and eBay, with their more consumer oriented ecosystems, focused marketing attention on advertising that corresponded to festive dates within the consumer calendar (such as Fathers' Day and the December holiday season). Google celebrated festive dates through its Doodles. In doing so they were framing themselves as part of the wider US institutional and societal environment. Amazon and Google enabled their service to be deployed onto third party websites, thus not only driving more traffic to their ecosystems, but also advertising the service that they were offering to potential participants who had not yet discovered their service. In this manner they emphasised their technical efficiency aspects. Salesforce, with its business to business orientation, undertook aggressive guerrilla marketing against the market dominant players, such as Seibel, emphasising its 'otherness' (Snow & Benford, 1988; Snow et al., 1986). For Facebook, Google and Wikipedia, marketing and public relations activity focused not so much on driving participants to the site but mitigating scandals, such as privacy concerns, that periodically erupted (Rao et al., 2000).

This phase is also characterised by the main competitive battles as the ecosystem strives to dominate its challengers (Davis & McAdam, 2000; Moore, 1993; Suarez, 2004). Although much of the dominant design literature emphasises that this competitive battle is for ownership of the technological standards that underpin a service (Hariharan & Prahalad, 1991), in the example of the cases at hand this was not such a concern as the main internet standards had been established. Instead, the main competitive thrust was to drive participant adoption so as to reach a tipping point and allow network effects to largely guarantee dominance; this was particularly so for those cases – eBay, Facebook, Google and Wikipedia – that relied on network effects for their lock-in. Thus much of the framing and market outreach activities were directed towards participant adoption. In addition to the actions of the hub firm, collectively the ecosystem participants also began to contest the domain vis-à-vis the competition (Davis & McAdam, 2000). For example, when Amazon received a poor review for the

service that it offered, the offending media outlet was bombarded with complaints, and a wider recognition of the value of the digital service emerged from the independent (un-orchestrated) actions of the ecosystem participants. Similarly in the case of eBay, when a competitor placed a stooge onto the eBay boards to promote a competitive digital auction service, ecosystem members responded aggressively to remove it. For Salesforce, the success of their roadshows generated such high levels of goodwill towards the digital service and ecosystem that individual participants, alone or collectively, would evangelise the ecosystem independently of any guidance from Salesforce themselves. Indeed this activity was so prevalent that marketing activities were established to help support it. Similarly for Wikipedia, individuals and groups of individuals would collectively act to maintain the coherence and stability of the service during large influxes of new ecosystem participants.

Summarising, based upon the insights gained from theory and complemented through the particular histories of each case, in Phase II the ecosystem begins to grow rapidly, driven by increasing numbers of participants (drive by positive network effects), aggressive marketing, much press and societal interest, as well as competitor activity. The market takes-off, and understanding of the ecosystem spreads rapidly as there is diffusion and dissemination of its value logic.

5.2.3 Phase III - Control

In Phase III, the ecosystem has now emerged and has socio-political and cognitive legitimacy (Greenwood et al., 2002; Hinings et al., 2004). Power relations stabilise and become more or less taken for granted and the hub firm is freer to act (Hensmans, 2003). Throughout this period regulative, normative and cognitive structures continue to develop, although these tend to become self-reinforcing, enhancing the dominant position of the hub firm in the ecosystem and the ecosystem itself (DiMaggio & Powell, 1983; Hoffman, 1999). This powerful position is reinforced through the installed base and network effects working to their advantage, assuring market dominance (Suarez, 2004). With the hub firm in such a powerful position, the nature of competition shifts from market momentum to competition for profits (Hariharan & Prahalad, 1991). This reflects the reality that value appropriation processes would not be able to occur unless the hub firm was in a powerful position vis-à-vis the other ecosystem participants. With the ecosystem established as the undisputed leader focus now shifts to closer control of the activities of ecosystem participants and value appropriation.

The case narratives (see Appendix C) provide insight into the transition events that initiated this phase, and which further support the identification of this phase. For Amazon, already the undoubted market leader, Phase III began in early 2000 with an explicit shift to profitability and value appropriation. Staff were made redundant, unprofitable lines of business closed down, and functions and programs of the digital service changed to drive profitability. For eBay, Phase III was ushered in mid-2000 with the resolution of the Million Auction March, a (successful) participant protest to move one million transactions to competing auction services. Resolution meant that ecosystem participants now recognised eBay's tensions to operate as a listed company, so conflict between the ecosystem and

hub firm declined. As a consequence, the functionality of the digital service was enhanced with the goal to increase revenues, such as the introduction of 'Buy-It-Now'. In addition, wider society and the press now viewed eBay as a neutral venue. For Facebook, Phase III began in 2009 as control was finally consolidated over the apps available through the platform, as well as formal acknowledgement of the wide ranging privacy concerns. A particular action here was opening up the terms of use to a vote for the users. In addition, internally operations had coalesced around a particular logic of value co-creation, and advertising and other value extraction techniques were now mature and continually tweaked to enhance revenue. For Google, Phase III began in 2004 as the service became the undisputed leader and the remaining competition (such as Microsoft and Yahoo!) were unable to maintain parity. Socially the service was now embedded in society, although there was an increasing wariness as to privacy. The shift to value appropriation was underlined with the winning of a court case which allowed trademarked terms to be used as keywords and a subsequent change in advertising policies further entrenched the focus on value appropriation. For Salesforce, Phase III began in 2006 with the rectification of the technical issues that had caused serious service delivery, and launch of trust.salesforce.com, a service that publically detailed the status of the service delivery. Press interest began to wane as the software as a service model was accepted as viable. In addition, there was a shift to value appropriation with the hiring of staff to focus on revenue collection, and release of monetisation strategy documents. For Wikipedia, Phase III commenced at the end of 2005 with the media crisis of the Seigenthaler incident, who wrote an op-ed piece in USA Today, entitled 'A False Wikipedia Biography'. This crisis led to an imposition of tighter editorial control, which in contrast to previous attempts, was welcomed by the ecosystem tired of the previous scandals and edit wars. In addition the Wikipedia Foundation formalised its fundraising process and technologically the service was stabilised.

As well as the importance of maintaining strong bargaining power in relation to other participants in the ecosystem, the hub firm needs to provide a compelling vision for the future (Moore, 1993). In this manner the hub firm in this phase corresponds to the 'platform leader' of Gawer and Cusumano (2002) and the 'keystone' of Iansiti and Levien (2004a). For instance, Gawer and Henderson (2007) and Gawer and Phillips (forthcoming) emphasise that a hub firm must use a number of mechanisms at a either firm level or ecosystem level in order to ensure ecosystem dominance. At the firm level, such mechanisms include organisational structure and processes that signal that the future viability of the ecosystem and the intention of the hub firm. As examples, Amazon underwent a wide ranging restructure to enable profitability; eBay instigated specialist teams to signal its intentions to collaborate with the ecosystem; and Google appointed senior executives to global communications and outreach roles. Other mechanisms involve discourse, such as explicitly framing a strategy for the future. As examples, eBay publically defended its actions regarding antiques auctions in the face of criticism and outlined its future strategy for the first time, Salesforce publically announced its monetisation strategy, and Wikipedia issued a series of press releases detailing how the service was to be run into the future.

Taken together, these strategies highlight how a dominant hub firm in an ecosystem can maintain its position within the ecosystem, and also signal its viability and success beyond the ecosystem.

Summarising, based upon the insights gained from theory and complemented through the particular histories of each case, in Phase III, the focus of activity moves from expansion to control and value appropriation. Power relations stabilise and become more or less taken for granted, technological change is driven by maintenance and value extraction reasons. Regulative, normative and cognitive structures continue to develop, becoming self-reinforcing, enhancing the dominant position of the hub firm in the ecosystem and the ecosystem itself, and the ability of the hub firm to control and extract value.

5.2.4 Code frequency variance analysis

Above three phases have been proposed from a synthesis of the ecosystem, dominant design, social movement and institutional entrepreneurship literatures, and retroductively analysed in the context of the case narratives. The goal of this section is to statistically confirm the existence of the three phases. To do so, this section presents the results of the code frequency variance analysis, where the occurrences of different types of event codes (resource, technological, institutional and contextual) are analysed in the context of these three phases.

There are two types of code variance analysis within this section. Both analyses consider the variance of a code in each phase as compared to the overall frequency of that code in the entire event sequence for that case. For example, for a particular case, if the overall occurrence of technological events is 25% and the frequency of technological events is 30% in a phase, then the 5% positive variance suggests that technological events are more prevalent in that phase. This approach is applied to the frequency of codes in all three phases. Caution should be exercised in attempting to extract too much insight from the frequency analysis results for Phase III. The results in Phase III are right censored in the sense that there are continuing to control and appropriation activities past the end date which are not included in the analysis.

The first code frequency variance analysis compares the code variance of each case within each phase, and considers the particular example mentioned above. However, rather than calculate this frequency direct from the data, this analysis bootstraps statistical significance into the code variances (see Section 4.11.3 in Chapter 4 for a more detailed overview of this technique). To do so, the complete event sequence for each case is randomised 10,000 times, resulting in 60,000 random complete event sequences. For each random sequence in each case, the three phases are extracted. This results in 180,000 phase event sequences, 10,000 for each phase (3), for each case (6). The code frequency is then calculated for each event sequence, resulting in 720,000 code frequencies, 10,000 for each code (4), for each phase (3), for each case (6). As there is a range of frequencies for each code, the mean frequency and standard deviation are calculated for each code for each case. This mean frequency is identical (if

not very close) to the code frequency for that phase if it had been calculated directly from the code counts on the actual event sequences (Appendix E outlines the code frequencies calculated from actual code counts as a comparison). The randomly generated mean code frequency is then subtracted from the actual code frequency to provide a variance; the standard deviation enables a calculation of the significance of the variance. A positive or a negative variance signifies a greater or lesser occurrence of a code in that particular phase.

Table 18 below presents the frequency analysis of Phase I, detailing the variance of each code frequency from the randomly generated mean code frequency for each of the six cases. Appendix B contains the means and standard deviations of the randomly generated code frequencies.

Table 18 – Phase I cross case comparison code frequency variance analysis

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Resource	2.158 (29.76%)	-7.823 (17.54%)	5.749 (24.10%)	1.275 (23.75%)	24.728 *** (40.00%)	-1.402 (5.62%)
Technology	14.286 ** (39.29%)	8.069 + (26.32%)	0.334 (34.94%)	7.946 (41.25%)	6.384 (18.33%)	0.749 (30.34%)
Institutional	-8.094 + (22.62%)	9.582 (52.63%)	2.956 (26.51%)	-8.894 * (13.75%)	-15.925 * (36.67%)	14.562 ** (55.06%)
Context	-8.350 * (8.33%)	-9.828 * (3.51%)	-9.039 * (14.46%)	-0.326 (21.25%)	-15.188 ** (5.00%)	-13.909 *** (8.99%)

Note: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
Numbers in parentheses are actual frequency; these may not sum to 100% due to rounding.

Phase I code frequency variance analysis indicates that there are similarities in the frequencies of the technology and context codes for each case in this phase. In particular, there is a decreased occurrence of context events and increased frequency of technological events. The increased occurrence of resource events and decreased occurrence of context events is emphasised by the significant variance from the mean frequency for some cases. For instance, both Salesforce and Wikipedia have frequencies of context events that are significantly lower than the overall frequency ($p < 0.01$). This means that the frequency of their context events is lower than 99% of the context frequencies calculated from the 10,000 random event sequences for this phase for each case. Similarly, Amazon, eBay, and Facebook also have frequencies of context events that are significantly lower than the overall frequency ($p < 0.05$). The increased occurrence of technology events is also emphasised through significant variance from the mean frequency, with both Amazon and eBay have significantly higher occurrences ($p < 0.01$ and $p < 0.1$ respectively).

There are higher frequencies of resource events compared to the overall frequency of resource event for all cases except for eBay and Wikipedia. All early stage businesses need to acquire resources (Gilbert, McDougall, & Audretsch, 2006), emphasised through the significantly higher level of resource events ($p < 0.001$) of Salesforce which, operating as a business-to-business service, was resourced as a major enterprise from the very beginning. In contrast eBay and Wikipedia both have lower frequencies of resource events than their overall frequency of resource events respectively. These lower frequencies

can be explained through their particular histories, as both services started through being supported by an existing resource base. eBay operated within the existing digital and physical infrastructure of Omidyar, the founder, while Wikipedia was operating as a subsidiary of Bomis Inc. In addition, both had handed over much of the governance and maintenance of their respective services to ecosystem participants. Together these reduced the requirement for substantial resource acquisition in this phase.

The frequency of institutional events is higher for ecosystems that have substantial social interaction in the service involvement, in particular, eBay, Facebook and Wikipedia. For eBay and Wikipedia, who opened up governance and maintenance to ecosystem participants early in their emergence, there were many regulative parameters to be established in order to structure the relations between the participants (Battilana et al., 2009; McAdam et al., 1996; Polletta & Jasper, 2001; Scott, 2008). There was also normative development in those ecosystems that allowed intense interaction between participants, reflected in the increased frequency of institutional events for Facebook. The effect of the regulative and normative development is most apparent in Wikipedia, which had the most open and dynamic levels of ecosystem participant activity, where its variance of institutional events from their overall frequency is significantly high ($p < 0.01$). In contrast, cases that maintained tighter control over the participation of ecosystems in governance and maintenance, Amazon ($p < 0.1$), Google ($p < 0.05$) and Salesforce ($p < 0.05$). Interestingly, cases that have a high frequency of institutional events also have resource event frequencies that are lower, reflecting the transfer of governance to the ecosystem and a reduced requirement for firm level resources.

Together, these code frequency variance analysis results provide statistical support for the existence of the retroductively derived Phase I. These results illustrate that in the early stages of ecosystem emergence, when the hub firm is setting up and the digital service is being originally designed, there are similarities in the types of underlying activities of ecosystem emergence. The decreased occurrence of context events reflects the nascent markets in which each ecosystem was emerging, and hence low competitive and media interest (Hargrave & Van De Ven, 2006; Santos & Eisenhardt, 2009). The increased frequency of technological events reflects the early development of the underlying service (Hargrave & Van De Ven, 2006; Suarez, 2004). And the increased frequency of resource events reflects the importance of the founders in acquiring resources to enable the launch of their digital service (Gilbert et al., 2006; Greenwood et al., 2002; Hinings et al., 2004). However for ecosystems that opened up governance and maintenance to ecosystem participants early on, there was instead decreased frequency of resource events counterbalanced with an increased frequency of institutional events.

Table 19 below presents the frequency analysis of Phase II, detailing the variance of each code frequency from the randomly generated mean code frequency for each of the six cases. Appendix B contains the means and standard deviations of the randomly generated code frequencies.

Table 19 – Phase II code frequency cross case comparison with bootstrapped significance

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Resource	-0.005 (27.57%)	-0.116 (25.23%)	2.086 (20.37%)	1.853 (24.30%)	-0.431 (14.75%)	-2.733 *** (4.31%)
Technology	-5.283 *** (19.73%)	-1.196 (17.12%)	-1.971 (32.72%)	-5.704 *** (27.62%)	-0.153 (11.84%)	7.732 *** (37.28%)
Institutional	-2.674 (28.11%)	-2.522 (40.54%)	-1.098 (22.53%)	2.451 * (25.06%)	-2.165 * (50.43%)	0.217 (40.73%)
Context	7.961 *** (24.59%)	3.834 *** (17.12%)	0.983 (24.38%)	1.400 (23.02%)	2.749 *** (22.98%)	-5.216 (17.67%)

Note: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Numbers in parentheses are actual frequency; these may not sum to 100% due to rounding.

The Phase II code frequency variance analysis indicates that, similar to Phase I, there are similarities in the variances of technological and context events. However in contrast to Phase I, there is instead an increased occurrence of context activities and a decreased occurrence of technological activities. The increased frequency of context events and decreased frequency of technological events in this phase is further accentuated by the significance of the variances. For instance, Amazon, eBay, and Salesforce all have significantly higher frequency of context events than occurs within their respective complete events ($p < 0.001$). Similarly, there is a significant decrease in the frequency of technological events for Amazon and Google ($p < 0.01$).

There is also a weak similarity in the frequency of institutional events for Amazon, eBay, Facebook and Salesforce, which have a lower frequency of events than the overall frequency for each case. In contrast Google and Wikipedia have a higher frequency of events, explained by their particular histories. The positive variance of Google is significant ($p < 0.01$), emphasising the scale of the marketing, media engagement and ecosystem development that occurred in this case during this phase. The slightly higher frequency of institutional events for Wikipedia in this phase is explained through the intense ongoing involvement of ecosystem participants in the governance and maintenance of the ecosystem.

However there are no similarities in the variances of resource events, with Facebook and Google having a higher variance of resource events and Amazon, eBay, Salesforce and Wikipedia having a lower variance of resource events. This variance is only significant for Wikipedia ($p < 0.001$), and the absolute amount of variance is also low for the other five cases (generally less than 2% on frequencies of approximately 25%). This suggests that although there is heterogeneity in the frequency of resource events, the overall levels of resource frequency are approximately the average of the resource events for each case. During this phase, with the exception of Wikipedia, all hub firms undertook extensive coalition building activity as well as hiring staff. In addition Amazon, Facebook and Google continued to seek and obtain funding from VC and other investors. In contrast Wikipedia continued to rely extensively on the actions of ecosystem participants for its maintenance and governance, and, apart

from leaving Bomis to become a philanthropic foundation, did not undertake much resource acquisition activity. This is reflected in its positive variance of institutional events.

Together, these results support the existence of Phase II, and imply that during the momentum phase when ecosystem adoption is rapidly expanding, there is a reduced focus on technological events and a significant increase in societal interest, regulation and competition. The decreased frequency of technological events reflects the emergent consensus on the form, structure and operation of the digital service (Garud & Karnoe, 2003; Suarez, 2004). The increased frequency of contextual events reflects the increasing reach of each case into wider society as it is legitimated as well as from competition (Hargrave & Van De Ven, 2006; Moore, 1993; Rao et al., 2000; Scott, 2008; Suarez, 2004). The average occurrence of resource events reflects the ongoing requirement for resources during this phase, but which is overshadowed by other activities.

Table 20 below presents the frequency analysis of Phase III, detailing the variance of each code frequency from the randomly generated mean code frequency for each of the six cases. Appendix B contains the means and standard deviations of the randomly generated code frequencies. To reiterate the earlier warning, caution should be exercised in attempting to extract too much insight from these frequency analysis results during to right censoring of data.

Table 20 – Phase III code frequency cross-case comparison with bootstrapped significance

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Resource	-0.688 (26.82%)	4.528 (29.91%)	-9.772 ** (8.47%)	-6.558 * (15.87%)	-11.409 *** (3.70%)	7.53 *** (14.59%)
Technology	2.891 (27.97%)	-0.577 (17.76%)	5.177 (39.83%)	12.656 *** (46.03%)	-2.720 (9.26%)	-19.754 *** (9.73%)
Institutional	6.395 ** (37.16%)	2.746 (45.79%)	0.937 (24.58%)	-1.959 (20.63%)	20.532 *** (73.15%)	-7.549 * (32.97%)
Context	-8.598 *** (8.05%)	-6.697 * (6.54%)	3.658 (27.12%)	-4.138 (17.46%)	-6.403 + (13.89%)	19.773 *** (42.70%)

Note: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Numbers in parentheses are actual frequency; these may not sum to 100% due to rounding.

In contrast to the two previous phases where there were similarities across cases in the variance of frequencies of technological and context events, in Phase III there are few similarities between the cases. There are no similarities of code frequency variances across all cases that are found in the earlier two phases. Instead there are positive and negative variances of code frequency across the cases. For instance, half of the cases experience a relative decline and the other half a relative increase in technological events, while the other codes have either four and two cases with either higher or lower frequencies of codes.

The frequency of resource events is lower than the overall frequency for four cases, Amazon, Facebook, Google and Salesforce. In particular, the frequencies for Facebook, Google and Salesforce are significantly lower (p<0.01, p<0.05, and p<0.001 respectively). This provides evidence of the successful emergence of each ecosystem, as a shift to value appropriation would result in additional

value within the firm and less need for resource acquisition. In contrast eBay and Wikipedia have higher frequencies of resource codes, Wikipedia significantly so ($p < 0.001$). Given that both eBay and Wikipedia were the most socially open of the cases, allowing participation in the governance and maintenance of the ecosystem from early on, the increased frequencies of resource codes here perhaps represents the gathering of resources now required as the hub firm assumes more responsibility. As Wikipedia was the most open, this explanation accords for the high significance of their code variance.

The frequency of contextual events is also lower than the overall frequency for four cases, Amazon, eBay, Google, and Salesforce, significantly so for Amazon, eBay and Salesforce ($p < 0.001$, $p < 0.05$ and $p < 0.1$ respectively). This supports the notion of decreased media and societal interest as the digital service and ecosystem are accepted and become taken for granted, as well as reduced competitive activity as the ecosystem comes to dominate its market. In contrast, there is an increased frequency of contextual events for Facebook and Wikipedia, significantly so for Wikipedia ($p < 0.001$). For Facebook, although the digital service and ecosystem were generally taken for granted by the end of 2009, there was at the time increased media speculation as to whether there would be an IPO. For Wikipedia, following the establishment of tighter editorial control that commenced Phase III, adoption and engagement in wider society began to increase as the perceived reliability of Wikipedia increased.

The frequency of institutional events is higher than the overall frequency for four cases – Amazon, eBay, Facebook and Salesforce – significantly for Amazon ($p < 0.01$) and Salesforce ($p < 0.001$). This reflects their focus on marketing and societal outreach, as well as the establishment of new ecosystem regulations, to their value appropriation activities. This is particularly so for Amazon and Salesforce who undertook significant marketing campaigns once market dominance and long term viability was attained, explaining their significance. In contrast, the frequency of institutional events is lower for Google and Wikipedia, significantly for Wikipedia ($p < 0.05$). For Google, although marketing activity and ecosystem maintenance continued, this was not the main focus of their strategy in this phase (which instead was focused on technological development). For Wikipedia, the establishment of editorial control at the beginning of this phase soon reduced the quantity of regulatory, normative and cognitive development within the ecosystem, reflected in the reduced frequency of the codes. As such, in the case of Wikipedia, the imposition of editorial control results in a lower frequency of institutional events.

The variance of the frequency of technological events is equally shared across the cases, with Amazon, Facebook and Google all having a higher frequency of technological events, Google significantly so ($p < 0.001$). In each case, following (or as part of) the attainment of market dominance, each hub firm adopted a policy of extensive technological development, much of which was focused on enhancing value appropriation from the ecosystem. This policy of significant technological development was particularly apparent in Google, explaining the high significance of the variance. In contrast, eBay, Salesforce and Wikipedia all have a lower frequency of technological events in this

phase, Wikipedia significantly so ($p < 0.001$). For Wikipedia, although maintenance of the service continued, following the imposition of editorial control and the service gaining operational stability, less effort was placed on the addition of new features and functions for the service. In fact, although there have been some service stability improvements, the Wikipedia service today looks very similar to when the data collection ceased. In the case of eBay and Salesforce, value appropriation and control was not addressed through technological means but instead was driven through increased levels of marketing and through changes in the rules that governed the ecosystem. This has resulted in lower frequencies of technological events in this phase.

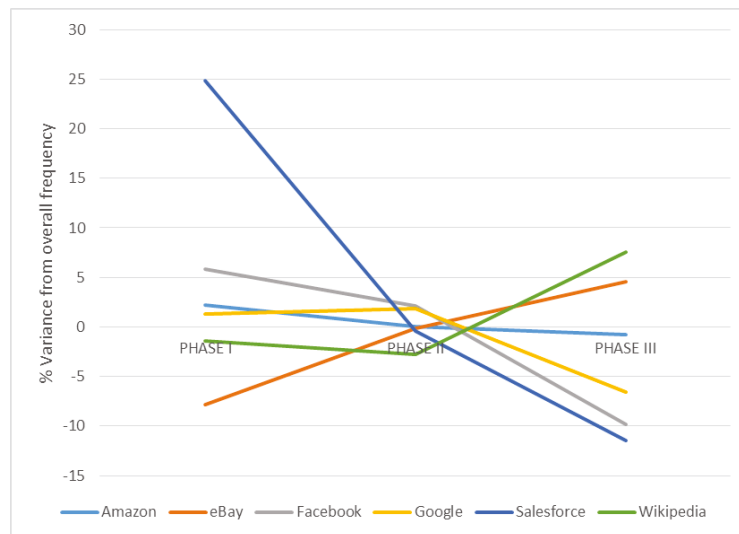
Together, these results tend to support the existence of Phase III. The general decrease of context events supports the notion that the ecosystem has been established in society and dominance over competitors. Furthermore the increased occurrences of institutional events and decreased occurrence of resource events tends to suggest value appropriation as ecosystem rules are tweaked, marketing initiatives are undertaken, and a reduced requirement for resources due to increased incoming value. However these specific frequencies of these contextual, institutional and resource events that support the existence of Phase III are not distributed evenly across the cases. Thus although there is evidence of value appropriation and control in these code frequencies, there is heterogeneity in the results. This heterogeneity of code frequencies could be a product of the right censoring of the data. Alternatively, as suggested in Analysis I, the complete sequence optimal matching analysis, this could be the result of different processes related to the idiosyncratic logics of value co-creation and appropriation of each ecosystem.

The second code frequency analysis considers the change in the variances of each code across phases. The intuition here is that similarities in changes of code variance across cases provide statistical support for each of the three phases. This analysis supports the previous code frequency variance analysis through a different focus, in this case how the code variance changes across phases. These results are presented as four graphs, one for each code, with the three phases on the x-axis, and the variance of the code frequency from the overall code frequency for that case on the y-axis. Thus on each graph there are six lines, one for each case, showing the changes in variance of the code for that case. Appendix E provides tables of the results of this analysis. Figure 3 on the next page details the change in variance of resource codes across the three phases for each case.

This figure indicates that the frequency of resource events for Amazon, Facebook, Google and Salesforce decreases with each progressive phase. This supports the notion that resource activities become less important as the ecosystem emerges. In Phase I, there is increased frequency of resource events reflecting the resource gathering required for the development of the underlying corporate form and the digital service is developed and the ecosystem is launched. The frequency of resource events in Phase II remain either slightly above or at the overall occurrence of resource codes, supporting the

notion that although there was not as intense resource gathering in this phase in as the previous phase, there was still resource gathering activity as the ecosystem gained momentum.

Figure 3 – Change in resource code variances across phases

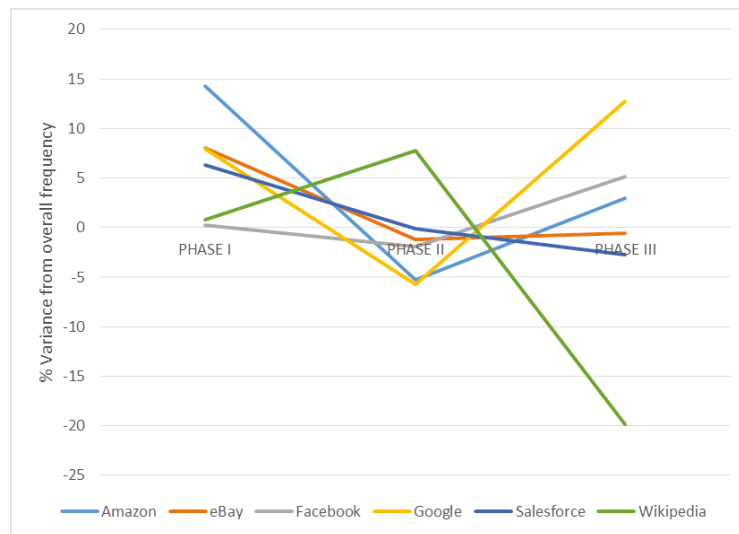


The decreased frequency of resource events in Phase III represents the successful emergence of the ecosystem and the relatively reduced requirement for resource acquisition as compared to the earlier phases. The exceptions of both eBay and Wikipedia are explained through the early opening of governance and maintenance of the ecosystem to participants, meaning that fewer resources were required for Phase I. However, as each digital service and ecosystem moved into Phase II, the frequency of resource codes is similar to that of the overall occurrence of resource codes, implying that there is a similar level of resource activity relative to the other cases in this phase. The increased frequency of resource events for both eBay and Wikipedia in Phase III reflects the increased requirement for resources as control is applied to the ecosystem, a requirement that the other cases did not have.

Figure 4 below details the change in variance of technological codes across the three phases for each case. This figure clearly suggests a U-shape in the frequencies of technological events for all cases except Wikipedia (and only weakly for Salesforce). This supports the notion that technological activities are important early in the emergence of the ecosystem as the original idea and the digital service initially developed. However, during Phase II, the technological activities become less salient as focus moves onto building the ecosystem, engaging with society and competing with challengers. In Phase III, the frequency of technological events in Amazon, Facebook and Google all increase, implying that this is in order to appropriate value and control the ecosystem. The frequencies of technological events for eBay and Salesforce remain fairly level from the previous phase, and are also below the levels of Phase I, and suggesting that technological activity had not ceased. The exception here is Wikipedia which has an inverted-U shape. This is explained through its particular circumstances, because although the frequency of technological events was approximately equal to the average occurrence in Phase I, the majority of the technological activity occurred in Phase II as funds became available, the service

expanded internationally, and new features and functions were added to manage the rapidly growing ecosystem.

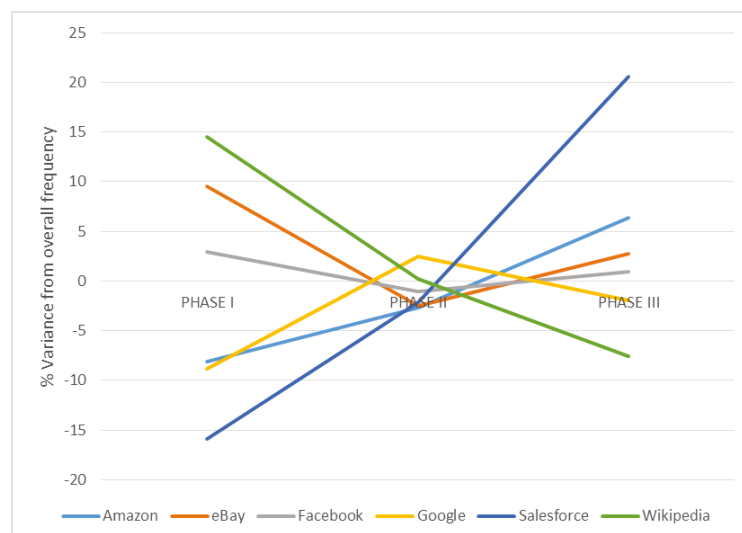
Figure 4 – Change in technological code variances across phases



Thus in contrast to the other cases, for Wikipedia the majority of the technological events occurred in Phase II as the ecosystem participants maintained the service. In Phase III the frequency of technological events declines as the focus returns on resource gathering (particularly gathering donations).

Figure 5 below details the change in variance of institutional codes across the three phases for each case.

Figure 5 – Change in institutional code variances across phases

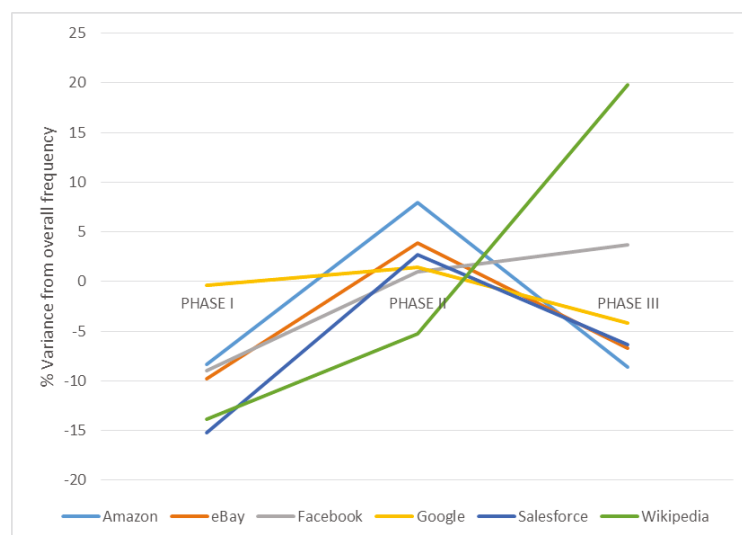


This figure suggests two different dynamics of change in the frequencies of institutional events across the phases, similar to the resource code frequencies. Those cases that from the very beginning were socially oriented, either through design (Facebook) or through the opening up of their maintenance

and governance to ecosystem participants (eBay and Wikipedia), exhibit increased frequencies of institutional events in Phase I. As these cases moved into Phase II, their frequency of institutional events decreased, reflecting the establishment of regulative, normative and cognitive mechanisms of governance. In contrast, those ecosystems that maintained fairly closed (Amazon, Google and Salesforce), all have lower frequencies in Phase I as there was little marketing, or regulative, normative or cognitive ecosystem development. However in Phase II, as these ecosystems opened up and began to grow rapidly, the frequency of institutional events rose, reflecting marketing activity and regulative, normative and cognitive development within the ecosystem. For all cases in Phase II the frequency of institutional events occurred at about the overall frequency for each case. However in Phase III, the frequency of institutional events rose for Amazon, eBay, and Salesforce, all cases that, now that they dominated their markets, continued to invest in ongoing outreach activities. For Facebook and Google, the frequency of institutional events remained approximately the same level as Phase II, reflecting the overall frequency of institutional events. However the frequency of institutional events for Wikipedia continued to fall, reflecting the increased editorial control and the removal of some governance and maintenance activities from the ecosystem participants.

Figure 6 below details the change in variance of contextual codes across the three phases for each case.

Figure 6 – Change in contextual code variances across phases



In this figure a clear inverted U shape can be observed, supporting the identification of the three phases. For all cases there is a low frequency of contextual events in the first phase, underlining the low levels of media interest, competitive challenges and societal interest. In Phase II, as the ecosystem takes off, there are increased frequencies of contextual events for all cases, illustrating engagement with the media, society and competitors. In Phase III, for Amazon, eBay, Google and Salesforce, the frequency of contextual events decreases, as the digital service and ecosystem becomes dominant, and becomes taken for granted in the press and wider society. The exceptions of Facebook and Wikipedia are

explained through their specific characteristics. For Facebook, although the digital service and ecosystem were generally taken for granted by the end of 2009, there was at the time increased media speculation as to whether there would be an IPO. For Wikipedia, following the establishment of tighter editorial control that commenced Phase III, adoption in wider society began to increase as the perceived reliability of Wikipedia increased.

As a whole, the changing frequencies of the types of events – resource, technological, institutional and contextual – support the identification of the three phases. In general there is a U-shaped frequency of technology events and an inverted-U shaped frequency of contextual events. This supports the notion of initial idea and digital service development with low societal interest in Phase I, intense media, societal and competitive interest in Phase II, and control and value appropriation in Phase III. In general, resource events decrease as the phases increase, supporting the notion that there is intense resource gathering in the first phase, ongoing resource gathering the second, and a decreased requirement for resource gathering in the third. The differing profiles of socially oriented cases (eBay, Facebook and Wikipedia) compared to those that remained more closed (Amazon, Google and Salesforce) explain the differing frequency variances of resource and institutional events.

5.2.5 Optimal matching analysis

Above, three phases have been identified through direct inspection, and each phase has been statistically verified through two differing applications of code frequency variance analysis. The goal of this section is to prove that each phase within each case is dissimilar to the others, thus validating the existence of each phase. To do so the event sequences of each phase are compared through optimal matching to determine a pairwise ‘distance’ between each phase within a case, as determined by the (dis)similarity of their phase sub-sequences.

In this analysis the phase event sequences for each case are compared with the other phase event sequences within that case. Eighteen phase-pair distances are calculated: for Amazon, one for Phase I-II, one for Phase II-III, and one for Phase I-III;¹⁴ for eBay, one for Phase I-II, one for Phase II-III, and one for Phase I-III; and so on. To create a comparison distance, the three phase sub-sequences for each case were randomised 10,000 times using their same respective frequency of codes (see Section 4.11.1 in Chapter 4 for rationale and details of the following technique). This resulted in 180,000 random event sequences – 10,000 for each phase (3) of each case (6). The optimal matching procedure was then run for each random event sequence for each phase-pair, so that 180,000 distances were created – 10,000 for each phase-pair (3) for each case (6). As there was a range of distances for each phase-pair, the mean distance and standard deviation was calculated. Thus following this procedure there were 18 mean distances and 18 standard deviations – one each for each phase-pair (3) of each case (6). Each phase-

¹⁴ For clarity and consistency, all phase comparisons have the following format *vertical phase number* hyphen *horizontal phase number*. For example, the comparison of Phase II and Phase III will be denoted Phase II-III.

pair mean distance (hereafter called the ‘random mean’) represents the average distance of 10,000 pairwise distances calculated.

The random mean for a particular phase-pair thus provides a measure from which the actual distance for that phase-pair can be compared. By subtracting the random mean from the actual distance, a measure of the variance from the random mean can be calculated. Thus, a positive sign represents an increased distance and a negative sign represents a lesser distance of the actual distance to the mean of 10,000 random iterations of phase sequences of the same code frequency.

These results are detailed in Table 21 below. Tables of the random means and standard deviations for each phase-pair are in Appendix B.

Table 21 – Optimal matching within case cross phase comparison

Amazon				eBay			
	Phase I	Phase II	Phase III		Phase I	Phase II	Phase III
Phase I	0.000 (0.000)			Phase I	0.000 (0.000)		
Phase II	-0.001 (0.773)	0.000 (0.000)		Phase II	0.000 (0.829)	0.000 (0.000)	
Phase III	0.011 (0.716)	0.039 * (0.678)	0.000 (0.000)	Phase III	-0.027 (0.617)	0.013 (0.715)	0.000 (0.000)
Facebook				Google			
	Phase I	Phase II	Phase III		Phase I	Phase II	Phase III
Phase I	0.000 (0.000)			Phase I	0.000 (0.000)		
Phase II	0.007 (0.756)	0.000 (0.000)		Phase II	0.000 (0.795)	0.000 (0.000)	
Phase III	0.075 * (0.737)	0.009 (0.691)	0.000 (0.000)	Phase III	0.087 ** (0.746)	0.016 * (0.719)	0.000 (0.000)
Salesforce				Wikipedia			
	Phase I	Phase II	Phase III		Phase I	Phase II	Phase III
Phase I	0.000 (0.000)			Phase I	0.000 (0.000)		
Phase II	0.000 (0.897)	0.000 (0.000)		Phase II	0.000 (0.808)	0.000 (0.000)	
Phase III	0.269 *** (0.889)	0.000 (0.815)	0.000 (0.000)	Phase III	0.062 ** (0.692)	0.110 *** (0.761)	0.000 (0.000)

Note: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001; numbers in parentheses are actual distances.

For all phases in all cases except Amazon and eBay, the sign of the variance is positive for all phase comparisons, providing evidence that each of the phases is not similar to the others within a case. For Amazon, Facebook, Google, Salesforce and Wikipedia, some phases are significantly different. Phase I-III of Salesforce and Phase II-III of Wikipedia are the most significantly different (p<0.001). This means that the distance between the phase-pairs is greater than 99.9% of the 10,000 random phase-pairs with the same code frequency. Similarly Phase I-III of Google and Phase I-III of Wikipedia are

also significantly different ($p < 0.01$). This means that the distance between the two phases is greater than 99% of the 10,000 random phase-pairs with the same code frequency. Phase II-III of Amazon, Phase I-III of Facebook and Phase II-III of Google are also significantly different ($p < 0.05$). This means that the distance between the phase-pairs is greater than 95% of the 10,000 random phase-pairs with the same code frequency. The remainder of the phase-pairs are not significantly different or similar, further indicating that within each case there is no similarity between the phases. eBay has positive variances from random mean for Phase I-II and Phase II-III, however the variance from the random mean for Phase I-III is negative but not significant. As the distance from Phase I to Phase II is positive, and Phase II to Phase III is positive, these results still suggest that the sequences within each of the three phases differ and hence validate the phase identification. Amazon also has a non-significant negative variance for Phase I-II, however the size of the variance is small (0.001). This suggests that Amazon may have begun Phase II earlier than their explicit strategy of “Get Big Fast” would suggest; perhaps network effects had already begun to drive the momentum phase.

These results overwhelmingly suggest that the phases within each case are not similar to one another. In fact they are dissimilar to each other. In part the sequence differences between each phase can be explained by recourse to the three phase model of institutional technological innovation of Hargrave and Van De Ven (2006). Hargrave and Van de Ven argue that in each phase there are three different underlying process engines, dialectical, collective action and evolutionary processes respectively. This supplies a useful rationale for understanding the differences between each phase independent of the other. However it does not explain the finding of overall dissimilarity of each case. Nor is it clear whether there are similarities across cases.

Summarising, this optimal matching analysis has confirmed that there are no similarities between phases within a case. This provides further statistical evidence of the existence of the three phases of ecosystem emergence.

5.3 Analysis III: Phase sequence comparison

Analysis II above has suggested that there are three phases of ecosystem emergence that occur during the development of an ecosystem. The purpose of this section is to apply optimal matching to determine how similar or different each phase is across cases.

In this analysis the event sequences of a phase are compared between the six cases. Forty five phase-case-pair distances are calculated: fifteen for Phase I, fifteen for Phase II and fifteen for Phase III. Alternatively expressed, three pairwise distances are calculated for Amazon-eBay (one for each phase), three for Amazon-Facebook, and so on. To create the mean distance for each phase-case-pair to which the actual case-pair distance could be compared (see Section 4.11.1 in Chapter 4 for rationale and details of the following technique), 10,000 random event sequences for each case were created, using the same frequency of codes as in the actual event sequence. This resulted in 180,000 random

event sequences in total – 10,000 for each phase (3) for each case-pair (6). The optimal matching procedure was then applied to the random event sequences for each phase-case-pair, so that 450,000 distances were created – 10,000 for each phase (3) of each case-pair (15). As there was a range of distances for each phase-case-pair, the mean distance and standard deviation was calculated. Hence following this procedure there were 45 mean distances and 45 standard deviations – one for each phase of each case-pair. Each phase-case-pair mean distance (hereafter called the ‘random mean’) represents the average distance of 10,000 pairwise distances calculated.

The random mean for a particular phase-case-pair provides a measure from which the actual distance for that phase-case-pair can be compared. By subtracting the random mean from the actual distance, a measure of the variance from the random mean can be calculated. Thus, a positive variance represents an increased distance and a negative variance represents a lesser distance from the random mean. The results for Phase I are presented in Table 22 below. The mean distance and standard deviations for each case-pair are in Appendix B.

Table 22 – Phase I optimal matching cross case comparison

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	0.081 + (0.750)	0.000 (0.000)				
Facebook	-0.009 (0.774)	-0.061 (0.675)	0.000 (0.000)			
Google	-0.141 ** (0.619)	0.102 + (0.838)	-0.005 (0.735)	0.000 (0.000)		
Salesforce	-0.069 (0.643)	-0.074 (0.650)	-0.068 (0.711)	0.003 (0.800)	0.000 (0.000)	
Wikipedia	-0.012 (0.775)	-0.074 (0.629)	0.050 (0.809)	0.095 + (0.865)	0.142 ** (0.798)	0.000 (0.000)

Note: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001; numbers in parentheses are actual distances.

The results indicate that, in contrast to the complete sequence comparison of Analysis I, a large majority of the phase-case-pairs are no different to the random mean and the significant differences between event sequences have disappeared. This indicates that the difference between each phase-case-pair is no different than the average of 10,000 phase-case-pairs calculated from random sequences with the same code frequency. Furthermore, the majority of these phase-case-pair comparisons now have a negative variance from their random mean. This implies that each phase-case-pair is tending towards a similar event sequence. This finding is emphasised through the significant similarity of the Amazon-Google event sequences for this phase (p<0.01), where the distance of the event sequences for the phase-case-pair, relative to one another, is less than 90% of the 10,000 pairwise distances calculated from the randomly generated sequences. In contrast, the phase-case-pair of Salesforce-Wikipedia is significantly different (p<0.01), where the distances of the event sequences for the phase-case-pair, relative to one another, is higher than 95% of the 10,000 pairwise distances calculated from the randomly generated

sequences. Similarly the phase-case-pairs of Amazon-eBay, eBay-Google and Google-Wikipedia are significantly positive, but only at a low level of significance ($p < 0.1$).

In general, the disappearance of the significant differences between each case-pair, and the negative variance from the random mean, suggest there is some *similarity* between the phases across the cases. Driving this similarity of event sub-sequences are the increased levels of technology and resource events and decreased levels of context events in this phase (see Section 5.2.4 and Table 18 above), as well as the patterns of interaction of these types of events. Put differently, the likelihood of similarity of sequence is higher if there are similar frequencies of event types. Thus the similar significant frequencies of resource, technology, and context events for both Google and Amazon provides an explanation for the significant negative variance from the random mean of the Amazon-Google phase-case-pair ($p < 0.01$). Similarly, the significant positive variance from the random mean of Salesforce-Wikipedia, and more at a more minor level, Amazon-eBay, eBay-Google and Google-Wikipedia, is a result of the interaction of different frequencies of event types. While Wikipedia has significantly more institutional codes than the random mean, Salesforce instead has significantly more resource and significantly less institutional codes. As a whole, these results illustrate that in the early stages of ecosystem emergence, when the hub firm is setting up and the digital service is being designed and developed, there are similarities in the processes of ecosystem emergence when compared to the overall sequence comparison.

The results for Phase II are presented in Table 23 below. The mean distance and standard deviations for each case-pair are in Appendix B.

Table 23 – Phase II optimal matching cross case comparison

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	-0.008 (0.673)	0.000 (0.000)				
Facebook	0.009 (0.714)	0.008 (0.802)	0.000 (0.000)			
Google	0.050 ** (0.765)	0.012 (0.747)	0.056 ** (0.714)	0.000 (0.000)		
Salesforce	0.005 (0.708)	0.023 + (0.666)	0.011 (0.750)	-0.014 (0.744)	0.000 (0.000)	
Wikipedia	0.110 *** (0.823)	0.074 *** (0.748)	0.073 *** (0.741)	0.075 *** (0.791)	0.065 *** (0.732)	0.000 (0.000)

Note: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; numbers in parentheses are actual distances.

Here the similarity that was observed in Phase I has mostly disappeared and instead there is now predominantly *dissimilarity* between the phase-case-pairs. The variances for all the phase-case-pairs, except Amazon-eBay and Google-Salesforce, are positive from their respective random means with eight significant, suggesting that these phase-case-pairs are either dissimilar or tending towards being

dissimilar. Amazon-Google and Facebook-Google are significantly different ($p < 0.01$) with eBay-Salesforce less so ($p < 0.1$). Strikingly all phase-case-pair comparisons with Wikipedia are highly significantly different ($p < 0.001$). This means that the distance of the event sequences for each phase-case-pair, relative to one another, are higher than 99.9% of the 10,000 pairwise distances in the randomly generated sequences. The negative variances of Amazon-eBay and Google-Salesforce are insignificantly negative. These results suggest that there are no longer any similarities in the underlying processes during emergence, and that, at best, any two ecosystem emergence process is no more similar than any two random sequences.

The finding of dissimilarity here is interesting as the analysis of code frequencies in Analysis II (see Section 5.2.4 and Table 19 above), suggests that there are commonalities in the frequencies of technological and contextual events. In contrast to Phase I where commonalities in code frequencies was complemented with similarity in the interactions of those codes, in this phase there are commonalities in the code frequencies but little similarity in the interactions of those codes. This implies that the emergence sequences in this phase are unique to each ecosystem. The exception of Wikipedia, which has significantly higher frequency of technological events and lower frequencies for context events than the other cases, explains its significant differences in phase sequence to the other five cases. Overall, there has been a transition from similarity of emergence processes in Phase I to dissimilarity of emergence processes in Phase II.

The results for Phase III are presented in Table 24 below. The mean distance and standard deviations for each case-pair are in Appendix B. As above, caution should be exercised in attempting to extract too much insight as the results are right censored due to continuing control activities past the end date that are not included in the analysis. Phase III appears to maintain the *dissimilarities* between the sequences for all cases. In particular, the variance from the respective random mean for the vast majority of phase-case-pairs is positive, with nine significant. This suggests that the sub-sequence for each phase-case-pair is either dissimilar or tending towards being dissimilar. In contrast to the previous phase, where there was strong significant differences for all phase-case-pairs with Wikipedia and weaker significant differences between the other phase-case-pairs, the levels of significance are much reduced for Wikipedia although it remains significantly different to all other cases in this phase. For instance, Amazon-Wikipedia and Google-Wikipedia are now the only phase-case-pairs that are highly significantly different ($p < 0.001$). Facebook-Wikipedia and Salesforce-Wikipedia remain significantly different although less so ($p < 0.05$). Google-Salesforce now exhibits a high significant difference ($p < 0.001$), followed by Amazon-Facebook ($p < 0.01$), Facebook-Salesforce ($p < 0.05$) and eBay-Salesforce ($p < 0.1$). The exceptions are Amazon-eBay and Amazon-Salesforce which has a non-significant negative variance from its random mean, suggesting that the respective sub-sequences within this phase tend to similarity. These results suggest that significant differences remain between each of the sub-sequences, but with reduced levels of significance.

Table 24 – Phase III optimal matching cross case comparison

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	-0.001 (0.659)	0.000 (0.000)				
Facebook	0.046 * (0.716)	0.064 (0.856)	0.000 (0.000)			
Google	0.009 (0.670)	0.058 (0.817)	0.000 (0.714)	0.000 (0.000)		
Salesforce	-0.021 (0.648)	0.095 + (0.806)	0.126 * (0.966)	0.225 *** (1.048)	0.000 (0.000)	
Wikipedia	0.167 *** (0.843)	0.049 (0.735)	0.072 * (0.751)	0.165 *** (0.859)	0.064 * (0.697)	0.000 (0.000)

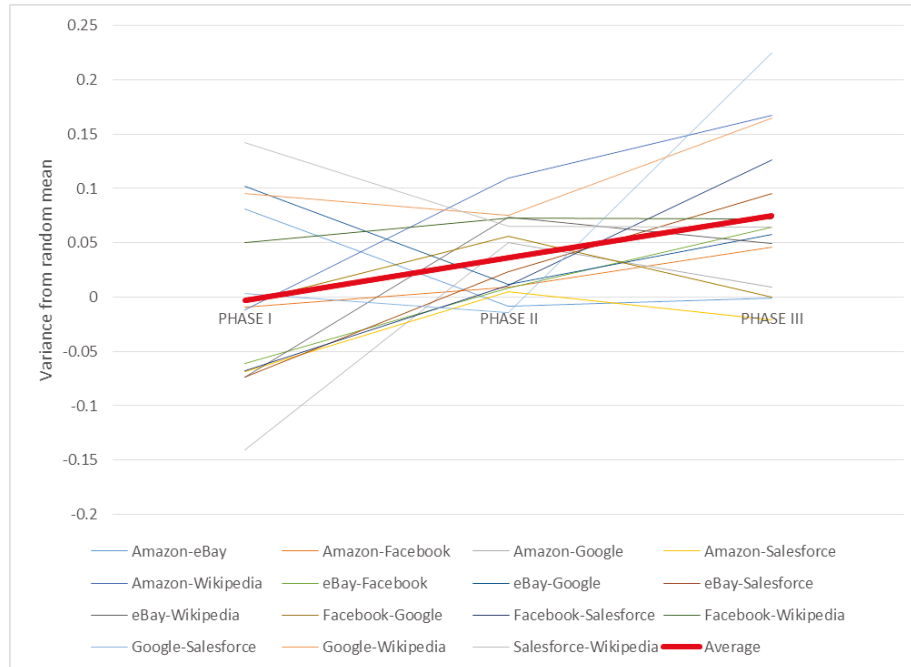
Note: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; numbers in parentheses are actual distances.

The finding of continuing dissimilarity, although of a lower significance, aligns with the analysis of code frequencies in Analysis II (see Section 5.2.4 and Table 20 above). This code variance frequency analysis suggested that in this phase there are few commonalities in the frequencies of all types of events. Although the general decrease in occurrences of context events supports notions of competitive dominance and taken-for-grantedness, and the increased occurrences of institutional events and decreased occurrence of resource events tends to suggest value appropriation as governance is tweaked, marketing initiatives are undertaken, and a reduced requirement for resources due to increased incoming value, these specific code frequencies are not distributed evenly across the cases. This distribution of code frequencies may have influenced the levels of difference between each case. For instance, the non-significant negative variance from the random mean for Amazon-Salesforce could be a product of the intense marketing that each case undertook in this phase, resulting in significantly higher occurrences of institutional events that Amazon. Similarly the similarities in Amazon-eBay could be the effect of the implementation of services on the eBay service such as “Buy-It-Now” which had the characteristics of retailing. The significant marketing effort of Salesforce in this phase, in comparison to the significant technical effort of Google, may have resulted in the significant differences in their event sequences ($p < 0.001$). Similarly the significant difference of Amazon-Facebook ($p < 0.01$) could be a result of ongoing media interest (and hence higher frequency of contextual events) in Facebook and the significantly reduced number of contextual events for Amazon. These results suggest that the ecosystem control and appropriation processes are heterogeneous across the cases and are unique to each ecosystem.

Taking the three phases together, this analysis suggests that ecosystems begin with fairly similar processes of resource acquisition and technological development (Phase I) which then have unique momentum processes of ecosystem growth, competition, and press and societal interest (Phase II). In Phase III each case settles into their own unique processes of value appropriation and ecosystem control. Figure 7 below plots the variance of the distance of each phase-case-pair from their random means

across phases. In this figure the x-axis consists of the three phases, and the y-axis the variance of each phase-case-pair from its respective random mean. An additional measure, the average of the phase-case-pair variances from their respective random means for each phase, is also plotted.

Figure 7 – Phase-case-pair variances from random mean distance with average variance



This figure suggests that the differences in the event sequences increase from one phase to the next. In Phase I the sub-sequences of each phase-case-pair tend to similarity. In Phase II the sub-sequences of each phase-case-pair tend to dissimilarity, and in Phase III there is a greater tendency to dissimilarity, despite decreased levels of significance. An explanation for the increasing dissimilarity lies in the differing logics of value co-creation of each case. In the early stages of ecosystem emergence (Phase I), the full extent of the logic of value co-creation has yet to emerge, and as all entrepreneurs have similar tasks such as resource gathering and the development of their service (Gilbert et al., 2006), there is some similarity in the emergence sequences of each case. However the processes for each ecosystem are not too similar as each is creating a different logic of value co-creation and hence will have event sequences that correspond to that nascent logic of value co-creation. As the ecosystem takes off (Phase II), and there is intense competition and media interest, the emerging value co-creation processes from the earlier phase are extended, formalised and embedded into the ecosystem. As each logic of value co-creation has a range of differing efficiencies, complementarities and lock-in (see Section 5.1 above), this results in different underlying event sequences for each ecosystem. With the imposition of value appropriation and ecosystem control (Phase III), the processes that enable the logic of value co-creation are now well established. The introduction of value appropriation and control mechanisms results in further differences in the event sequences between each ecosystem, as these

mechanisms necessarily are extensions of the established logic of value co-creation, and hence introduce additional differences into the emergence sequences.

A consequence of this analysis is that it provides evidence counter to what would be suggested by institutional theory. Given that in this phase the ecosystems are now moving towards control, value appropriation and optimisation, it would be reasonable to consider that wider institutional concerns, particularly regulatory pressures, could also exert a homogenising influence on activities in later phases (DiMaggio & Powell, 1983). For instance, as the majority of cases experienced an IPO (Facebook and Wikipedia excepted), the resource activities required for the preparation and execution of the IPO, and particular the subsequent requirements for reporting, could impact both the frequency and pattern of resource, institutional and contextual events. Similarly, case responses to societal concerns such as privacy (Facebook and Google), viability (Amazon and Salesforce) and trust and fraud (eBay and Wikipedia), as well as engagement with regulators and other institutions, could also influence the both the frequency and patterns of institutional and contextual events. However, Figure 7 above demonstrates that there is no homogenising effect and instead value appropriation and control activities tend to further differentiate the underlying ecosystem event sequences.

An alternative explanation for the increasing dissimilarity across phases between the emergence sequences of ecosystems is imprinting and path dependence. Path dependence occurs when the end state depends on the particular sequence of unfolding events (Arthur, 1989; David, 1985; Garud & Karnoe, 2001). Organisations are imprinted by the forces present at the time of their creation, leading to them to assume specific characteristics that tend to be carried forward (Stinchcombe, 1965). For instance, dominant design theorists have outlined the formative influence that pre-existing technologies have on the emergence of a new design (Anderson & Tushman, 1990; Murmann & Frenken, 2006). Furthermore, differences in technologies, beliefs and other founding conditions can lead to differing attributes of an ecosystem (Scott, 1983). Social movement theorists have also emphasised that the form of a social movement bears the imprint of the specific opportunity that gives it life (McAdam et al., 1996). For example, each of the founders came from different backgrounds which shaped the subsequent processes of emergence. Bezos and Benioff (Amazon and Salesforce) both came from corporate backgrounds, and Page and Brin and Zuckerberg (Google and Facebook) were students, and these different starting positions influenced the service development process and resource acquisition of the respective ecosystems. Similarly the developer background of Omidyar and Wales (eBay and Wikipedia) meant that the hacker ethos and ideas of open participation were integral to the early development of eBay and Wikipedia. As a consequence, the conditions in which each ecosystem began influenced the constituent events and dynamics that drove the emergence of the ecosystem.

The decisions which are taken throughout the emergence of an ecosystem also shape its final state, as each provides the raw material that subsequent decisions are made (David, 1985). In particular, the early decisions of founders, as well as the early influence of customers and other stakeholders, can

have a strong influence on the structure and dynamics of an ecosystem due to the amplification effect of structuration processes (Lawrence & Phillips, 2004). Similarly, processes such as breakthrough, translation and bricolage that shape the ecosystem mean that an emergence sequence will be idiosyncratic to the decisions made (Campbell, 2005; Garud & Karnoe, 2003). For instance, each case faced challenges – technological failure (eBay and Salesforce), internal conflict within the ecosystem (eBay, Facebook and Wikipedia), and intense societal pressure (Google and Facebook) – each of which was addressed uniquely according to the demands and interests of the service, ecosystem and founders. How each case addressed these challenges influenced the subsequent actions that were taken. For instance, Facebook's habit of initially ignoring the demands or concerns of ecosystem participants, responding arrogantly, and then eventually backing down, led to feature retractions, ongoing conflict with both ecosystem participants and society, and a subsequent requirement for specialised resources and technologies that was not shared with other cases. Thus the decisions taken both enable and constrain the activities of the ecosystem, as it became embedded in paths that it tried to shape and which in turn shaped it (Garud & Karnoe, 2003). As a consequence the relationship between a hub firm, the ecosystem and society is the product its own distinct history, reflecting the assimilation of values and demands over time and the residues of past processes (Astley & Van De Ven, 1983; Scott, 1983).

Path dependency complements the logic of value co-creation explanation by suggesting that beyond the differences for each logic of value co-creation, each process is unique due to the influence of initiating conditions and decisions made during the ecosystem emergence (Arthur, 1989; David, 1985; Garud & Karnoe, 2001). More specifically, it is path dependence that drives the emergence of each logic of value co-creation and hence the increasing dissimilarity across each phase. In the first phase, the environment conditions and early decisions of the founders resulted in the nascent logics of value for each particular ecosystem case. For example, developer background and hacker ethos of Omidyar and Wales (eBay and Wikipedia) led to their early decisions to open up governance of the ecosystem to participants at an early stage. This meant that as the logic of value co-creation emerged in each ecosystem, it necessarily reflected and incorporated the ongoing governance activities of ecosystem participants into its nature. In contrast the more closed governance models of Amazon, Facebook, Google and Salesforce did not need to take into account the opinions of participants as much and did not integrate the ecosystem participants in the same way into the regulative aspects of the logic. As an ecosystem takes off (Phase II), path dependency enables both an extension of the value co-creation logics from the earlier phase by building on what was already present, as well as constraining the application of other logics of value co-creation through the structure of what was already present. This further differentiated the underlying event sequences in this phase. For instance, the outright rebellion of Wikipedia ecosystem participants to the suggestion of advertising meant that Wikipedia became a philanthropic-based ecosystem, counter to the original aspirations of Wales. Similarly the revelation that a publishers' placement feature (paying for higher listings on a page) had been

implemented on Amazon resulted in a furious ecosystem backlash requiring the retraction of the monetisation feature. The influence of path dependency continues into Phase III, as the logic of value co-creation that was established in the earlier phase both enables idiosyncratic value appropriation and control mechanisms, as well as restricting the availability of other mechanisms of value appropriation and control. In doing so this further differentiates the emergence sequences of each ecosystem. Taken together, path dependence provides the link between each of the three phases, driving the establishment of a particular logic of value co-creation in an ecosystem.

Summarising, this section has compared the event sequences of each phase across-cases, and found similarities in the first phase, with increasing differences in the second and third phases. The increasing differences between the event sequences in each phase are proposed to be result of the establishment of idiosyncratic logics of value co-creation and the influence of path dependency. Specifically, path dependence drives the establishment of an idiosyncratic logic of value co-creation, in the process differentiating the event sequence of each case.

5.4 Conclusion

This chapter has reported the results of the phasic analysis of the six empirical cases. The first analysis, comparing the complete sequences of each of the six cases, found that each sequence is significantly different to the others. The second analysis found that there are three phases of ecosystem emergence. Phase I, or Initiation, consists of the initial idea and digital service development, resource gathering and early operation. In Phase II, or Momentum, the ecosystem begins to grow rapidly, characterised by increasing numbers of participants (drive by positive network effects), aggressive marketing, much press and societal interest, as well as competitor activity. In Phase III, or Control, the ecosystem is established as the undisputed leader and the focus of activity moves from expansion to control and value appropriation. The third analysis compared each of the individual phases, finding that the event sequences of the first phase are similar, and that these similarities decrease from one phase to the next as the ecosystem emerges.

This chapter has proposed that the idiosyncratic logics of value co-creation of each case explain the differences in their emergence sequences. In particular, the types of transaction efficiencies, complementary assets and ecosystem participants, and lock-in that characterise a logic of value co-creation vary for each case resulting in idiosyncratic value processes. Path dependency is also demonstrated, where the starting conditions and early decisions of the founders result in particular characteristics of value co-creation, which is subsequently embedded and further distinguished through idiosyncratic responses to circumstances that were unique to each ecosystem. Together the influence of the logics of value co-creation and path dependency drive the increasing dissimilarity in the emergence sequence of each case.

The following chapter discusses the implications of the above, as well as outlining theoretical implications of earlier chapters.

6 DISCUSSION

This chapter discusses the theoretical arguments and empirical findings that answer the three research questions posed by this thesis. To address these questions, I have developed an institutional approach to ecosystems, proposing that ecosystems represent a distinct subset of organisational fields, distinguished by the importance of value co-creation as a recognised area of institutional life (Chapter 2). In doing so I have argued that there are a number of distinct areas of institutional life, integrating the concept of value co-creation with the existing literature on common industries, common technologies, social issues and markets. Furthermore, I have synthesised the dominant design, social movement and institutional entrepreneurship theories to highlight four activities – resource, technological, institutional and contextual – that drive ecosystem emergence (Chapter 3), thereby contributing to our understanding of the mechanisms of organisational field formation. The identification of these four activities provides a theoretical basis for understanding the processes which underpin ecosystem emergence. Through an empirical comparison of the emergence sequences of six digital service ecosystems, I have also contributed by developing an ecosystem perspective that explicitly integrates value co-creation processes as an important regulator of the evolution of ecosystems (Chapter 5). I have also shown that ecosystem emergence exhibits three distinct phases that link to form a coherent whole when considered from the perspective of value co-creation (Chapter 5). More specifically, in the first phase the processes of ecosystem emergence are similar across cases, however with subsequent phases these processes become increasingly dissimilar.

A number of implications arise from these contributions that require further elaboration. A first set of implications concerns the impact of the empirical findings and the development of an institutional approach to ecosystem research. The empirical findings provide empirical validation of existing theories of ecosystem emergence, as well as extend our understanding of the processes that underlie ecosystem emergence. These empirical findings also suggest that the emergence sequence of each case should be considered equifinal, as although each case emerged along its own path with its own distinct processes, each case also resulted in a functioning ecosystem consisting of a value-creating network, governance system and institutional logic. Furthermore, the finding of the importance of value co-creation highlights that value captured first needs to be co-created, and that value co-creation and value appropriation need to be considered holistically. Theoretically, institutional theory, and the organisational field construct, brings additional insight that enhances our understanding of ecosystem dynamics and boundaries.

A second collection of implications considers the impact of the empirical findings and the development of an institutional research on institutional theory, and theorisations of the organisational field in particular. The empirical findings provide empirical validation of a number of models of institutional formation, as well as directing analytical attention towards the processes that drive institutional formation, as distinct to the extant focus on the sources of institutional change. Moreover,

the identification of four activities that drive ecosystem emergence influences our understanding of the mechanisms of organisational field formation, potentially providing a novel analytic lens. Theoretically, the development of an institutional approach to ecosystems also provides the opportunity for particular aspects of ecosystems to develop our understanding of organisational fields, including powerful central organisations and technological interdependence.

A final implication, and by extension an additional contribution of this thesis, relates to strategic management practice. The contributions and implications listed above suggest a range of practitioner guidance that should assist managers who seek to gain strategic edge over rivals through the promotion and facilitation of their ecosystems.

6.1 Implications for ecosystem research

Thus far, ecosystem research has focused on the dynamics of existing ecosystems, with only limited research into the emergence processes of ecosystems. For instance, research attention has focused on issues relating to the technological interdependences and their relationship to value co-creation and value appropriation (Adner & Kapoor, 2010; Jacobides et al., 2006; Pierce, 2009), network structure (Brusoni & Prencipe, 2009; Jacobides et al., 2006; Luo et al., 2012), platform leadership (Gawer & Cusumano, 2002; Schilling, 2009), governance (Nambisan & Sawhney, 2011; Tiwana et al., 2010) and the economics of multisided markets (Eisenmann et al., 2009; Evans, 2009). Although this research has provided insight into the dynamics of existing ecosystems, it has not really developed our understanding of how ecosystems emerge.

Consequently, the empirical findings and development of an institutional approach to ecosystem research provide scholars with new ways of thinking about ecosystem emergence. Specifically, the empirical findings enhance current theorisations of ecosystem emergence, both validating extant theory as well as deepening our understanding of the processes that underpin ecosystem emergence. Furthermore, the finding of dissimilarities in the emergence sequence of each case, explained through idiosyncratic logics of value co-creation and appropriation, suggests that ecosystem emergence should be considered equifinal as each case “reach[ed] the same final state from differing initial conditions and by a variety of paths” (Katz & Kahn, 1978:p. 30). The finding of the importance of value co-creation also highlights that value captured first needs to be co-created, and that value co-creation and value appropriation need to be considered holistically. Building upon this insight the notion of an ‘ecosystem model’, the rationale through which an ecosystem co-creates, delivers and shares value, is powerful as it provides a useful tool with which to consider ecosystem value logics. Furthermore, the additional insight that institutional theory, and the concept of organisational fields in particular, brings to our understanding of dynamics and boundaries, means that their application to ecosystem contexts offers potential to advance ecosystem research.

6.1.1 Models of ecosystem emergence

To date, the only substantive model of ecosystem system emergence is that of Moore (1993), although others have considered ecosystem emergence from the perspective of platforms (such as Gawer, 2009; Thomas et al., forthcoming). As such the empirical findings of three phases of emergence, and the increasing dissimilarity in the emergence processes across the phases, extend our understanding of ecosystem emergence.

To begin, these empirical findings provide perhaps the first empirical validation of the four stage model of an ecosystem lifecycle of Moore (1993). Moore proposes four evolutionary stages of a business ecosystem lifecycle – birth, expansion, leadership and self-renewal – of which the first three align to the Initiation, Momentum and Control phases identified in the empirical findings. Although this validation should be expected given the retroductive approach to phase identification (see Section 5.2), this finding is still worth noting as there has only been limited empirical work on ecosystem emergence that addresses this model. In addition, Moore, as a strategy practitioner, is more concerned with ecosystem creation – the deliberate acts of the hub firm to create the ecosystem. Thus the findings of three phases can be applied to both ecosystem emergence – the subject of study here – as well as to the processes of ecosystem creation.

A closer reading of Moore's model also indicates a number of key processes that typify each stage, that are also generally supported by the results. For instance, each of Moore's birth stage processes – developing the seed innovation, discovering the right customer value proposition, and designing the business to serve the potential market – are indirectly empirically supported through the frequency analysis results of increased levels of resource and technological activities. Specifically, these types of processes internal to the firm and will involve the technological development of the product or service that underpins the offering. Similarly, Moore's processes in the expansion stage – competition against other ecosystems, stimulation of demand, and ensuring that demand is met – and the leadership stage – guidance of ecosystem direction, maintaining a robust community, and the maintenance of bargaining power – are also supported by the frequency analysis. In particular, in the expansion stage, the findings of increased context activities supports the notions of ecosystem competition, ongoing resource and institutional activities implies both demand maintenance and satisfaction. Similarly, in the leadership stage, the increased frequency of institutional and resource activities supports the existence of ecosystem guidance, the maintenance of hub firm bargaining power and the community. Taken together then, the empirical findings also provide support for the existence of typical processes in each phase.

More importantly, however, is the finding that there are process similarities across cases in the first phase which then become increasing dissimilarities in the later phases. This suggests that the typical processes suggested by Moore also start similarly then begin to become dissimilar in comparisons across cases. Accordingly the typical processes of the Initiation phase – the development of a seed

innovation, value proposition and business design – can be understood to be similar across different ecosystems. This also means that the processes of ecosystem competition, demand stimulation and meeting demand in the Momentum phase, and the processes of ecosystem guidance, community maintenance and power maintenance in the Control phase, differ according to the specific ecosystem. Thus although Moore has identified the processes that typify a phase, these empirical results suggest that how these processes actually unfold within an ecosystem are specific to that ecosystem.

Taking the analysis further, these findings suggest that the typical processes of ecosystem competition, demand stimulation, meeting demand, ecosystem guidance, community maintenance and power maintenance, are specific to the idiosyncratic logic of value co-creation. Correspondingly, the instantiations of the typical processes of development of the seed innovation, value proposition and business design are not idiosyncratic to the logic of value co-creation. This implies that the ecosystem emergence processes should be distinguished from those processes that are of a more general entrepreneurial nature. As a consequence, ecosystem research that seeks to understand commonalities in the underlying processes (for instance, as suggested by Van De Ven & Poole, 1995) should be of ecosystems with similar logics of value co-creation, as ecosystem comparisons may be more heterogeneous than researchers realise. As value co-creation is non-linear (Moore, 1996; Nalebuff & Brandenburger, 1996; Normann & Ramirez, 1994), this also indicates that notions of equilibrium and linearity are not suitable for analyses of ecosystem emergence, or indeed, ecosystem processes in general. Instead, ideas such as complex adaptive systems, self-organising networks and autocatalytic feedback may be preferable to understanding the emergence and dynamics of ecosystems (Anderson, 1999; Meyer, Gaba, & Colwell, 2005).

These empirical results also speak to other models of emergence that do not consider ecosystems directly but instead consider platforms. For instance, Gawer (2009) has suggested an evolutionary typology of platform leadership which results in the emergence of an ecosystem. Gawer focuses on the architectural openness of the platform; in her model, the supply side components are first outsourced from external suppliers, leading the internal platform to evolve into a supply chain platform. As the outsourced subsystems take on a life of their own and horizontal links develop, an ecosystem emerges as the supply chain platform evolves into an industry platform. More recently, Thomas et al. (forthcoming) have extended this evolutionary model to suggest another mechanism that drives ecosystem evolution. Drawing on their identification of the three logics of leverage that drive value creation in platform systems (economies of production, innovation and transaction), they suggest that shifts in the type of leverage that a platform utilises, along with shifts in the level of architectural openness, together drive the evolution of a platform-centric ecosystem. They argue an evolutionary progression occurs as leverage logics change or platform opening allow others to participate. Eventually a platform-centric ecosystem emerges which represents a combination of three leverage logics,

coordinated and orchestrated through the platform architecture. Thus the emergence of a platform-centric ecosystem requires the integration of three leverage logics within an open system environment.

As differing leverage logics would have different underlying processes – for instance, the processes which drive a leverage logic based on economies of innovation would differ those processes that drive a leverage logic that is based on economies of transaction – the empirical finding of increasing dissimilarities in emergence sequences suggests that the interplay between these logics as the ecosystem emerges is idiosyncratic to each ecosystem. For instance, at the early stage of ecosystem emergence, there are similarities in the processes of different ecosystems as the three types of leverage logics have not yet begun to combine, nor has the progressive opening of the platform begun to occur. However, as the ecosystem emerges and the leverage logics adjust and platform opening occurs, then the processes of architectural opening and the dominant leverage logic begin to intertwine leading to differences in the emergence processes of ecosystems. Given that the dissimilarities in ecosystem emergence processes continue to increase as the ecosystem emergence continues, these results suggest that there is not one evolutionary route of platform-centric ecosystem emergence. Providing empirical justification for the claims of Thomas et al. (forthcoming), there is perhaps no common evolutionary route to platform-centric ecosystem emergence, but instead exists a variety of unique paths to emergence.

Summarising, the empirical findings of the three phases of emergence and the increasing dissimilarity in the emergence processes across the phases, both validate current models of ecosystem emergence, as well as provide insight into the nature of the processes which underpin ecosystem emergence.

6.1.2 Equifinal emergence

The empirical findings of significant dissimilarities between each emergence sequence, the increasing differences in the emergence processes of each case, and the influence of the idiosyncratic logics of value, suggest that it is possible to argue that each ecosystem case is not comparable. Put differently, this view privileges ecosystem processes over ecosystem structures, arguing that different ecosystem processes mean that comparisons between ecosystems are not valid. Taking the view of Amit and Zott (2001), this implies that the heterogeneity in each of the four factors in their models of value co-creation – efficiency, complementarity, lock-in and novelty – results in processes than mean that ecosystem structures, dynamics and boundaries that are not comparable. It surfaces a tension between the structural characteristics of an ecosystems – the network of organisations, governance structure and institutional logic – and the dissimilar processes that have been empirically identified here.

To claim such non-comparability would unnecessarily restrict the wider application of the term ‘ecosystem’ and to do so would merely make the term a loose label for heterogeneous incompatible phenomena. If the ‘ecosystem’ as a term is to be used in any meaningful way in management research, it must be one that covers a range of different empirical examples. It must be broad enough to encompass

multiple instances of a phenomena, yet narrow enough to be meaningful. Theoretically, an ecosystem has a range of attributes that enable it to be applied to a range of different empirical examples (c.f. Adner & Kapoor, 2010; Chapter 2; Iansiti & Levien, 2004a). For instance, Chapter 2 argues that ecosystems consist of a value-creating network of organisations, governance system and institutional logic. Similarly, the whole thrust of the Autio and Thomas (forthcoming) definition – a network of interconnected organisations, connected to a focal firm or a platform, that incorporates both production and use side participants and that co-creates and appropriate value – is to be wide enough to encompass a range of empirical examples as well as defined enough to remain useful as a model. Specifically, the prerequisite that an ecosystem is a network of interconnected organisations connected to a focal firm or platform opens up a large conceptual space, however this space is limited through the further stipulations that the network must incorporate both production and use side participants and that together they co-create and appropriate value. For the six cases in this research, by the end of the period under investigation, each case certainly consisted of a network of interconnected organisations connected to a platform, incorporating both production and use side participants engaged in the co-creation and appropriation of value. Put differently, by the end of the period of investigation, each case consisted of a value-creating network, governance system and institutional logic. Furthermore, the empirical findings of similarity in the first phase also suggest that differing cases can be compared.

If each of the six cases are comparable, then to resolve the tension between the process dissimilarities found empirically and the similar structural characteristics of ecosystems, it is productive to consider these emergence processes to be equifinal, in the sense that each case became a similar state, a functioning ecosystem, through dissimilar paths and processes. This provides both relevance to the term ‘ecosystem’, as well as to the generalisability of the results. In this sense, the processes of emergence are equifinal as each case “reach[ed] the same final state from differing initial conditions and by a variety of paths” (Katz & Kahn, 1978:p. 30). However to claim equifinality requires an understanding of what a ‘same final state’ is in the context of ecosystem emergence.

Originally Bertalanffy (1968), with his focus on open systems, considered the ‘same final state’ to be the broad notion of a ‘steady state’. From this perspective, each case can be considered in a steady state – indeed the successful emergence to undoubted market leader of each case drove the scope of data provision. Data collection ceased when a case was considered to have stabilised and be in a steady state. However the notion of a ‘steady state’ is not conducive to operationalisation for empirical research, and as such organisation theory and strategy scholars, in their adoption of the notion of equifinality, have operationalised the ‘same final state’ in terms of organisational performance.

Organisation theory and strategy have considered the ‘same final state’ from a variety of different perspectives. Within structural contingency theory and configurational theory, equifinality has generally been invoked when there are different paths to similar organisational performance, such as survival or effectiveness. Introducing equifinality to structural contingency theory, Van De Ven and

Drazin (1985) relaxed the assumption that there are unique, best structured solutions for a given level of context. Instead they recognised that there are multiple, equally effective alternatives of ‘fit’ to any context. Analytically, the basic hypothesis of equifinality in structural contingency theory is that some measure of organisational performance is a function of organisational context and structure. The influential approach to equifinality of Gresov and Drazin (1997) adopted the concept of functional equivalence of Giddens (1979). For Gresov and Drazin (1997), equifinality occurs when there are different structural alternatives that yield the same functional effect. Equifinality is also explicitly invoked in configurational theory, acknowledging that there is more than one way to success in a given setting (Doty, Glick, & Huber, 1993; Meyer et al., 1993). Here equifinality exists where there is a feasible set of equally effective, internally consistent patterns of strategy and structure for a given context (Jennings & Seaman, 1994). Analytically, the basic hypothesis of equifinality in configurational theory is that some measure of organisational performance is a function of organisational context, structure, and an appropriate pattern of coherent organisational processes.

Equifinality has also been adopted within strategy literature, where the ‘same final state’ is competitive advantage. In the resource-based view, for instance, differing bundles of resources and capabilities have been shown to lead to competitive advantage (Gruber, Heinemann, Brettel, & Hungeling, 2010), or different combinations of business strategies and resource acquisition strategies can lead to competitive advantage (Zaefarian, Henneberg, & Naude, 2011). Perhaps counter intuitively, ‘strategic equifinality’ occurs when strategic substitutes exist. Specifically, if a resource is valuable, rare and costly to imitate but has strategically equivalent substitutes that are themselves not rare or not costly to imitate, then that resource cannot be a source of competitive advantage (Barney, 2001). The two resources are strategically equifinal with respect to the end state of competitive advantage. Analytically, the basis hypothesis of equifinality in the strategy literature is that competitive advantage is a function of the underlying resources, strategies or both. As a contrast, within the behavioural strategy literature, the ‘same final state’ has been ‘tie formation efficiency’ – the avoidance of lengthy and high-effort searches, failed attempts, and undesirable partners (Hallen & Eisenhardt, 2012).

Taken together, the organisation theory and strategy literatures have operationalised the ‘same final state’ as a measure of organisational performance, such as survival, efficiency or competitive advantage. Each of the six cases meets these three measures, although at a different level of analysis. By definition each case and its ecosystem has survived. Similarly each case has demonstrated efficiency through their profitability (in the case of Wikipedia gaining donations), and in the emergence and maintenance of their network of ecosystem participants. Arguably each also has competitive advantage, as they successfully saw off rivals to become the dominant ecosystem for their particular logic of value co-creation. However in contrast to the original formulations in organisation theory and strategy, each of these objective measures is applied at the network level rather than at the level of the organisation. This is in the spirit of the original formulation of equifinality of Bertalanffy (1968) which looked to

open systems. As an ecosystem is an open system, there is little doubt that such an extension to the network level is feasible, if not desirable.

The application of equifinality in the dynamic capabilities literature is illustrative of, and provides further support for, the claim of equifinality in ecosystem emergence. Eisenhardt and Martin (2000), in their analysis of dynamic capabilities, noted that there are significant commonalities in product development, strategic decision-making and alliancing across firms (so called ‘best practices’). As a consequence, they argue that dynamic capabilities emerge equifinally within an organisation, noting that although dynamic capabilities are similar in terms of key attributes (‘best practices’), the specifics of any given dynamic capability are idiosyncratic to an organisation (for example, exact composition of a cross-functional product development team). By the same logic, equifinality can be claimed for the emergence of ecosystems. Each ecosystem meets the measures of performance that are commonly invoked, specifically survival, efficiency and competitive advantage. Each ecosystem is functionally equivalent (Gresov & Drazin, 1997), in that it is a successful network of interconnected organisations that are co-creating value. And each ecosystem is similar in terms of its key attributes – namely that it has a network of interconnected organisations, connected to a focal firm or a platform, incorporating both production and use side participants and co-creating value, and which has a governance system and an institutional logic – but where the specifics of each of these attributes are idiosyncratic. In this case, the underlying processes and logics of value of co-creation are idiosyncratic – but this does not deny a claim of equifinality.

Summarising, this section has argued that to resolve a tension between the similar structural characteristics of an ecosystem and the empirical finding of dissimilar processes in each case, the emergence processes of the six cases should be considered equifinal, in the sense that they reached the same final state from differing initial conditions and by a variety of paths and processes. Despite the influence of the idiosyncratic logic of value co-creation of each case on the emergence processes, the end state of each is similar in terms of its key attributes, and as such specific examples of ecosystems are able to be compared meaningfully. To consider the emergence processes of ecosystems as equifinal is in the spirit of the original formulation of equifinality of Bertalanffy (1968), extending the application of equifinality in the management discipline from the organisational level to the network level.

6.1.3 The ecosystem model

These empirical findings, particularly the importance of the logic of value co-creation and appropriation in ecosystems, also highlights the close relationship between value co-creation and value appropriation. In ecosystem contexts, value co-creation and value capture are intrinsically intertwined: without value synergies, ecosystems would have little reason to exist, and value appropriated must first be co-created. Empirically, this interlinking is demonstrated by the increase in dissimilarity in the Control phase, when the imposition of value appropriation and control further differentiated the logic of value co-creation, and hence the emergence sequences of each case. As fair distribution of value

underpins the long term viability, success and health of an ecosystem, each participant must capture a sufficient portion of the overall value to justify its participation (Iansiti & Levien, 2004b; Lin, Wang, & Yu, 2010). If there is not fair value appropriation, powerful firms can drain value from the ecosystem and eventually destroy them by leaving too little value to support it (Cusumano & Gawer, 2002; Iansiti & Levien, 2004a, b). As a consequence, any discussion of the logic of value co-creation in ecosystem contexts must also include how that value is shared.

However, in ecosystems, value co-creation and value appropriation operate at fundamentally different levels of analysis. The synergies required for value co-creation are enabled and facilitated at the level of the ecosystem: it is the ecosystem structure, participant composition, governance system institutional logic, and resulting value and participant synergies, and compatibilities between complementary offerings that underpin the synergistic value processes (Adner, 2012; Adner & Kapoor, 2010). On the other hand, value appropriation always occurs at the level of participants and shows up in their balance sheets (Teece, 1986). Thus the model of value creation in e-business of Amit and Zott (2001), which has been useful demonstrating the heterogeneity of the logics of value co-creation, is not sufficient as it is predominantly focused at the level of the hub-firm. Moreover, it does not consider value appropriation extensively and is restricted in application to e-business, reducing generalisability. Similarly, the vibrant and growing business models literature, which is framed in the context of value creation, delivery and capture, could also hold promise were it not for its firm-level of analysis (c.f. Afuah, 2003; Chesbrough, 2007; George & Bock, 2011; Magretta, 2002; Osterwalder & Pigneur, 2010; Zott & Amit, 2009).

The few models of value creation and appropriation in the ecosystem literature hold promise. Adner and Kapoor (2010) consider value creation through the lens of technological interdependencies; however they do not consider in depth value appropriation nor the influence of institutional processes in value co-creation. Jacobides et al. (2006) have outlined how organisations can create an ‘architectural advantage’ in terms of high levels of value appropriation through the enhancement of both complementarity and mobility in parts of the value system where they are not active. However they do not consider value co-creation in any substantive way. Thomas, Autio, and Gann (2012) have proposed three structural characteristics that regulate the ability of an ecosystem to support value co-creation. A technology architecture represents the set of design choices relating to modularity, standardisation, connectivity and complementarity. An activity architecture operationalises the technological architecture as a series of specialised artefacts and organisational structures that coordinate to provide the technological artefacts. Together these two architectures influence a value architecture by determining the salience of different value creation mechanisms – economies of production, innovation and transactions (Thomas et al., forthcoming). Combined, the technological, activity and value architectures drive the logic of value co-creation in an ecosystem. With the Thomas et al. (2012) model

of value co-creation, each ecosystem participant develops firm-specific control mechanisms that enable them to appropriate their share of the overall value co-created.

Synthesising these differing perspectives on value creation and appropriation in ecosystem contexts, as well as the business model literature, an ‘ecosystem model’ provides a useful lens to consider the ecosystem as a whole. An ecosystem model is analogous to a business model; however the difference is that while the business model applies at the level of the focal firm, the ecosystem model applies at the level of the network. The ecosystem model has been anticipated by the earliest of ecosystem thinkers, Moore (1996), who argued that for a hub firm to perform best within the ecosystem it was important for them to think about the ‘business model’ of the ecosystem (p. 57). Similarly, the network management literature has also anticipated this type of idea. Möller, Rajala, & Svahn (2005) have suggested that it is important to manage the network as a whole. Ritter, Wilkinson, & Johnston (2004) have distinguished between the ‘managing in’ of relationships such as the coping within a certain network situation, versus the ‘managing of’ relationships such as leading, determining, and organising.

An ecosystem model is formally defined as *the stable configuration of attributes that jointly define how an ecosystem supports value co-creation by its participants and the distribution of this value among its participants*. This suggests that value, technological, participant, and institutional attributes jointly define how an ecosystem supports value co-creation and the distribution of this value. Put differently, in the spirit of Osterwalder and Pigneur (2010), the ecosystem model can be considered ‘the rationale of how an ecosystem creates, delivers and shares value’.

The concept of an ecosystem model complements the concept of a business model. Each participant within an ecosystem has its own business model, which determines how they individually will create, deliver and capture value; simultaneously each participant will also be part of the ecosystem model, which determines how collectively they co-create, deliver and share value. As a consequence the ecosystem model is constituted of the business models of its participants, but due to network level attributes, it is more than the sum of the underlying individual business models. This implies that those firms that have power within an ecosystem, such as a hub firm, have a tension between the ecosystem model and their business model. On the one hand, the hub firm needs to ensure that there is value co-creation, delivery and fair distribution at the network level – it needs to manage the ecosystem model (perhaps collectively so with ecosystem participants). On the other hand, the hub firm needs to ensure that it creates, delivers and captures value for itself. Hub firms that balance this tension have been called ‘keystones’ by Iansiti and Levien (2004a) and ‘platform leaders’ by Gawer and Cusumano (2002). Iansiti and Levien (2004a) eloquently describe how those firms that do not successfully balance the tension between the ecosystem model and their business model, so called ‘landlords’ and ‘dominators’, destroy or drain ecosystems, using Enron as an example.

Summarising, given the importance of value co-creation as a regulator of ecosystem evolution, a holistic understanding both value co-creation and value capture is necessary due to their intrinsic intertwining in ecosystems contexts and their fundamentally different levels of analysis. I have proposed the ecosystem model as the rationale of how an ecosystem creates, delivers and shares value.

6.1.4 Ecosystem dynamics

Theoretically, the development of an institutional approach provides insight into the dynamics of ecosystems. Theorisations of how dominant organisational arrangements reproduce themselves due to the distribution of rules and resources, and the ability of skilled actors to use these to reproduce their power (Fligstein, 2001), assist the scholar in appreciating similar dynamics in ecosystem contexts. Furthermore, theorising into organisational fields offers a sophisticated understanding of how these structures are created, sustained and transformed, which external forces are at work, and the conditions for change (Fligstein, 2001).

The attention to legitimacy and the institutional logic in theorisation of organisational fields are also relevant to understanding the dynamics of ecosystems. Theorisations of the sources of legitimacy (Deephouse & Suchman, 2008; Meyer & Scott, 1983; Suchman, 1995b), legitimisation processes (Deephouse & Suchman, 2008; Greenwood et al., 2002), as well as the consequences of legitimacy (Deephouse & Suchman, 2008; Meyer & Rowan, 1977), offer the potential to advance research into ecosystem dynamics. Some ecosystem scholars are already adopting such approaches. For instance, analysing the emergence of Cisco as a platform leader, Gawer and Phillips (forthcoming) expound upon the differing legitimacy and practice work a hub firm undertakes in order to become and remain a platform leader in an ecosystem. Sharapov, Thomas, and Autio (2013) illustrate how the development of cognitive legitimacy for the hub firm enables socio-political legitimacy for both the ecosystem and its participants. The analytic tools in institutional theory to understand cognition, such as framing, are a potent lens through which to understand legitimacy and institutional logic in ecosystem contexts. The three overlapping framing processes of Benford and Snow (2000) – discursive, strategic (including collective identity construction) and contested – provide a powerful framework to understand the development of legitimacy and the institutional logic within an ecosystem. The multi-level cognitive technological frame model of Kaplan and Tripsas (2008), where there is a reciprocal relationship between the individual participant frame and the negotiated collective frame, also offers a powerful tool to understand the evolution of the institutional logic in ecosystem contexts. The Kaplan model outlines the process by which the emergence of an institutional logic involves the sociological resolution of both competing frames and competing technologies. Specifically, congruent with the approach taken in this thesis, the collective frame for the ecosystem emerges through the interaction of the interpretive processes of the hub firm, complementors and other participants in the ecosystem, as well as the wider social, political and technological context. Their technological frame model also provides insight into the individual actions of participants involving adoption, investment and institutional support decisions,

illuminating a direct mechanism for how technology and technological interdependence evolves in an ecosystem.

Existing research into collaboration also holds promise of theorising ecosystem dynamics. As organisational fields act as sources of rules and resources for collaboration, often collaborating parties draw from their 'home' organisational field in order to agree the terms of the partnership (Phillips et al., 2000), underscoring the potential of collaboration research. One potential approach is negotiated order theory, which holds that organisations can collaborate in constructing their organisational field by agreeing on the 'rules of the game' for their interactions with one another (Day & Day, 1977; Gray, 1989; Nathan & Mitroff, 1991; Strauss et al., 1963). Older conceptions of the organisational field in institutional theory may also be pertinent. For instance, Scott and Meyer (1983) outlined how decision making power can be centralised on three differing axes: programmatic, the right to determine the purposes or goals towards which sector activities are to be directed; instrumental, the right to determine the means or procedures to be employed in pursuing sector objectives; and funding, the right to determine what level of funds are to be expended and/or to be allocated. These axes may assist in considering how the collaborative actions of ecosystem participants are shaped by the distribution of power within an ecosystem. Hardy and Phillips (1998) differentiate differing types of conflict and cooperation that occur within organisational fields. Cooperation can be distinguished between reciprocal collaboration where there is a probable change to the ecosystem, and compliance typified by high dependency on, and regulation by, a central authority which results in a reduced likelihood of change within the ecosystem. Conflict can morph into contention where there is a significant likelihood of change within the ecosystem and contestation where there is only limited possibility of change. Taken together these theorisations of collaboration suggest a more nuanced understanding of how ecosystem participants interact.

Dominant design theory is particularly relevant to understanding ecosystem dynamics when it has a coordinating platform, considered a slowly changing collection of reusable assets (Baldwin & Woodard, 2009), structurally very similar to the nested model of dominant design of Murmann and Frenken (2006). This nested understanding of technological design could advance ecosystem research through theorisations of the technological trajectories that underpin value co-creation within the ecosystem. For example, the experience of Salesforce with the gradual opening of the underlying technological base to customisation at the request of participants, and then the wider release of sForce and AppExchange, could be analysed in more depth. How this progressive opening of a particular technological design, and the interplay with ecosystem participants who shaped the technological direction, is of particular interest in light of the later technological crisis that Salesforce experienced. Social movement theory also has potential to advance research into ecosystem dynamics, particularly where the ecosystem participants have a large role in the ongoing governance of the ecosystem, such as typified by Wikipedia and the early period of eBay. An understanding of the triggering events,

mobilising structures and framing that are used by participants in ecosystem contexts are valuable in understanding its dynamics. The institutional entrepreneurship literature offers theorisations of how the actions of participants in an existing ecosystem can alter it for their own benefit. In ecosystem contexts occasionally a participant has the ability to build their own ecosystem within the existing ecosystem (Iansiti & Levien, 2004a), or a dominant participant in one ecosystem challenges the hub firm in another (Eisenmann, Parker, & Van Alstyne, 2011). Given the emphasis on regulatory, normative and cognitive processes, as well as the contestation processes of incumbents, in theorisations of institutional change, their application to ecosystem competition may lead to a fuller understanding of such dynamics.

Summarising, theorisations of the organisational field, as well as of collaboration, dominant design, social movement and institutional entrepreneurship, together offer the potential to advance ecosystem research. More specifically, they offer insight into the sources and processes of legitimacy and institutional logic, collaboration and conflict, the technological trajectories that underpin value co-creation, and how participants can alter the ecosystem for their own benefit.

6.1.5 Ecosystem boundaries

Theorisations of the organisational fields provide also useful insight into the boundaries of ecosystems, as the variety of ecosystem participants gives rise to difficulty in defining the boundaries of ecosystems. Ecosystem boundary definition is complex, as the boundaries are usually considered to be fairly open and permeable (Gulati et al., 2012; Iansiti & Levien, 2004a). This difficulty is reflected in the different attempts to operationalise ecosystem boundaries. As an example, in their value-based model, Adner and Kapoor (2010) operationalised an ecosystem as consisting of those participants (suppliers, complementors, customers) that are only one network link away from the focal firm or customer. In contrast, other boundary definitions are not as clear. Iansiti and Levien (2004b) emphasise participant identification with ecosystem membership and argue that ecosystem boundaries are hub firm specific, drawn through the identification of ecosystem participants with the hub firm. Santos and Eisenhardt (2005) point out that ecosystems have broader boundaries than those implied by market efficiency. They specifically highlight power and the specialisation of organisational competencies as defining features of ecosystem boundaries. Although different boundary definitions may be applicable to different purposes and perspectives, it is clear that ecosystem boundaries are difficult to define.

Boundary definition has been directly faced by institutional theorists when considering theorising the organisational field. Specifically, the boundaries of an organisational field are defined through the dominant institutional logics (Scott, 2008; Zietsma & Lawrence, 2010) and shared cultural-cognitive, normative or regulatory frameworks (DiMaggio & Powell, 1983; Scott, 2008). Boundaries have also been defined through the extent of the adoption of institutional practices (Zietsma & Lawrence, 2010). The boundaries of an organisational field have also been seen as truce-making in a process of contestation, in that they only become established only when the ecosystem participants coalesce around

a frame that organises activities (Rao et al., 2000). Taken as whole, the boundaries of organisational fields are defined institutionally.

By extension, the boundaries of an ecosystem can be defined through the adoption of institutional theorisations. To theorise the boundaries of the ecosystem in such a way aligns with the approach of Iansiti and Levien (2004b) who emphasise participant identification with the ecosystem membership. However, Iansiti and Levien (2004b) also consider the ecosystem boundaries to be hub firm specific, as the ecosystem participants impliedly define the boundaries through their identification with the hub firm. In contrast, institutional theorisations, such as the extent of the institutional logics and the shared regulatory, normative and cognitive frameworks, enable ecosystem boundaries to be drawn with reference to the participants of the ecosystem. This is a potentially more powerful approach as it moves the referent by which a boundary is defined from an ecosystem participant (the hub firm), to the ecosystem as a whole.

Summarising, the boundaries of ecosystems are difficult to define, as boundaries are fairly open and permeable. Theorisations of the organisational field, which define boundaries institutionally (such as through the institutional logics or regulative, normative, and cognitive structures), have the potential to advance ecosystem research as they move the referents of definition from the hub firm to the level of the ecosystem.

6.2 Implications for institutional theory

The empirical findings and the development of an institutional approach to ecosystems also have implications for institutional theory, and theorisations of the organisational field in particular. Institutional theory has a long tradition of research into organisational fields, which has made great contributions to our understanding of how networks of organisations interact within a framework of regulative, normative and cognitive elements (Garud et al., 2002; Lawrence & Phillips, 2004; Scott, 2008). These contributions have been enhanced through insights into institutional logics (Friedland & Alford, 1991), discourse (Phillips et al., 2004), identity (Polletta & Jasper, 2001) and framing processes (Benford & Snow, 2000; Fligstein, 2001; Snow et al., 1986). Indeed the focus on organisational fields as an object of study is viewed by institutional scholars as an important device to help transition this research domain from a paradigm-driven mode to a problem-driven mode (Davis & Marquis, 2005; Wooten & Hoffman, 2008).

The empirical findings of this thesis provide some empirical validation of a number of models of institutional formation, as well as directing analytical focus towards the processes of formation, as distinct to an earlier focus on the enabling sources of change. In doing so it extends our understanding of the formation processes of organisational fields. Furthermore, the identification of four activities that drive ecosystem emergence offers the promise of extending our understanding of the mechanisms of organisational field formation. Building upon existing theories of institutional work (Jepperson, 1991;

Lawrence & Suddaby, 2006) and field-configuring events (Lampel & Meyer, 2008; Meyer et al., 2005), these four activities potentially provide a novel analytic lens to assist our understanding of the mechanisms of organisational field formation. Theoretically, the development of an institutional approach to ecosystems also provides the opportunity for particular aspects of ecosystems to develop our understanding of organisational fields. Beyond consisting of a value-creating network of organisations, a shared governance system and a shared institutional logic, ecosystems also exhibit powerful central organisations and various degrees of technological interdependence among ecosystem participants. These latter attributes have not received much attention within the organisational field literature and as a consequence their theoretical integration has the potential to enrich the theorisation of organisational fields.

6.2.1 Models of organisational field formation

Only recently have scholars begun to consider in detail the processes of organisational field formation (Anand & Jones, 2008; Powell et al., 2005). Early on DiMaggio and Powell (1983) proposed a four step process that leads to the emergence of mutual awareness of participants, focusing on the emergence of a collective rationality. In contrast Bourdieu (1993) focused on conflict as the driving principle of emergence, where the competitive forces arise due to the resource limitations in any field (DiMaggio, 1979). More recent theorisations of organisational field formation have primarily drawn from institutional entrepreneurship theory, which considers the question of how actors can change institutions if their actions, intentions and rationality are all conditioned by the very institution they wish to change (Holm, 1995; Seo & Creed, 2002). Taken together, the majority of institutional, and more specifically organisational field, formation research addresses broad processes such as discourse, theorisation, contestation, legitimation and diffusion (Ferguson, 1998; Greenwood et al., 2002; Hinings et al., 2004; Phillips et al., 2004; Strang & Soule, 1998). Only recently have more specific considerations of the mechanisms of organisational field formation been proposed, such as ‘institutional work’ (Jepperson, 1991; Lawrence & Suddaby, 2006) and ‘field-configuring events’ (Lampel & Meyer, 2008; Meyer et al., 2005).

As understanding of organisational fields and institutions has developed, a number of models of organisational field formation have been proposed. Not surprisingly, given the analytic focus on the sources of institutional entrepreneurship (Battilana et al., 2009), these models primarily consider enabling conditions that give rise to field formation. For instance, Zietsma and Lawrence (2010) focus on the interaction of practices and boundaries, Greenwood and Suddaby (2006) consider when embedded elites are enabled and motivated to act as institutional entrepreneurs, and Seo and Creed (2002) focus how institutional contradictions arise and lead to change. Although these models do include some elements of the subsequent formation processes see for instance Seo and Creed (2002), these are not developed in any depth. There are a number of models that integrate the enabling sources of institutional change with broader emergence processes. The models of Suchman (1995a) and Tolbert

and Zucker (1996) both consider in detail the processes of problem generation, cognition and response, as well as broader processes of theorisation, objectification, contestation and diffusion. A more complex model is that of Lounsbury and Crumley (2007) who provide a detailed understanding of the processes, such as theorisation, contestation and boundary definition, which lead to the emergence of a new practice field. However these models do not establish any distinct stages or temporality, instead outlining the relationships between each type of process.

There are a number of models of organisational field formation that include, either implicitly or explicitly, discrete formation stages as distinct to the sources of the change. The early model of Tolbert and Zucker (1983) suggested an adoption stage underpinned by the recognition of performance gaps, followed by a second stage of mimetic isomorphism driven by legitimation and theorisation. However this model is more focused on the processes of isomorphism at the organisational level and does not consider the organisational field in any substantive manner. A more recent high level model is that of Battilana et al. (2009), who identify the creation of a vision for divergent change and the mobilisation of allies behind the vision as two processes that drive institutional change. Although not named as separate stages, these two stages are presented as such, and roughly correspond to the empirical findings of the Initiation and Momentum phases. In contrast, Hinings et al. (2004), who incorporate and extend the earlier model of Greenwood et al. (2002), explicitly propose distinct stages of organisational field formation. However, unlike the Moore (1993) model of ecosystem emergence, the correspondence of their stages to the three empirically identified phases is not as clear cut. For instance, both the Hinings et al. (2004) and Greenwood et al. (2002) models, similar to other models of organisational field formation, also include the enabling conditions along with the subsequent broad emergence processes of theorisation, legitimation, objectification and diffusion. These models have six stages, with the Hinings et al. (2004) model specifically proposing: pressures for change (functional, political and social), sources of new practice (including institutional entrepreneurs), processes of de- and re-institutionalisation (theorisation, legitimation and dissemination), dynamics of de- and re-institutionalisation (value commitment, interest satisfaction, power structure and capability) and re-institutionalisation. As such the first stage, consisting of precipitating jolts and deinstitutionalisation, occurs prior to the Initiation phase and represents the enabling conditions for organisational field formation. The following stage – sources of new practice, typified by institutional entrepreneurship – most closely relates to the Initiation phase in that there is independent innovation and activities to prove technological viability. The processes of de- and re-institutionalisation stage – theorisation, legitimation and dissemination – and the dynamics of de- and re-institutionalisation stage – value commitment, interest satisfaction, power structure and capability development – correspond to the Momentum phase, in that socio-political legitimacy and a power structure emerges, as well as societal and ecosystem outreach activities occur that justify participation in the ecosystem. The final stage – re-

institutionalisation – corresponds to the Control phase, reflecting the emergence of cognitive legitimacy and the establishment of the hub firm as a powerful field level actor.

Other institutionally-related theorisations of organisational field formation are also salient, including models from social movement theory and dominant design theory. These theories generally do not include the enabling conditions for change, and instead focus on the field formation processes themselves. From social movement theory, Davis and McAdam (2000) have proposed a linear model which emphasises the identification of an opportunity, the gathering of resources to enable change, followed by collective action. Although this model does not specifically identify stages and is more concerned with the interplay between the challenger and incumbents, the processes are presented as being in a temporal order, with one following the other. The first two processes – identification of opportunity and the gathering of resources – roughly correspond to the Initiation phase, and the collective action process to the Momentum phase. As Davis and McAdam (2000) do not propose any subsequent activities, instead suggesting that contention between the incumbent and challenger continues, the empirical identification of the Control phase directs attention to the processes that occur subsequent to successful collective action. In particular it highlights that there are additional processes of a dominant social actor consolidating its position, and control processes imposed on the new institutional settlement.

From dominant design theory Suarez (2004) has suggested a model with five distinct phases of dominance design emergence – R&D build-up, technical feasibility, creating the market, decisive battle and post dominance. Here the first two stages correspond to the Initiation phase, focusing on resource gathering and technological activities with a focus on gathering complementary assets and development technological superiority. The next two stages correspond to the Momentum phase, typified by market outreach and competition, and as network effects, the installed base, and strategic manoeuvring become critical. Finally the last stage corresponds to Control phase, as the winning design becomes dominant and activities shift to incremental value improvements. Relatedly, Hargrave and Van De Ven (2006) have suggested three stages of institutional technological innovation – emergence, development and implementation – where each stage corresponds to each of the three phases found empirically. Specifically, the emergence stage correspond to the Initiation phase, as in this phase the hub firm begins to develop a new innovation and organise to launch. Their development stage corresponds to the Momentum phase, where collective action processes become more evident and networks of actors develop and compete for dominance. Their third stage, implementation, corresponds to the Control phase, as the particular innovation has achieved dominance and becomes legitimated and ratified.

As a whole then, the correspondence of the existing models of organisational field formation with the empirical findings of three phase model provides some empirical validation of the existing institutional models. Although some validation should be anticipated given the retroductive approach to phase identification (see Section 5.2), this finding is still worth noting as there has only been limited

empirical work on these models to date. Furthermore, the three phases direct analytic focus to the later formation processes of the organisational field as distinct to the enabling conditions for emergence. In doing so the three phase model proposed within this thesis joins only a small number of extant models that have explicitly considered these processes of organisational field formation. Moreover, driven by the retroductive approach undertaken to empirically develop the three phases, these findings further integrate the institutionally-related theorisations of organisational field formation and change of social movement theory and dominant design theory with mainstream institutional theory.

This analytic focus on the processes of formation is further enhanced through the related findings of differing event frequencies within each phase. In particular, the U-shaped frequency of technology events, an inverted-U shaped frequency of contextual events, the decreasing frequency of resource events, and the dependency of the institutional event frequency on the type of governance, provide a level of insight into the types of activities within each phase that has not been present in existing theorisations. At a broad level, these findings clarify the types of activities which constitute the broader processes of theorisation, legitimation and diffusion, and may be able to provide empirical insight into the underlying process motors (Van De Ven & Poole, 1995) which drive the formation. Moreover, these findings extend our understanding of theorisations of organisational field formation by providing additional justification for the integration of social movement theory into institutional theory more generally (see for instance Lounsbury et al., 2003; Rao et al., 2000). For instance, the Initiation phase, with its emphasis on resource gathering and the development of the business and technological artefacts, provides additional justification for the integration of social movement theory as it echoes the notion of the mobilising structure (Tilly, 1978). Similarly, in the Momentum phase, the increase in context activities and ongoing institutional activities underlines the importance of the discursive, strategic and contested framing processes of Snow and Benford (1988).

The finding of increasing dissimilarity in the emergence processes in each case as an ecosystem emerges also has implications for theorisations of organisational field formation. In particular, these findings suggest that scholars should be aware of the nature of the change they are studying, and not assume that processes identified in one case are generalisable across all cases of organisational field formation. In particular, these findings suggest that these processes may be idiosyncratic to their context. From the point of view of institutional entrepreneurship, these findings suggest that although the processes may be similar across cases at the earlier stages of organisational field formation, such as reactions to social, technological or regulatory change (Hinings et al., 2004), or independently innovating and testing the technical viability of their innovation (Greenwood et al., 2002), the later processes of institutional entrepreneurship are specific to their context. For instance, the processes of theorisation and framing, such as the specification of the general failings and justification of the possible solution, as well as the processes of diffusion, with the concomitant increasing objectification, vary depending on the specific context. Similarly for social movement theory, these empirical findings

suggest that the early stages of social movement activity are characterised by similarity in these processes, such as reacting and mobilising to the political opportunity. However, the processes of collective action, particularly framing and identity construction, may be idiosyncratic to the social movement. For dominant design theory a similar logic applies, with suggestions that there are similarities in the processes of R&D build-up and technical feasibility across cases, but that the processes of market creation and competitive battles are idiosyncratic to the particular dominant design. As all theorisations of organisational field formation have legitimation as an important process in enablement, these findings also suggest that the processes of legitimation are similarly idiosyncratic to their context.

The idiosyncratic nature of the processes that drive the formation of organisational fields may be reflected in extant empirical studies. To date, there has only been a small number of studies which specifically consider the emergence processes of organisational fields. Interestingly, these studies have focused on specific contexts, such as US art museums (DiMaggio, 1991), environmentalism (Hoffman, 1999), and gastronomy in nineteenth-century France (Ferguson, 1998), rather than consider organisational field emergence as a general process. Given that the later processes of organisational field formation may be idiosyncratic to its context, this implies that scholars may be only able to identify the broad processes of organisational field formation. Put differently, these studies perhaps reflect the fact that granular process theories to explain organisational field formation may not be possible, and that the models discussed above are already at the best level of granularity that can be achieved. Instead, research and analytic focus may need to concentrate on those specific mechanisms of organisational field formation that are similar, and hence generalisable, across cases. (This insight is developed in more detail in Section 6.2.2 below.)

Summarising, the empirical findings of the three stages and the increasing dissimilarity of the processes within each phase when compared across stages provide welcome empirical validation and direct analytic attention towards the processes of organisational field formation as distinct to the enabling conditions. The empirical findings also suggest complementary insights that extend our understanding of a number of models of organisational field formation. Furthermore, the finding of increasing dissimilarity in the emergence processes of the six cases suggests that granular process theories to explain organisational field formation may not be possible.

6.2.2 Mechanisms of organisational field formation

Building upon the empirical findings, and resultant suggestion that research focus may need to be on generalisable mechanisms of organisational field formation, the theoretical identification of the four activities that drive ecosystem emergence hold the promise of a novel analytic lens.

As noted above, only recently have researchers begun to theorise the mechanisms of organisational field formation. One line of research has been ‘institutional work’, which focuses

attention on human action in institutional change (Jepperson, 1991; Lawrence & Suddaby, 2006). Institutional work considers the “purposive action of individuals and organisations aimed at creating, maintaining and disrupting institutions” (Lawrence & Suddaby, 2006: 215), in doing so reintroducing notions of practice into institutional change. For the creation of an institution, Lawrence and Suddaby (2006) from their review of the literature, propose such actions as: advocacy (the mobilisation of political and regulatory support); defining (the construction of rule systems); vesting (the creation of rule structures that confer property rights); constructing identities; changing normative associations; constructing normative networks; mimicry (associating new practices with existing sets of taken-for-granted practices, technologies and rules); theorising; and educating. More recently Gawer and Phillips (forthcoming) have identified external practice work, internal practice work, legitimacy work and identity work as salient in ecosystem emergence contexts. Another recent line of research has been in ‘field-configuring events’ (Lampel & Meyer, 2008; Meyer et al., 2005). Field-configuring events are mechanisms that occur at specific temporal moments in the evolution of an organisational field, where a structuring moment has a role in shaping technological artefacts, market boundaries and regulatory frameworks (Lampel & Meyer, 2008; Oliver & Montgomery, 2008). Field-configuring events include competitions (Rao, 1994), conferences (Garud, 2008), and ceremonies (Anand & Jones, 2008; Anand & Watson, 2004).

Together both institution work and field-configuring events link field evolution at the macro level with individual action at the micro level (Lampel & Meyer, 2008; Lawrence & Suddaby, 2006; Meyer et al., 2005). Similarly, the four underlying activities theoretically derived from dominant design theory, social movement theory and institutional theory also link macro level change with individual action. However in contrast to an analytic focus on a particular actor or organisation, or on specific events that shape organisational field emergence, these four activities analytically focus on the ongoing actions of multiple actors. Thus resource activities are those concerned with the procurement and management of resources by the hub firm in an ecosystem. Technology activities are those related to the design and provision of the underlying technologies, not necessarily but often undertaken by the hub firm. Institutional activities are those related to the institutional structure and operation of the ecosystem, undertaken by both ecosystem participants and the hub firm. And contextual activities provide the conditions for ecosystem emergence as well as shape the environment in which emergence occurs, undertaken by actors such as regulators, the press and competitors. As a whole, the interaction of these four types of activities and their actors builds legitimacy, and shapes the technological design, ecosystem boundaries and regulatory frameworks. As a consequence, these four types of activities cover the totality of actors, including the institutional entrepreneurs, who interact to create institutions. Furthermore these ongoing activities encompass field-configuring events, where resource, technological, institutional and contextual activities come together in a single, field-configuring event.

The analytical lens provided by these four activities complements research into institutional work and institutional change. Recent research has suggested that uncoordinated collective action can result in institutional change (see for instance Dorado, 2005; Wijen & Ansari, 2007). Rather than focus on the actions of an institutional entrepreneur, this suggests that institutional work – those actions aimed at “creating, maintaining and disrupting institutions” (Lawrence & Suddaby, 2006: 215) – could also be undertaken by actors other than the institutional entrepreneur. However, to do so removes the requirement for the work to be ‘purposive’ for institutional change, and allows for work undertaken for other purposes to have institutional consequences. This is congruent with Dorado’s (2005) notion of ‘institutional partaking’, where institutional change results from the autonomous actions of countless agents converging over time, so that no single individual or organisation can be responsible for the changes. The attribution of institutional work to a wider collection of actors implies that it could occur within any of the four types of activities. For example, contextual activities, such as those of the media or regulators, could be considered to have similar effects on institutional change such as advocacy or vesting respectively. Similarly, as rules are often embedded into features of a technology such as modularity (Baldwin & Clark, 2000), technological design activities could have the same effect as institutional work like rule systems that confer status or identity, define boundaries of membership or create status hierarchies (c.f. Gawer & Phillips, forthcoming).

That institutional work may occur purposively or incidentally in any of the four activities by any actor is enhanced through an appreciation of the sub-categories for each category. Building upon the original four categories, each sub-categorisation (detailed in Appendix A) iteratively emerged from an analysis of the empirical data using the original theoretical constructs (Poole et al., 2000). Thus resource activities include corporate, financial, competence, appropriation, coalition, and operational infrastructure sub-activities; technological activities include design, delivery and internationalisation sub-activities; institutional activities include rule-making, discourse, identity, support programs, pricing, membership and promotional sub-activities; and contextual activities include regulatory, competitive, accolades and the discourse of the press and wider society sub activities. By partially operationalising the four activities framework with examples of each sub-activity, specific types of actions are identified which can be associated with institutional work. In doing so each of these sub-activities enables an appreciation of the different types of institutional work undertaken by different actors.

The analytical lens provided by the four activities also complements the recent interest in field-configuring events, as they focus attention on the ongoing incremental activities of organisational field formation that surround an event, as well as provide the constituent elements of a field-configuring event. As a consequence, the four activities permit an examination of the interactions prior and post a field-configuring event to provide insight into the overall dynamics of organisational field formation. For instance, the activities prior to a field-configuring event, such as increased contextual or resource

activity, have the potential to influence both the likelihood of a field-configuring event, and what impact the event itself would have in the overall emergence of an organisational field. The activities post the field-configuring event would provide evidence of the impact of the event. The interplay of resource, technological, institutional and contextual activities could also provide insight into the dynamics within a field-configuring event. As well as occurring prior to a field-configuring event, the four activities will continue within it. As such events have a range discursive spaces (Hardy & Maguire, 2010) and rarely occur at a single specific moment in time – conferences normally occur over a series of days (c.f. Garud, 2008) and award giving ceremonies unfold over longer periods (c.f. Anand & Jones, 2008) – the four activities potentially provide a lens to tease apart the microprocesses within a particular field-configuring event.

The analytic lens provided by the four activities should also enable deeper insight into theorisation, legitimation and diffusion processes involved in organisational field formation. For instance, as a technological design can also be a cognitive aid that assists ecosystem participant understanding and adoption of a technology (Hargadon & Douglas, 2001), understanding the impact of a technological design event on theorisation and legitimation processes holds promise. Similarly, as financial assets can act as a legitimating factor (DiMaggio, 1988) and can be used to attract others into the coalition (Battilana et al., 2009; Garud et al., 2002), understanding the interaction of investment events on legitimation, and diffusion processes also holds promise. Furthermore, by widening attention from the focal actor to the totality of actors who influence the emergence of a field, the inclusion of resource, technological and contextual activities should enable a more detailed understanding of field structuration processes (DiMaggio & Powell, 1983; Giddens, 1979; Scott et al., 2000).

Summarising, the identification of the four activities that drive ecosystem emergence offers promise as an analytic lens that assists in research on the mechanisms of organisational field formation. Complementing the institutional work conducted by institutional entrepreneurs and field-configuring event mechanisms of organisational field formation, the four activities extend analysis to include the totality of actors involved in organisational field formation as well as the incremental activities that occur around field-configuring events. Furthermore, they hold promise in enabling a deeper understanding of the processes of legitimation, theorisation and diffusion involved in organisational field formation.

6.2.3 Powerful central organisations

The notion of a powerful central organisation represents an attribute of the ecosystem construct that is unfamiliar to received theorisations in the organisational field literature. From the beginning of managerial and academic interest in ecosystems, a central organising firm has been treated as essential to this concept (Autio & Thomas, forthcoming). For instance, although a such an organisation was not explicitly highlighted by Moore (1993), his ecosystem nevertheless existed around a powerful focal firm as demonstrated by his examples of Ford, GM and Wal-Mart. Iansiti and Levien (2004a, b)

explicitly included ‘keystone’ organisations in their conception of ecosystems, and Cusumano and Gawer (2002), in their study of platform leadership, also have a powerful organisation at the centre of the ecosystem.

Although institutional theory acknowledges the role of powerful central actors in the field (see for instance Scott & Meyer, 1983), in general theorisations of the organisational field have tended to eschew close inspection and associated theoretical development of the notion of a powerful central organisation. Instead, organisational field research has tended to dwell on the relative power of different actors in a field (see for instance Beckert, 2010; Fligstein, 1991; Hardy & Phillips, 1998). More broadly within institutional theory, Scott and Meyer (1983), in their notion of ‘societal sector’ consider the level of centralisation of the decision making powers as a determinant in the organisation of a societal sector.

The notion of a powerful central organisation is not new to organisation theory, and many of the previous theoretical conceptualisations of central actors are congruent with the notion of a hub firm in an ecosystem, and hence have the potential to enrich research and theorising on organisational fields. Very early on, Litwak and Hylton (1962) suggested ‘coordinating agencies’ as organisations that facilitate the interaction between two or more interdependent formal organisations. Similar to the hub firm in an ecosystem, a coordinating agency manages behaviour between participating organisations through the communication of pertinent information, adjudicates areas of dispute, provides standards of behaviour, and promotes the common interest. Resource dependency theorists also explicitly consider the role of a powerful central organisation. For instance, Benson (1975) noted that an interorganisational network can consist of a clustering or centring of linkages around one or a few mediating or controlling organisations. This central organisation gains its authority from the centrality of its functions and critically to the resource acquisition of the other organisations. Echoing notions of platforms in ecosystems, he suggests that these controlling organisations derive their power from network structures, where, for example, they provide a service that is vital to all or a large number of organisations in the network. Astley and Van De Ven (1983) observed that there is a growing dominance of big business at the core of interorganisational networks who attempt to construct an artificial social environment to ensure immunity from the harsh realities of competition in the natural environment. Similar to hub firms in ecosystems, those powerful central organisations exercised their power by determining membership access and dictating the terms of exchange (Astley & Van De Ven, 1983; Benson, 1975).

From a collaboration perspective, Trist (1983) introduced the ‘referent organisation’ as one that is essential to establishing cooperative links between organisations in turbulent environments (Emery & Trist, 1965). A referent organisation regulates the cooperation organisations, setting the ground rules, determining the criteria for membership, maintaining the values from which goals and objectives are derived, undertaking conflict resolution, and sanctioning activities. In addition the referent organisation provides long term direction, as well as infrastructure support such as mobilising resources, sharing

information, and developing a network of external relations. Similarly the ‘bridging organisation’ of Westley and Vredenburg (1991) is essential to establishing cooperative links between organisations. In contrast to the referent organisation, a bridging organisation acts as both broker and agent, entering collaborative negotiations to forward their own ends as well as to serve as links (brokers) among domain stakeholders. Also from the perspective of collaboration, more recently Phillips et al. (2000) have noted that the social processes that constitute a collaboration – the negotiation of membership, definition of issues, and standardisation of practices – are enacted in terms and concepts drawn from the institutional fields in which the members are located. In doing so the rules may be structured for the continued dominance of the originating members as the rules and resources that are most influential in the structuring of a collaboration are those drawn from the institutional fields of the dominant members.

Taken as a whole, these conceptions of central actors in earlier models of the environment in organisation theory offer useful theoretical approaches for the inclusion of a powerful central organisation in research and theorising on organisational fields. In common across these differing conceptions of a powerful central organisation is control over the shared governance system. This particularly relates to the power to set the rules of membership (Astley & Van De Ven, 1983; Benson, 1975; Phillips et al., 2000; Trist, 1983), as well as to dictate the terms of engagement – either through control of scarce resources (Astley & Van De Ven, 1983; Benson, 1975), through standardisation of activities (Phillips et al., 2000; Trist, 1983), or through conflict resolution and sanctioning activities (Trist, 1983). The approaches to a powerful central firm based around collaboration possibly holds the most promise given their already explicit acknowledgement of the organisational field and consideration of normative and cognitive elements (Phillips et al., 2000). These approaches also align with theoretical considerations of ecosystem governance which include the rules and standards that cover interactions between the participants, as well as the rules of membership (Adner, 2012; Gawer & Cusumano, 2002; Gulati et al., 2012; Iansiti & Levien, 2004a; Nambisan & Sawhney, 2011)

Taken as a whole, these existing approaches to a powerful central organisation provide a useful starting point to theoretically develop the notion of a powerful central organisation in research on organisational fields. Although more theoretical and empirical development is required, the discussion above provides some first steps.

6.2.4 Technological interdependence

Institutional theory, and the organisational field construct, has tended to focus on social and cultural interdependence, specifically considering cultural elements comprising of both normative and cognitive belief systems relevant to the system of organisation (Battilana et al., 2009; Friedland & Alford, 1991; Scott, 1983; Scott et al., 2000; Wooten & Hoffman, 2008). In contrast, ecosystem research has generally focused on the role of technological interdependence, looking to the effects of such interdependence on value co-creation (Adner & Kapoor, 2010; Iansiti & Levien, 2004a) or the survival of niche firms in the ecosystem (Pierce, 2009). However, ecosystem research has also acknowledged

that there is social and cultural interdependence, such as involvement in a common enterprise (Adner, 2012) and the need to gain social acceptability and legitimacy (Adner & Snow, 2010; Gawer & Phillips, forthcoming).

Technological interdependence between participants is not new to organisation theory, and many of the previous models of the environment including contingency theory, resource dependency theory and organisation ecology have explained the relationships between organisations in terms of technological interdependence (see Chapter 2). For instance, both resource dependency theory and community ecology argue that symbiosis and co-evolution are driven by the technological interdependence of each of the heterogeneous but complementary participants, fusing them into a functionally integrated network (Astley & Van De Ven, 1983) or community of populations (Astley, 1985).

However, models of the environment from institutional theory other than the organisational field hold promise for the introduction of technological interdependence into the organisational field construct. For instance, the ‘societal sector’ of Scott and Meyer (1991) specifically differentiates between technical and institutional sectors, suggesting that although there is considerable variation within each, and that they tend to be negatively correlated to each other, “they are apparently not strongly so, so that varying combinations may be observed” (p. 140). However Scott and Meyer’s focus is on the effect of these combinations of technological and institutional interdependencies on organisational forms. More promisingly, the ‘business system’ of Whitley (1992a, b), does not draw a distinction between technological and institutional interdependencies. Instead it focuses on the ways that different institutional environments generate different kinds of technical efficiencies but which have equally effective value co-creation dynamics.

Adopting the same approach as Whitley (1992a, b), this suggests that technological interdependence can be reintroduced to theorisations of the organisational field. Specifically, an organisation field could be characterised by both the production and exchange of goods and services, where organisations are rewarded for effective and efficient control of their production systems, and also by the elaboration of rules and normative requirements to which individual organisations must conform if they are to receive support and legitimacy. This aligns with the notion of an ecosystem consisting both of a value-creating network (the production and exchange of goods and services characteristic) and a governance system (rules and normative requirements).

Further theoretical and empirical effort is required to develop technological interdependence alongside institutional interdependence in the theorising of the organisational field. However the first tentative steps have been sketched out here.

6.3 Implications for strategic management practice

A final implication concerns contributions for strategic management practice. As the locus of competition shifts from the firm to the network, the ecosystem is becoming a new referent for competitive strategy (Doz & Kosonen, 2008; Gulati et al., 2000; Iansiti & Levien, 2004b; Iyer et al., 2006; Moore, 1993; Normann & Ramirez, 1993), and, as a consequence, managers are seeking to gain strategic edge over rivals through the promotion and facilitation of their ecosystems. As I have shown that there exist three phases of emergence, and that ecosystem emergence processes exhibit unique, distinct idiosyncrasies depending on their evolving logic of value co-creation and appropriation, a number of areas of managerial guidance suggest themselves.

For industry practitioners, a core insight is that by understanding emergent value processes, it may be possible to understand, perhaps even anticipate, phases and challenges in ecosystem emergence. Much prescriptive writing tends to focus on providing generalised models, often called ‘best practices’, which industry practitioners can adopt and adapt to their specific organisational context. However the importance of the evolving logic of value in ecosystem contexts suggests that following generalised best practices blindly may not be advisable. My results suggest that understanding the particular logic of value co-creation in the ecosystem may assist industry practitioners in understanding, if not anticipating, some of the challenges they may have. For instance, the experience of eBay and Wikipedia where the some (or all) governance process was opened up to ecosystem participants, suggests that those practitioners who do the same should anticipate high levels of contestation between the hub firm and the participants. Furthermore, although this research has not compared the emergence sequence of ecosystems that have similar logics of value co-creation, these results suggest to managers that perhaps they should first look to ecosystems with similar logics of value co-creation for guidance.

It is also important for industry practitioners to recognise that successful ecosystem evolution processes exhibit distinct phases, each characterised by distinct challenges and arenas of activity. This suggests that managers need to be flexible and prepared to shift their focus according to the migrating foci of activity during ecosystem evolution. The original four stage model of Moore (1993) suggested a collection of cooperative and competitive challenges in each stage that a hub firm in an ecosystem needs to address. The current findings extend this by suggesting particular combinations of activities a manager needs to consider alongside these challenges. For instance, in the Initiation phase, as well as emphasising the activities to provide the technology that underpins value co-creation, these results suggest that institutional activities, such as the establishment of rules of engagement and membership, need to commence almost immediately if there is to be participant involvement in the management of the ecosystem. Similarly, for the Momentum phase, these results suggest to managers that they should pay greater attention to those contextual activities that enable socio-political and cognitive legitimacy both within the ecosystem and wider society to ensure their dominance.

A tool that could be of significant use to industry practitioners is the ‘ecosystem model’. Given that value co-creation and value appropriation occur at fundamentally different levels of analysis, the ecosystem model complements the insight gained through the use of the business model. A business model is a tool by which a manager can determine how they will create, deliver and capture value at their firm level (Osterwalder & Pigneur, 2010). In contrast, the ecosystem model gives managers a tool through which they can understand the dynamics of the wider ecosystem in which they reside. It should provide managers with insight into the overall value co-created, their contribution to that value co-creation, and how the value is being shared. Furthermore, it should permit managers to identify and manage tensions between their business model and the ecosystem model. In a nutshell, the ecosystem model enables both sensemaking and strategic planning within the ecosystem where their organisation operates.

A final insight for industry practitioners is the salience of the cognitive and normative structures, in addition to regulatory structures, that both shape an emerging ecosystem and which characterise an existing ecosystem. Contrasting with the current prescriptive ecosystem literature that has focused on technological interdependence (Adner, 2006) or the steps for getting the different sides of a multi-sided market on-board (Hagiu & Eisenmann, 2007), these results suggest that managers should also pay attention to how potential and existing ecosystem participants think about their ecosystem. Specifically, this thesis suggests that managers should focus on building a common identity for ecosystem participants, as well as encourage the development of reinforcing normative behaviours, in order to shape the emergence of the ecosystem in their favour.

6.4 Conclusion

This chapter has discussed the implications of the theoretical arguments and empirical findings from earlier chapters. One set of implications concerns the impact of the empirical findings and the development of an institutional approach to ecosystem research. These include the empirical validation of existing theories of ecosystem emergence, an extension of our understanding of ecosystem emergence processes, the consideration that ecosystem emergence should be considered equifinal, the development of the ‘ecosystem model’, and additional insight of ecosystem dynamics and boundaries. A second collection of implications considers the impact of the empirical findings and the development of an institutional research on institutional theory, and theorisations of the organisational field in particular. These include empirical validation of a number of models of institutional formation, the direction of analytical attention towards the processes that drive institutional formation, the development of a novel analytic lens for the mechanisms of organisational field formation, and the theoretical development of powerful central organisations and technological interdependence as new aspects of organisational fields. A final implication, and by extension an additional contribution of this thesis, relates to strategic management practice.

The following chapter concludes the thesis, outlining contributions, limitations and future directions.

7 CONCLUSION

This thesis has addressed the processes of ecosystem emergence, an area of ecosystem research that has not been well investigated. To do so, I have investigated ecosystem emergence both theoretically and empirically in the context of six digital service ecosystems. Theoretically, I have developed an institutional approach to ecosystems, arguing in Chapter 2 that an ecosystem is an organisational field, distinguished from other organisational fields through its analytic focus on value co-creation. In Chapter 3, synthesising dominant design theory, social movement theory and institutional entrepreneurship theory, I have proposed four activities – organisational, technological, institutional and contextual – that drive ecosystem emergence. Chapter 4 expounded the process methodology, detailing the data collection, event colligation, optimal matching, direct inspection, frequency analysis and statistical boot-strapping techniques. Empirically, Chapter 5 revealed that the emergence sequence of an ecosystem is unique to the ecosystem and that there are three phases of emergence – Initiation, Momentum, Control. The first of these phases is similar across cases, however subsequent phases then exhibit increasing differences as the ecosystem emerges. To explain these findings I argued that idiosyncratic logics of value co-creation and path dependency result in dissimilar emergence sequences. Chapter 6 discusses the implications of both the theoretical and empirical contributions on ecosystem research, institutional theory, and strategic management practice. Specifically considering the important role of the logic of value co-creation on ecosystem evolution, I discuss how the close relationship between value co-creation and appropriation in ecosystem contexts requires an ‘ecosystem model’ – the rationale of how an ecosystem co-creates, delivers and shares value.

7.1 Contributions

The primary contribution of this thesis is the development of an ecosystem perspective that explicitly integrates value co-creation processes as an important regulator of the evolution of ecosystems. Emerging from the unexpected finding of significant differences between the emergence sequences of each case – the success bias in the case selection and the restricted context of digital services would suggest that there would be similarities – the emphasis on the logic of value co-creation extends our understanding of factors that influence ecosystem processes. In particular, by demonstrating that differing logics of value co-creation result in differing processes, differences in ecosystem evolution can be explained by reference to their idiosyncratic logics of value co-creation. This moves the locus of discussion of value co-creation in ecosystem contexts from interdependencies between participants (c.f. Adner, 2012; Adner & Kapoor, 2010) to value co-creation itself, introducing institutional factors such as the regulative, normative and cognitive structures in ecosystems. Moreover, the importance of the logics of value co-creation highlights that value appropriated must first be co-created in ecosystem contexts. Demonstrated empirically through the increase in dissimilarity in Phase III as value appropriation and control is applied, this suggests that value creation and value appropriation need to be considered holistically in ecosystem contexts. Extending the value co-creation

oriented ecosystem perspective, I proposed the ‘ecosystem model’ as an analytic tool to better conceptualise value co-creation and appropriation in ecosystems. Defined as the stable configuration of value, technological, participant and institutional attributes that jointly define ecosystem value co-creation and distribution, an ecosystem model is the rationale of how an ecosystem creates, delivers and shares value. The ecosystem model promises more systematic future research into ecosystem dynamics.

The importance of value co-creation processes for ecosystem evolution is further emphasised by the finding that ecosystem emergence exhibits distinct phases that link to form a coherent whole when considered from the perspective of value co-creation. The finding of three phases of ecosystem emergence itself contributes through supporting and extending existing ecosystem emergence and institutional formation models, providing a useful empirical verification of process models that to date have not been extensively validated. In particular, the three phases of emergence are congruent with the ecosystem emergence model of Moore (1993), and process models from dominant design (for instance Suarez, 2004), social movement theory for instance Davis and McAdam (2000) and institutional entrepreneurship (for instance Greenwood et al., 2002; Hinings et al., 2004). In doing so it focuses analytic attention on the emergence processes as distinct to the conditions that lead to ecosystem emergence. Combined with path dependency, the logic of value co-creation links these phases together by explaining the increasing dissimilarity between cases from one phase to the next. Specifically, in the first phase, when the logics of value co-creation are nascent, there are similarities due to the common requirements of resource gathering and the technological development of the digital service. However, driven by path dependence, in the second phase the idiosyncratic logics of value co-creation are extended and embedded, and in the third phase idiosyncratic value appropriation and control imposed, resulting in increasing dissimilarities in the event sequences of each case. As a consequence, an ecosystem perspective that focuses on value co-creation processes has the potential to shed further light on ecosystem evolution.

The importance of value co-creation processes in ecosystem evolution also suggests that comparisons of ecosystems that seek to understand commonalities in the underlying process motors (Van De Ven & Poole, 1995) should be of ecosystems with similar logics of value co-creation, not of collections of ecosystems that utilise the same type of technology. Underlining the role of information and communication technologies as general purpose technologies, this implies that ecosystem studies which use samples selected for their adoption and utilisation of such technologies (such as ‘digital services’) may be more heterogeneous than researchers realise. Methodologically, this also indicates that notions of equilibrium and linearity are not suitable for the investigation of the dynamics of ecosystems, as value co-creation is non-linear (Moore, 1996; Nalebuff & Brandenburger, 1996; Normann & Ramirez, 1994). Instead, ideas such as complex adaptive systems, self-organising networks and autocatalytic feedback may be preferable to understanding the emergence and dynamics of ecosystems (Anderson, 1999; Meyer et al., 2005).

The development of an institutional approach to ecosystems contributes to ecosystem research. Further underlining the importance of value co-creation in ecosystem contexts, I have argued that an ecosystem has value co-creation as its recognised area of institutional life, differentiating it from other facets of the organisational field which have either a common industry, technology, issue or market as their recognised area of institutional life. Although not the first study to take an institutional approach (see for instance Gawer & Phillips, forthcoming; Meyer et al., 2005; Muegge & Grant, 2013), this is the first to theoretically link the ecosystem construct with theorisations of the organisational field. By taking an institutional approach, focus is directed to the processes of legitimacy building, identity construction and the structuring of institutional logic within the ecosystem. More specifically, an institutional approach directs attention towards the regulatory, normative and cognitive elements of ecosystems, as well as the dynamics of power, contestation and accommodation (Scott, 2008). This institutional approach is in sharp distinction to existing approaches to ecosystems which have emanated primarily from the strategy literature. Although researchers have started to consider legitimacy aspects (see for instance Gawer & Cusumano, 2002; Gawer & Phillips, forthcoming; Iansiti & Levien, 2004b), ecosystem research generally has taken theoretical perspectives that emphasise technologically interdependent networked organisations, such as value co-creation, network embeddedness and network management (Autio & Thomas, forthcoming).

The synthesis of dominant design, social movement and institutional entrepreneurship theories to derive four activities that drive ecosystem emergence – resource, technology, institutional and contextual activities – contributes to our understanding of the mechanisms of organisational field formation as they address multiple levels of analysis and multiple actors. This is in contrast to existing concepts such as that of institutional work, which focuses attention on the human action in institutional change (Jepperson, 1991; Lawrence & Suddaby, 2006), and field-configuring events, which are specific mechanisms that bring together actors and relationships to configure organisational fields at particular points in time (Anand & Jones, 2008; Lampel & Meyer, 2008; Meyer et al., 2005). Although similar to both institutional work and field-configuring events, in that they link organisational field evolution at the macro level with individual action at the micro level (Lampel & Meyer, 2008; Lawrence & Suddaby, 2006; Meyer et al., 2005), these four activities widen the analytic focus to encompass the activities of the totality of institutional actors, including institutional entrepreneurs, as well as to ongoing incremental activities that shape organisational field formation, including field-configuring events. The analytic lens afforded by these four activities should permit deeper insight into theorisation, legitimation and diffusion processes, as well as a more detailed understanding of organisational field structuration processes (DiMaggio & Powell, 1983; Giddens, 1979; Scott et al., 2000).

The innovative use of optimal matching contributes methodologically. In management research, although optimal matching has been proposed at various times as a useful method for process research (see for instance, Abbott, 1990b; Langley, 1999; Poole et al., 2000), it has not been widely adopted.

Where it has been adopted it has tended to follow similar applications to sociology, such as to the analysis of career paths (see for instance Biemann et al., 2011; Huang et al., 2007; Joseph et al., 2012). Other applications of the technique have tended to focus on organisational processes, such as information system implementation (Saberwhal & Robey, 1993), product development (Salvato, 2009), and acquisition and alliance behaviours (Shi & Prescott, 2011). Therefore, a minor methodological contribution is successfully demonstrating the application of optimal matching to sequences of events at the interorganisational level of analysis. The more significant contribution however, is the development of the statistical bootstrapping technique that enables a limited number of sequences to be compared in a statistically meaningful way. Prior to this research, optimal matching as a technique was not utilised alone, but was paired with cluster analysis so that groups of sequences could be identified (see for instance Biemann et al., 2011; Huang et al., 2007; Joseph et al., 2012; Saberwhal & Robey, 1993; Salvato, 2009; Shi & Prescott, 2011). This was necessary because although a single distance provides a numerical value of the dissimilarity between any two sequences, the real meaning of this value has remained obscure (Poole et al., 2000). As a consequence optimal matching was only viable when there was a large enough sample of sequences that could provide statistically significant results from cluster analysis. This has meant that optimal matching has not been available for comparisons of a limited number of sequences, except where there is a model or ideal sequence, perhaps from prior research or theory, to which each sequence can be compared to gauge their relative fit (Poole et al., 2000). The bootstrapping method of randomising each sequence 10,000 times while maintaining the same code frequency, calculating the distance for each random sequence, and determining the mean and standard deviation of these 10,000 distances, provides a method for meaningful comparisons between limited numbers of sequences. This methodological innovation should permit the wider application of a promising sequence analysis technique.

A final contribution is to strategic management practice. With the locus of competition shifting from the firm to the network, the ecosystem is becoming a new referent for competitive strategy (Doz & Kosonen, 2008; Gulati et al., 2000; Iansiti & Levien, 2004b; Iyer et al., 2006; Moore, 1993; Normann & Ramirez, 1993), and, as a consequence, managers are seeking to gain strategic edge over rivals through the promotion and facilitation of their ecosystems. For industry practitioners, a core insight is that by understanding emergent value processes, it may be possible to understand, perhaps even anticipate, phases and challenges in ecosystem emergence. These results also recognise that successful ecosystem emergence processes exhibit distinct phases, each characterised by distinct challenges and arenas of activity. This suggests that industry practitioners need to be flexible and prepared to shift their focus according to the migrating foci of activity during ecosystem evolution. A tool that could be of significant use to industry practitioners is the 'ecosystem model'. Given that value co-creation and value appropriation occur on fundamentally different levels of analysis, but that they need to be considered holistically, the ecosystem model complements the insight gained through the use of the business model.

A final insight for industry practitioners is the salience of the cognitive and normative structures, in addition to regulatory structures, that shape an emerging ecosystem and which characterise an ecosystem.

7.2 Limitations

There are a number of limitations of this empirical research. To begin, it considers ecosystems in digital service contexts and as a consequence these results may not be generalisable beyond internet-based businesses. However within digital service contexts these results are salient, as they encompass a heterogeneous sample of digital service ecosystems. Further, with the continuous diffusion of ICT across industry sectors and the associated spread in the use of platform strategies, it is feasible that generalisability may increase.

Another limitation is that the success bias in the cases may have painted a subjective picture of ecosystem emergence. Success bias is particularly difficult to avoid in these situations, as in most cases ecosystem (and related digital service) failure events are not well documented to enable archival research. Indeed, to gather enough empirical detail to include an ecosystem failure the researcher must be lucky enough to be following the ecosystem emergence in real time. It is not anticipated that the success bias in the cases has resulted in a biased picture of the results. For instance, the claim of equifinality runs counter to the sort of bias which would be expected, namely the recognition of similar processes across the cases. Instead the results seem to indicate that emergence processes are more path dependent and uniquely evolutionary.

There are also a number of methodological limitations. First, data collection techniques mean that only a sample of the possible events was identified; as such the analysed sequences are incomplete. Furthermore, each sample gathered was not random as the majority of the data sources considered the context of the hub firm and not the ecosystem. This may have potentially biased the results towards the digital service and hub firm in terms of the quantity of incidents and events that have been recorded and collected. As such the sequence data may represent the ecosystem emergence as seen from the perspective of the hub firm. This is not considered to be an issue as the possible bias applies to all cases and any cross-case comparison would still be valid.

A further methodological technique relates to incident extraction, event colligation and event coding. The reduction of narrative to sequences which are then coded means that all other elements of narrative structure are systematically removed. Although this enhances generalisation, it excludes those other features that are required to create rich narrative explanations (Pentland, 1999). A related limitation concerns the fact that each event is treated equally in importance, meaning that minor events have the same effect on the sequence as one which was game-changing. Thus the impact of potential field-configuring events has been removed from the data. These methodological techniques are

necessary to apply optimal matching and frequency analysis, but can be addressed through the application of other process techniques, some of which are detailed below.

7.3 Future research

A number of areas warrant further research, both theoretical and empirical. Despite the importance of value co-creation as the recognised area of institutional life, and the importance of the logic of value co-creation in ecosystem emergence, forcefully illustrated by the empirical results here, the majority of research literature to date has not directly considered value co-creation and appropriation, or the more nuanced perspective of fair value appropriation. Adner and Kapoor (2010) have explicitly and empirically linked value creation and value capture within ecosystem contexts, although they are perhaps the only to have done so to date. In this thesis, I have begun to develop a more holistic and rigorous consideration of value co-creation, delivery and capture with the suggestion of the ecosystem model. Given the importance of the co-creation and the fair appropriation of value in ecosystem contexts, further development of the ecosystem model, and a more coherent and detailed formulation of value creation logics in the same style as Doz and Hamel (1998) for alliance contexts, would aid both academic and practitioner understanding.

The adoption of other organisation theory approaches to understand ecosystems also holds promise for future research. Indeed, as many approaches that have been labelled institutional have implicitly been organisational ecology and resource dependency arguments clothed in the language of institutionalism (Wooten & Hoffman, 2008), an analysis of ecosystems using these arguments may indeed be fruitful. For instance, the focus on technological interdependence in ecosystem contexts underscores the salience of resource dependency theory logics to ecosystem research (Pfeffer & Salancik, 1978). In ecosystems all participants, including the hub firm, are dependent on each other for the co-creation of value, and also jointly dependent on the environment external to the ecosystem. Although the types of control strategies that are used in ecosystems are being systematically analysed in the strategy (see for instance Gulati et al., 2012; Nambisan & Sawhney, 2011) and industrial economics literature (see for instance Boudreau & Hagiu, 2009), a resource dependency view which incorporates the influences of multiple dependencies on an ecosystem participant could shed light on these interdependencies. Similarly, given the importance of participant diversity in ecosystem contexts (Iansiti & Levien, 2004a), an organisational ecology approach (Hannan & Freeman, 1977) could provide a useful lens to study homogeneity and heterogeneity in ecosystems contexts. For example, the application of a variation and selection logic driven by technical interdependence has the potential to shed light on participant heterogeneity. Furthermore, this approach could enable an analysis of the dynamics of participant symbiosis, providing a framework to consider the process of how new populations branch out from established ones to take advantage of new ecosystem niches. An investigation of ecosystem participant and hub firm 'fit' in an ecosystem holds intriguing possibilities. For example, Pierce (2009) has outlined how the decisions of a hub firm can have varied repercussions

on the organisations that participate in the niches. Taking the perspective of the niche firm, the insights from contingency and configurational theories may be able to provide an understanding of the challenges that such niche organisations face. Are there particular strategies or structures a niche firm should adopt in ecosystem contexts? Are there ideal configurations for a niche firm? How do these vary across different ecosystem models?

Empirically, research into the processes of ecosystem creation, as distinct to emergence, also holds promise. Rather than considering how complex systems arise out of a set of relatively simple interactions, research into ecosystem creation considers the actions and strategies through which a hub firm constructs an ecosystem. A fruitful approach is to re-code the event data of each case identifying the primary actor of each event. For instance, the release of a new feature on the digital service would be coded as a hub firm event, while a critical article in the media would be coded as a broader environment event. This coding is applied multifunctionally, such that an alliance would be coded twice; once for the hub firm and a second time for the other actor in the broader environment. Both optimal matching and frequency analysis can then be applied to determine if there are similarities or dissimilarities between the emergence sequences of each case. Appendix G presents the early results of the optimal matching analysis. These results provide further support for the findings of this thesis, finding dissimilarities in the majority of the case-pairs in the comparison of the complete sequences, as well as validation of the phase identification. Furthermore, these early results also support the finding of similarities in the emergence sequences in the Initiation phase, which then become dissimilar in the Momentum phase and which become even more dissimilar in the Control phase. However there are some interesting differences between this analysis and the one within this thesis – such as an overall increased level of similarity and significances which do not occur in the original analyses – that require further research. Appendix H, presenting the early results of the moving average frequency analysis, offers an intriguing insight into the dynamics of interaction between the hub firm and its broader environment. This analysis suggests that there is a cycle of heightened activity by the hub firm and followed by heightened activity in the broader environment. More research is required to further investigate these emerging findings.

Other narrative explanation process methodologies could also provide insight into the emergence processes of the six cases. Beyond phasic analysis, other techniques include Markov analyses and, given the findings of equifinality and the influence of the logic of value co-creation, time series non-linear analysis (Anderson, 1999). Markov analyses, if analytically possible, would enable the investigation of particular patterns of activities to infer differing underlying process motors within each phase, such as teleological, lifecycle, evolutionary or dialectic mechanisms (Van De Ven & Poole, 1995). If the event sequence pattern appears random, then non-linear time series analysis could enable greater insight into the emergence sequence both at the level of the full sequence and within each phase, identifying periodic (stable equilibria), chaotic (strange attractors), white noise (truly random) or coloured noise (plotted as

a negative power law characteristic of a punctuated equilibrium process) dynamic patterns (Dooley & Van De Ven, 1999). In the event there is a non-linear change pattern, such as chaotic or pink noise, there is also the possibility of modelling the underlying process using an NK(C) approach (Kauffman, 1993). A more detailed approach could utilise the sub-categories of each of the four activity types (see Appendix A). Phasic analyses and the process methodologies mentioned above could be reapplied at this more granular level of coding to provide further insight. Overall, future process research should be able to provide a finer grained understanding of the dynamics within each phase, such as theoretically suggested by Suarez (2004) and Hinings et al. (2004).

Research into the ecosystem failure cases could also provide further insight into the processes of ecosystem emergence. Although the gathering of data can be difficult for failure cases, in the event that data became available, a comparative analysis of failure cases with the six cases analysed in this thesis has the potential to validate and extend the findings of this thesis. For instance, an analysis of the code frequency in each phase could provide insight into the salience of particular activities at particular phases of ecosystem emergence, and whether the lack, or too much, of certain activities influenced the success or failure of a case. Moreover, an analysis of the emergence and embedding (or lack of) of the logics of value co-creation of the failure case and comparison with those of a successful ecosystem has the potential to shed light on how the logic of value co-creation evolves in an ecosystem. Furthermore, direct inspection of failure cases could provide the means to identify and analyse the key decisions that differentiated between success and failure.

The adoption of a discursive approach to understanding ecosystem evolution would also be rewarding. Discourse analysis provides an alternative coherent framework for the analysis of the processes of institutional and field formation, investigating the relationships among texts, discourse, institutions and action (Hardy & Maguire, 2010; Phillips et al., 2004). Discourse analysis is particularly salient in ecosystem contexts as it is not necessarily the nature of the technology that is important, but instead the degree of meaning the technology has and its level of embeddedness in the regular routines of participants (Munir & Phillips, 2005). For instance, the continued commercial success of Google is driven by cognitive adoption, so that there is confidence in, and the embeddedness of, the search service into consumers' daily habits, and not just the quality of the technology and search results. Given the quantity of texts available, the accessibility of digital discourse, and the transparency of institutions and actions in the post-industrial economy, a discursive approach could be a rewarding methodological approach to further insight into the emergence processes of ecosystems.

A further avenue of future research is analysing the emergence of ecosystems through the lens of field-configuring events (Lampel & Meyer, 2008). All cases examined in this thesis had conference events (Garud, 2008), award ceremony events (Anand & Jones, 2008; Anand & Watson, 2004), or both. The limitations of the research design meant that these events were treated as having an equal impact as any other. Given that the literature on field-configuring events suggests that these events should be

given a special emphasis, a potentially fertile avenue would be to single out specific events as field-configuring, and analyse the dynamics on either side of them. A comparative analysis of the sequence patterns on either side of a number of field-configuring events may provide sufficient empirical data to enable searching for other field-configuring events that are either unknown or were not recognised as such. Alternatively this type of analysis may enable an appreciation of the field dynamics that lead to the field-configuring event, a more nuanced understanding of the activities within the field-configuring event, and more detailed insight into how it changed the emergence dynamics of the ecosystem.

Further operationalisation of the ecosystem as an organisational field would also be useful. To begin, the four activities of ecosystem emergence have been operationalised to some extent, both through the retroductive derivation of the sub-activities and the empirical identification of specific examples of each (see Appendix A). However the activities have been operationalised for a process methodology based on narrative explanation, and it is possible that this operationalisation would not be viable for a variance approach. Moreover, these activities have been synthesised for the purpose of ecosystem emergence, and there is no certainty that they would constitute all the dimensions for an analysis of existing ecosystem change, maintenance or decline. As such, further operationalisation would be useful for additional fruitful empirical research.

Given that an ecosystem is a network of organisations, research into the network itself could also be a productive approach (see for instance, Ginsberg et al., 2010). One approach would be to analyse the tangible pattern of organisational ties, an approach which has generally considered first order ties to a focal firm (see for instance, Adner & Kapoor, 2010). This approach has potential issues as it is difficult to move beyond first order ties in ecosystem contexts given the scope and porous nature of ecosystem boundaries (Gulati et al., 2012). However, through the consideration of an ecosystem as an organisational field, a more rewarding approach may be that of Hoffman (1999), who suggests that organisational field structures can be analytically detected through observing an increase in organisational interaction, an increase in the shared information load they share and the development of mutual awareness that they are involved in a common dialogue.

7.4 Concluding remarks

In conclusion, this thesis has investigated the emergence of ecosystems, a topic within ecosystem research that has not been well examined to date. Theoretically, I have developed an institutional approach to ecosystems, arguing that an ecosystem is an organisational field, and theorised four activities that drive ecosystem emergence. Empirically I have found that emergence sequences of ecosystems are significantly dissimilar, but that there are three phases of emergence. I also found that the sequences are similar in the first phase, but then there is increasing dissimilarity as each phase unfolds. I have emphasised the importance of the logic of value co-creation in ecosystem contexts, and proposed the 'ecosystem model' as the rationale of how an ecosystem creates, delivers and shares value.

Theoretically and empirically this research contributes to our understanding of ecosystems, organisational fields and process methodologies. It also provides practitioner guidance. I hope that these findings will inspire fellow researchers to further investigate why and how ecosystems emerge.

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9 APPENDICES

9.1 Appendix A – Event coding categories

Activity Type	Sub-Activity	Example activities
Resource	Corporate	• Formation activities • Governance activities, such as board elections, committee elections, Annual General Meetings, Publication of annual reports and account balances • Ownership activities, such as equity distribution, shareholder agreements, share splits
	Financial	• Incoming funding activities, such as angel investors, VCs, IPO, donations, in kind and in cash • Debt related activities, such as guarantees, loans, debt issuance
	Competence	• Personnel activities, such as hiring / firing, promotions, leadership changes, training and development and certification of competence • Capability development or enhancement activities, such as hiring of specialist supplier firms, such as advertising or law firms, outsourcing of a function to a specialist provider, creation of a new team within the hub firm, restructuring of teams within the hub firm
	Appropriation	• Acquisitions • Divestments • Investments
	Coalition	• Activities relating to alliance and partnerships, such as establishment, extension, re-affirmation, negotiation, failure • Activities relating to the licensing of core technologies
	Infrastructure	• Technological infrastructure activities, such as data centres, hardware, such as servers, load balancing and failsafe software • Software selection, such as database or coding technology • Internet provision
	Litigation	• Legal activities by courts, such as injunctions, countersuits, settlements
Technological	Design	• Research and development activities, such as researching similar services, writing the code, testing • Technological feature activities, such as new and changed features, API release, toolkits, customisation suites, wireless access, offline access • Graphic design activities, such as fonts, logos, naming, site layout, (e.g., new sections, stores, etc.)
	Delivery	• Technological performance activities, such as system launch, system down, limited functionality, hacks and security breaches, bugs and issues, malicious and troublesome activity, such as vandalism • Day-to-day service delivery activities, such as data acquisition, (e.g., creation, crawling, access, preparation, loading, indexing), data provision, (e.g., performance metrics, data dumps, CDs and DVDs), inflow of merchandise (stock and goods), outflow of merchandise stock and goods, e.g., packing and delivery • Customer and technical support activities, such as fraud monitoring and control, product returns
	International	• Internationalisation activities, such as translations to other languages, launch in non-US country domains (e.g., .co.uk, .co.jp, .de, etc.), support of non-US currencies (e.g., Yen, Sterling, Euro, etc.)
Institutional	Rules	• Rules and policies of use, such as of coordination, behaviour, operation, contracts • Standard setting activities, such as joining boards or committees • Ecosystem governance activities, such as committees, elections, voting and polls, surveys, ratification, sanctions
	Support	• Support program activities, such as mailing lists support, alliance and partnership programs, loyalty programs, support websites and services, peer data centre provision, incubators, grant programs

Activity Type	Sub-Activity	Example activities
Contextual	Pricing	• Educational activities, such as seminar and lectures, ‘University’ like operations, guidelines, manuals and cheat-sheets, publication of ‘How-to’ books • Pricing activities, such as establishment of pricing, making free, pricing changes, discounting activities, commissions and bonuses
	Membership	• Limited access such as beta, previews, locations • General availability of the service • Opening up to new markets
	Promotional	• Marketing and PR activities, such as press releases that promote the service or ecosystem, promotional linking between sites • Launch of marketing only website, branded items (e.g., t-shirts, pens, pagers, credit cards, etc.), attendance at 3rd party conferences • Sales activities, such as strategies, pitches, commissions • Indexing by search engines
	Discourse	• Outreach activities with ecosystem members, such as conferences, feature proposals, focus groups, product reviews, user testing • Dialogue with Competitors • Word of mouth marketing and testimonials • Response to changes in ecosystem parameters • Dialogue between members of ecosystem
	Identity	• Cognitive activities, such as trust and credibility, sense of ownership, emotional connection, ecosystem and service positioning, sense of appreciation, emergence of ‘cult’ artefacts • Participation activities, such as contests and competitions, education, conferences, unique traditions (ceremonies and practices), advisory and governance boards, administration and feedback, calls to action and action requests, naming and issuing of awards
	Discourse (Press)	• Press • Blogs • Television and radio • Financial analysts • Other commentators
	Discourse (Society)	• Entering the general lexicon • Becoming more generally ‘known’ • Release of books and magazines • Academic research • Medical diagnosis • Referencing in Art
	Accolades	• Industry awards, such as certification from a market participant, industry awards, individuals awarded accolades • High profile adoption, such as by prestigious stakeholders, invitation to Davos or other high profile conferences • Demonstrations of achievement and value, such as Longevity and/or scale (including surpassing competitors), tangible public demand for the services (e.g., access sold on eBay), proficiency with ecosystem services recognised as a skill
	Regulatory	• Activities of government, regulators and powerful actors, such as rules or legislation (proposal, enactment or retraction), official investigations, offers of collaboration by regulators, blocking of access • Activities by courts, such as favourable or unfavourable decisions
	Competition	• Service design and delivery • Resource acquisition • Acquisition activities • Litigation activities

9.2 Appendix B – Means and standard deviations

Table 25 – Complete sequence optimal matching comparison mean and standard deviation

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	0.625 (0.011)	0.000 (0.000)				
Facebook	0.662 (0.011)	0.775 (0.013)	0.000 (0.000)			
Google	0.675 (0.011)	0.723 (0.012)	0.664 (0.013)	0.000 (0.000)		
Salesforce	0.759 (0.010)	0.633 (0.009)	0.756 (0.009)	0.785 (0.010)	0.000 (0.000)	
Wikipedia	0.747 (0.011)	0.666 (0.009)	0.664 (0.010)	0.703 (0.010)	0.699 (0.010)	0.000 (0.000)

Note: The top number is the mean and the number in parentheses is the standard deviation.

Table 26 – Within case cross phase comparison mean and standard deviation

Amazon				eBay			
	Phase I	Phase II	Phase III		Phase I	Phase II	Phase III
Phase I	0.000 (0.000)			Phase I	0.000 (0.000)		
Phase II	0.774 (0.002)	0.000 (0.000)		Phase II	0.829 (0.000)	0.000 (0.000)	
Phase III	0.706 (0.011)	0.639 (0.017)	0.000 (0.000)	Phase III	0.644 (0.035)	0.702 (0.010)	0.000 (0.000)
Facebook				Google			
	Phase I	Phase II	Phase III		Phase I	Phase II	Phase III
Phase I	0.000 (0.000)			Phase I	0.000 (0.000)		
Phase II	0.749 (0.005)	0.000 (0.000)		Phase II	0.796 (0.001)	0.000 (0.000)	
Phase III	0.663 (0.036)	0.682 (0.012)	0.000 (0.000)	Phase III	0.659 (0.033)	0.702 (0.008)	0.000 (0.000)
Salesforce				Wikipedia			
	Phase I	Phase II	Phase III		Phase I	Phase II	Phase III
Phase I	0.000 (0.000)			Phase I	0.000 (0.000)		
Phase II	0.897 (0.000)	0.000 (0.000)		Phase II	0.808 (0.001)	0.000 (0.000)	
Phase III	0.620 (0.038)	0.815 (0.000)	0.000 (0.000)	Phase III	0.630 (0.023)	0.651 (0.010)	0.000 (0.000)

Note: The top number is the mean and the number in parentheses is the standard deviation.

Table 27 – Phase I optimal matching case comparison mean and standard deviation

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	0.669 (0.048)	0.000 (0.000)				
Facebook	0.783 (0.056)	0.736 (0.057)	0.000 (0.000)			
Google	0.760 (0.053)	0.736 (0.059)	0.739 (0.050)	0.000 (0.000)		
Salesforce	0.712 (0.060)	0.724 (0.072)	0.778 (0.067)	0.797 (0.069)	0.000 (0.000)	
Wikipedia	0.787 (0.057)	0.703 (0.053)	0.759 (0.055)	0.770 (0.057)	0.655 (0.049)	0.000 (0.000)

Note: The top number is the mean and the number in parentheses is the standard deviation.

Table 28 – Phase II optimal matching case comparison mean and standard deviation

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	0.681 (0.020)	0.000 (0.000)				
Facebook	0.705 (0.020)	0.794 (0.024)	0.000 (0.000)			
Google	0.715 (0.019)	0.735 (0.020)	0.658 (0.017)	0.000 (0.000)		
Salesforce	0.703 (0.016)	0.642 (0.013)	0.738 (0.015)	0.758 (0.016)	0.000 (0.000)	
Wikipedia	0.713 (0.018)	0.673 (0.016)	0.668 (0.016)	0.716 (0.018)	0.668 (0.016)	0.000 (0.000)

Note: The top number is the mean and the number in parentheses is the standard deviation.

Table 29 – Phase III optimal matching case comparison mean and standard deviation

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	0.660 (0.015)	0.000 (0.000)				
Facebook	0.671 (0.018)	0.792 (0.051)	0.000 (0.000)			
Google	0.662 (0.019)	0.760 (0.047)	0.714 (0.038)	0.000 (0.000)		
Salesforce	0.668 (0.017)	0.711 (0.049)	0.840 (0.057)	0.822 (0.055)	0.000 (0.000)	
Wikipedia	0.676 (0.024)	0.687 (0.033)	0.679 (0.031)	0.704 (0.033)	0.634 (0.028)	0.000 (0.000)

Note: The top number is the mean and the number in parentheses is the standard deviation.

Table 30 – Phase I code frequency comparison mean and standard deviation

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Resource	27.60% (4.611)	25.37% (5.537)	18.35% (3.900)	22.48% (4.325)	15.27% (4.457)	7.02% (2.532)
Technology	25.00% (4.490)	18.25% (4.790)	34.61% (4.788)	33.30% (4.957)	11.95% (4.073)	29.59% (4.586)
Institutional	30.71% (4.725)	43.05% (6.190)	23.55% (4.274)	22.64% (4.386)	52.59% (6.191)	40.49% (4.928)
Context	16.68% (3.842)	13.34% (4.264)	23.50% (4.226)	21.58% (4.292)	20.19% (5.038)	22.90% (4.163)

Note: The number in parentheses is the standard deviation; this may not sum to 100% due to rounding.

Table 31 – Phase II code frequency comparison mean and standard deviation

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Resource	27.57% (1.594)	25.34% (1.371)	18.28% (1.325)	22.44% (1.251)	15.18% (0.711)	7.04% (0.728)
Technology	25.01% (1.560)	18.31% (1.200)	34.69% (1.643)	33.33% (1.431)	11.99% (0.637)	29.55% (1.304)
Institutional	30.78% (1.659)	43.06% (1.549)	23.63% (1.470)	22.61% (1.248)	52.59% (0.979)	40.52% (1.391)
Context	16.63% (1.363)	13.28% (1.077)	23.40% (1.449)	21.62% (1.219)	20.24% (0.788)	22.89% (1.199)

Note: The number in parentheses is the standard deviation; this may not sum to 100% due to rounding.

Table 32 – Phase III code frequency comparison mean and standard deviation

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Resource	27.51% (2.220)	25.38% (3.716)	18.25% (3.150)	22.43% (3.341)	15.11% (3.221)	7.06% (1.633)
Technology	25.08% (2.138)	18.33% (3.292)	34.65% (3.865)	33.38% (3.781)	11.98% (2.829)	29.47% (2.909)
Institutional	30.77% (2.272)	43.05% (4.217)	23.64% (3.451)	22.59% (3.348)	52.62% (4.439)	40.52% (3.138)
Context	16.64% (1.840)	13.24% (2.915)	23.46% (3.435)	21.60% (3.278)	20.29% (3.559)	22.93% (2.682)

Note: The number in parentheses is the standard deviation; this may not sum to 100% due to rounding.

9.3 Appendix C – Case narratives

This Appendix contains the case narratives for each case. Each phase is illustrated through these.

9.3.1 Amazon

For Amazon, Phase I commenced with Jeff Bezos' decision to create an online bookshop to take commercial advantage of the emerging internet. After a report he authored for his then employer D.E. Shaw argued for investment in online bookselling was rejected, Bezos resigned and moved to Seattle, rented a house with a garage and began researching bookselling and the potential competitors. Originally called Cadabra, the company was founded en route to Seattle by Bezos with \$10,000, and later supported by a number of loans from Bezos. He also personally guaranteed the obligations of the company, such as credit cards and other facilities. A little later also Bezos raised some more money from his father and from a trust where his mother was a beneficiary.

Within a couple of weeks of founding the company, Bezos had hired a couple of programmers from UC Washington and began to develop the service. He also renamed the company to Amazon after comments and advice from friends and colleagues. Initially they planned to provide both email and online trading capabilities, however by the time of the launch due to the development of the internet only the web-store was launched. In addition specialist systems were developed for handling credit cards and ordering. The service was optimised for all types of browsers because at this stage of the internet a dominant browser had not yet emerged. The company operated very frugally, with an informal atmosphere, with all hands helping in packing and shipping, meetings held in local bookshops and desks made out of doors. The company philosophy was that the customer was always right, and to under-promise and over-deliver.

In April 1994 the service was launched in Beta to several hundred friends to test and pretend to buy books. By June live purchases were possible, and word of mouth marketing began to drive users to the service, quickly making the service number one book-related service on the internet. In July 1995 the service was officially launched, with over 1 million titles in its database and the claim that it was the 'world's biggest bookstore'. In fact Amazon carried only about 2,000 titles in stock in its Seattle warehouse, and most orders were placed directly through wholesalers and publishers, and then shipped to the customer. The service was designed to be as user-friendly as possible, with 10-30% discounts on most titles, powerful search capabilities, topic areas to browse, a recommendation centre, book reviews in its 'Spotlight' section and a gift wrapping service.

Very soon after launch, Amazon developed an excellent reputation and became a very popular service; within a month they filled orders from all 50 states in the US and 45 other countries. Customers rallied around the service as features such as customer reviews and personalised services made it into an early social network for book fans. Very soon a sense of community developed around the service. These feelings of goodwill and trust were further encouraged by such actions as posting the 'Amazon

Bill of Rights' and 'Shipping Policy' documents on the service. They were also recognised by web commentators, and almost immediately placed on Yahoo's 'what's cool list' and Netscape's 'what's new list'. As the year wore on they continued to add new features, fine tune the operation of service and hire more staff.

For Amazon, Phase II commenced in late 1995 with Bezos raising approximately \$1 million from local Seattle investors. Following the investment round, the strategy became 'get big fast', an explicit change in ecosystem strategy from incremental organic growth to market domination. Very quickly business development staff were hired, their first advertising agency brought on board, and an aggressive advertising campaign launched, featuring in major mainstream publications, general interest media, and banner ads on other services. With increasing customers and growing sales driven by glowing lead story in the Wall Street Journal in May, there was a deluge of calls from VCs who wanted to invest, and by June 1996 Kleiner Perkins Caufield & Buyers invested \$8 million, valuing the company at \$60 million. This led to a much higher profile for the digital service, further enhanced when Al Gore dropped by for a photo opportunity, Bezos appearing on a PBS news show in late 1996 and Time magazine voting the service one of the '10 Best Webservices of 1996'.

New features were continually added to the service, such as automated recommendations based on past buying habits. An out-of-print department was created, a new look web service launched and many internal functions formalised with experienced managers brought in and professional systems put in place. In addition, better relationships with distributors were established and formalised. Following an email from a customer asking to be allowed put a link to books on their service, the 'Associates' program was launched in July 1996, an explicit ecosystem building mechanism. This innovative program created a network of individual web services with Amazon ads for them, with visitors able to purchase those books. Order fulfilment was done through Amazon, and associates were sent reports on their sales and made a 3 to 8 percent commission from books sold on their services. This program rapidly became popular and gained a reputation where one could find any book on any topic. The participants continued to support the service, and independently acted to defend the service from bad press, such as when Slate magazine ran an online ordering test and found that the local store could deliver faster.

However competition was beginning to stir, with Borders Group announcing it was going to launch a service, and books.com promoting themselves more aggressively. In addition Barnes & Noble entered an agreement to be an exclusive bookseller on AOL. Analysts and press began to argue that Amazon did not have sustainable competitive advantage and that the big book retailers would eventually dominate. In late 1996 and early 1997, Barnes & Noble expressed an interest in acquisition, launched their own bookstore, and eventually sued regarding the use of the phrase the 'Earth's Biggest Bookstore'. This case was settled in late 1997.

In May 1997, after less than two years of operation and in a poor IPO market, Amazon listed and became a public company, despite claims of overvaluation. The IPO was for three million shares of common stock on the NASDAQ exchange, valuing the company at \$419 million. This investment drove further development of the service, such as the addition of One-Click, increased discounting, and advertising. At the same time distributors began to renegotiate access (to charge higher prices) and in response Amazon began to reduce their reliance on them. To counter the emerging competition adjustments to the Associate program promoted offered greater commissions and more exclusive agreements. By mid-1997 Amazon formed marketing partnerships with Yahoo! and AOL, giving broad promotional capabilities on two of the most visited services on the internet, as well as with many others, including Prodigy, Netscape, GeoCities, Excite, and AltaVista. By the end of 1997, to help broaden the company's distribution capabilities, and to ease the strain on the existing distribution centre they expanded the company's Seattle centre and opened an East Coast distribution centre in New Castle, Delaware. With customers in all 50 US states and over 160 countries worldwide, and with \$147.8 million in yearly sales, Bezos announced in October that Amazon would be the first Internet retailer to reach one million customers. To help achieve this goal in late 1997 the company secured a \$75 million credit facility.

In 1998 the company continued to grow and Amazon was soon the third largest bookseller in the United States. By February, the Associates program had reached 30,000 members, and four months later, this had doubled to 60,000. The company's customer database continued to grow with cumulative customer accounts reaching 2.26 million in March. Amazon continued to develop its services, with new features and more than 2.5 million titles. In February Amazon Advantage was launched, a program to help the sales of independent authors and publishers, and in March, Amazon Kids, with over 100,000 titles for younger children and teenagers. In early 1998 Amazon also expanded into Germany and the UK through the acquisitions of Telebook and Bookpages respectively, relaunched as Amazon.de and Amazon.co.uk later in the year. Around this time Amazon also acquired the Internet Movie Database (IMD) to support plans for a move into online video sales, which began advertising for Amazon by the end of the year. In order to continue their growth in early May Amazon issued \$326 million of debt. Later in the year more acquisitions continued with the purchase of Junglee and PlanetAll, price comparison and contact management services respectively; Junglee was re-launched as a 'Shop the Web' feature on the service.

In mid-1998, after seeking feedback from bookstore customers and members of the music profession on the design the new web service, a music store was added, with over 125,000 music titles available. The new service had the same services as the book side including the ability to listen to music before a purchase; this began operations at the same time that Amazon debuted a redesigned book service. Over time accolades built up, despite some mixed reviews on the ability of the service to expand beyond books. Amazon also extended the titles available, such as classical music, and launched an

Advantage program for Music in November 1998. By the end of the year both video and DVD stores were launched, continuing the move away from books.

Marketing and advertising continued on both online and offline, and there was huge brand recognition amongst consumers with many customers still arriving through word of mouth. By the end of the year the word 'Amazon' was part of the business lexicon. The launch of a book ranking feature also gained much press. In June Amazon was honoured by the Smithsonian Institute for business and related services and, in July 1998, Bezos was on the cover of *Forbes* as one of the 'Masters of the New Universe'. In September Amazon extended its promotional partnership with Yahoo across their world services, including Asia, UK and Ireland, France, Germany, Denmark, Sweden, Norway, Canada, Australia and New Zealand, Japan and Korea. However growth was not without criticism, with some commentators arguing that the growth could not continue, and was much overvalued and part of a bubble.

Despite continued investment in the technology that underpinned the service, in October 1998 the service went down for 10 hours during a problem with routine maintenance. In keeping with the corporate philosophy all customers on the service were offered a \$5 gift voucher and communication was transparent and prompt. In addition, the hiring of a number of executives from Wal-Mart earlier in the year caused Wal-Mart to sue in October, which was later settled in March 1999. However, other events also assisted in their growth. The passing of the Internet Tax Freedom Act meant that internet sales were now protected from multiple taxes, and Barnes & Noble, in their failed attempt to acquire Ingram, the main book wholesaler, garnered an FTC anti-trust action and later threats of Congressional investigation. Bertelsmann, after a failed JV attempt with Amazon, invested in the Barnes & Noble web service.

By the end of the year Amazon was flying high, with over three million customers and an exceptionally busy Christmas. Amazon's focus on growth continued, with the successful issuance of the largest convertible debt auction in history, of \$1.25 billion. In addition it received a patent for its 'One-Click' technology. Acquisitions and investments continued in such organisations as Drugstore.com, Pets.com, LiveBid, Alexa Internet, Accept.com, Exchange.com, HomeGrocer.com, Gear.com, Della & James, Convergence Corporation, Toolcrib of the North, Back to Basics Toys, and Ashford.com. In early 1999 it opened fulfilment and distribution centres in Nevada, Kansas, Kentucky, Georgia, Washington, and North Dakota. During 1999 Amazon quadrupled its hardware, and continued the development of new features, such as Cross Links, Amazon Payments, zBubbles, Amazon Anywhere and Overnight delivery. In a further explicit ecosystem growth measure, the launch of zShops enabled anyone to offer merchandise for sale through Amazon, be they micro- or major manufacturers, small businesses or global corporations, specialised retailers or 'mega-conglomerates'. One new feature, Purchase Circles, which pointed out the most popular products in particular regions, garnered many negative reviews due to the implications on privacy, forcing Amazon to issue specific policies

for the service. In March 1999, the service was extended with an online auction service entitled Amazon Auctions, positioned as a place to buy anything one needed. This was later extended with a partnership with Sotheby's in June and a joint auction service in November. Amazon also began offering toys and games in and electronics mid-1999, and then later divided its product offerings into individual stores on its service to make it easier for customers to shop for certain items.

Amazon remained in the press spotlight, with Bezos featuring on *Sixty Minutes* in February 1999, profiled by *New York Times* magazine in March; the cover story of *Fortune* in December, and named the Times 'Person of the Year'. Amazon itself was also labelled the 'poster child of the internet' by NYT Magazine in October and was the case of a Jeopardy question in July. However the press was not all positive; there was much derision in relation to the awarding of the 'One Click' patent, as well as the discovery of paid product placement, causing much shock and a special policy to denote it. Similarly, the aggressive litigation tactics used in their suit with the Amazon Bookshop company did not reflect well on the company, Amazon also sued Barnes & Noble over its infringement of 'One Click' technology, winning an injunction in December 2000.

For Amazon, Phase III began in early 2000 with an explicit shift to profitability and value appropriation. Despite continued accolades, stellar end of year sales, and being the most widely recognised e-commerce brand, by early 2000 sales began to slow and Amazon began to focus on cutting costs and becoming profitable. In spite of issuing 690 million Euros of debt, Amazon made 2% of its staff redundant, wrote off more than \$39 million of merchandise, and internally restructured and refocused employees on profitability. Cost reduction was added to the business strategy, which had traditionally been centred on vast selection and convenience.

Despite the cost reductions, the functionality of the service continued to be expanded, with new stores added, including lawn and patio furniture, health and beauty, kitchen wares, photos and cameras, and computer and video games. In November 2000, expanding the ecosystem further, Amazon launched Marketplace, which complemented zShops in that second-hand goods could now be offered alongside new goods. It also continued its expansion, with a new service in West Virginian, French and Japanese services, and with investment or acquisitions in Greenlight.com, Audible Inc, Greg Manning Auctions, Basis Technology, Kozmo.com, Eziba.com, and Wineshopper.com. However the company continued to post net losses. The market share focus over profits was making Wall Street analysts speculate on whether the company would ever be able to turn a profit. In addition the company was sued over the privacy implications of its Alexa subsidiary, while it sued Barnes & Noble to protect its 'One Click' patent

After another strong Christmas, however, in January 2001 Amazon made redundant over 1,300 employees and closed a distribution centre in an effort to be profitable. Amazon also moved into third-party deals with such well-known retailers as Target Corporation and AOL, as well as Waterstones in

the UK, Toysrus.com, Circuit City Stores, and the Borders Group. The service continued to be enhanced with Amazon Honour System, Software downloads, eDocuments, Computers and a 'Look Inside the Book' launched in October 2001. By the end of 2001, sales grew to \$3.12 billion and secured a net profit of \$5 million for the final quarter. Then Amazon was the undisputed leader in online retailing. Following the announcement of profitability, in 2002 and 2003 Amazon worked to move to outright profitability, with another small profit at the end of 2002. To do so they continued to promote and enhance the service. As well as launching an apparel store, which included clothing from retailers The Gap and Lands' End, it launched a Sports and Outdoor store, and launched discounted shipping rates. In addition Amazon Web Services were launched in July 2002 and 'Search Inside the Book' in 2003. By the end of 2003 Amazon was solidly profitable.

9.3.2 eBay

For eBay, Phase I commenced in September 1995 with the decision of Pierre Omidyar, a Paris-born programmer who lived in Silicon Valley, to create the perfect market. Omidyar wrote the service over a long weekend, calling it AuctionWeb, and added it to his home page, which already hosted a number of other services. After posting a broken laser pointer on the service and watching it sell, Omidyar realised that the service may have potential. With little marketing, the ecosystem began to grow through word of mouth, and a commission based on a percentage value of the final sale was established after a couple of weeks of operation when the internet service provider dramatically increased their prices due to escalating web traffic (the ecosystem was profitable from the start).

Very early on Omidyar outlined the ethical guidelines that he wanted the participants to follow (essentially 'do unto others as they would do unto you'). To reduce Omidyar's in-person involvement in mediating disputes between buyers and sellers, the administration of the ecosystem was handed over to participants through the establishment of bulletin boards and many of the early policies and service policing was done through participants. During this time a strong sense of community developed, typified by high trust and strong sense of identity, where it was not uncommon for goods to ship before payment arrived and payments by post. By the end of 1995 there were thousands of auctions, with operations based in Omidyar's house.

In early 1996 functionality continued to be developed, with the addition of premium fees, such as Featured Auction Fees, and by May 1996, revenues had risen to \$5000 a month prompting Omidyar to give up his day job. In mid-1996 another fee was added to list an item so as to 'remove a lot of the junk', resulting in the first large pushback from participants, leading to a graduated approach for the listing fee. At this stage the fee that eBay was charging was still based on an honesty system, where the seller would send a cheque, money order or cash once they had received payment. By summer 1996 AuctionWeb took over the whole ebay.com homepage, with the other services taken away, and the service itself had been split into 30 categories under three headings. Also around this time Jeff Skoll joined as President to develop the business so that Omidyar could focus on technology and the

ecosystem participants. Towards the end of the year PR management arrived and to alleviate poor customer support two ecosystem members were hired. Operations were frugal, with the guiding principle of to 'spend the money like it was your own'.¹⁵

The number of participants continued to grow, with vibrant debates concerning many issues of functionality, purpose and naming of features. Late in the year, Bulletin Board was split into two, with the Q&A Board and the eBay Café launched. These had a convivial feel, and developed a form of neighbourhood watch, and became a mechanism for participant oversight of duplicitous dealings. A proposal for feedback 'stars' for participants getting high feedback scores, resulted in a strong pushback as participants wanted to be involved in all stages of the process. eBay quickly apologised and launched a consultation regarding feedback stars. Also by the end of 1996 the first complementary services were arriving, such as an image rendering and hosting service.

For eBay, Phase II commenced at the beginning of 1997 as ecosystem participants began to pour in, with over 330,000 completed auctions and the total transaction value of more than \$10.25 million in the first quarter alone. The nature of the users also began to change, moving from computer related items to collectibles, and by March 1997 the service was the largest distributor of Beanie Babies in the US. As a result it was unable to scale to meet demand and continually crashing, giving rise to the moniker 'the Great eBay Flood'. Additional technical staff were hired to build a new infrastructure that was able to scale. In the meantime Skoll and Omidyar attempted to reduce the load on the service by manipulating the behaviour of ecosystem participants, resulting in successive backlashes until a satisfactory solution was found. Paradoxically this manipulation resulted in enhanced bonding as participants collectively responded to unwelcome rules of use, and as they waited to be able to use the service. Staff also became intimately involved in discussions on the boards, deepening the feeling of community. As the participants became more intimately involved with the service, any changes to the service resulted in large backlashes, and a process for participants to input and revise potential changes.

Following the efforts to deal with the 'Great eBay Flood', a new service was launched in September 1997, with new branding, a new design, and a new, scalable infrastructure, and a rebranding from AuctionWeb to eBay. However competition also began to emerge, such as OnSale (launched in May 1997) and AuctionUniverse. eBay responded with a more aggressive growth strategy, including the hiring of business development staff, engagement of an advertising agency, marketing partnerships with other internet companies, such as AOL, and marketing campaigns taking advantage of societal trends. eBay was having difficulty getting traction with the mainstream media, and it was only with the invention of the PEZ myth (eBay was started by Omidyar so that his fiancé could find PEZ dispensers) in late 1997 that the media began to respond to their press releases. To combat rising occurrences of fraud, an anti-fraud policy was established, and a legal capability hired to build relationships with all

¹⁵ Cohen (2002), p. 49.

the relevant authorities. This also laid the legal groundwork asserting that eBay was a neutral venue, and hence had no legal duty to look for fraud on the service. Supporting this policy the Legal Buddy system was set up where eBay's customer services would assist brand holders in removing offending auctions. Also during mid-1997, Omidyar and Skoll decided that the company needed venture capital and a more experienced management team, and in mid-1997 Benchmark Capital, a venture capital firm in Menlo Park, California, put \$5 million into the company to acquire a 22 percent stake.

In 1998, with the new infrastructure in place and the AOL partnership, eBay was truly able to grow, recording gross merchandise sales of \$100 million, revenues of \$6 million in the first quarter and 950,000 registered users. The service began to garner awards and plaudits from commentators. Early in the year Meg Whitman joined as CEO, introducing formal organisation to the company for the first time and deepening the management capabilities with more experienced personnel. Within two weeks the service went down for eight hours, and Whitman invested heavily in new technology and replaced the technical leadership. Marketing was considerably extended with a \$12 million deal with AOL, and also refocused on vertical publications, as well as maintaining more generalised marketing based around social and cultural events. To combat the emerging competitors, in early 1998, eBay continued to encourage users on the service, positioning itself as a 'personal trading community for individuals', and launching a category management process with specialised sub-services, a Powersellers program for heavy users, and a 'Safe Harbor' programme to combat fraud. Up4Sale, a competing advertising trading/auction service, was acquired, rapidly absorbed and closed down. New features enabled greater user interaction with the service, such as PowerChat, the 'My eBay' personalisation tool and an 'About Me' feature. Supporting services, such as sniping, and other complementary assets also started to appear in the ecosystem, driving yet more volume to the service. A number of third party oriented services also appeared as responses to the draining conversation on the eBay boards.

In September 1998, eBay was taken public, with the stock price tripling within a few days. Initially the goal was to include participants in the IPO, however legally this proved difficult and despite a letter from Omidyar explain the situation, the IPO caused outrage amongst many participants. Following the IPO, marketing capabilities were expanded and a national marketing campaign launched. However some high profile pranks, including a charity auction where all top bids were fake, and fraudulent activity garnered much press coverage and increased interest in online trading by regulators. By the end of 1998 eBay hosted nearly 1.8 million auctions and were one of the few digital services returning solid profits. Despite Yahoo! announcing a partnership with OnSale just prior to the IPO, by the end of the 1998 eBay was the undoubted, but not yet undisputed, leader.

In 1999 eBay continued its rapid growth, publically announcing that it was sticking to its 'core' business, and drove traffic through strategic relations with supporting firms and complementary service providers such as shipping and wireless services. International expansion began with the purchase of Alando.de in Germany, a launch in the UK, and joint venture in Australia. The types of users began to

evolve, with government start selling through the service. Some academic research supported some of the service principles, 'eBay addiction' was identified as a psychological disorder, and the service also became the case of conceptual art. Accolades continued to be won, with the service ranking the second most popular service on the internet, and media interest was driven by listings for virginity, drugs and body organs. Overall, the media interest had the effect of promoting eBay as fun place to be. However facing increasing criticism from the press, eBay launched a high profile anti-fraud initiative, VERO, to reassure both users and regulators alike. New competition also arrived, with Half.com launching, and Amazon firstly hosting its own daily auctions then signing an agreement with Sotheby's for an online auction house. eBay responded through acquiring Butterfield and Butterfield and launching Great Collections (later renamed eBay Premier) by the end of the year, with partnering auction houses, galleries, and dealers having their own branded areas. It also acquired Kruse International to launch an automotive section in the service, and after unsuccessfully trying to partner with some financial institutions to create a pay service, acquired BillPoint to provide payment services.

Participant identity continued to evolve with the development of idiosyncratic rituals and behaviours, such as Friday Night Sing-alongs and birthday celebrations becoming common. eBay encouraged some of this behaviour with entertainment oriented activities such as the 'eBay Addicts' contest where users boasted of their most compulsive behaviour. The 'Official eBay Magazine' and *eBay for Dummies* book were also launched that assisted in identity development. Around this time the live support bulletin boards were closed, reducing some of the contact between the participants and the organisation. However, relations between the ecosystem and eBay were volatile in 1999. By mid-year the VERO was causing problems with ecosystem participants over the enforcement of the protection. A ban on selling guns and ammunition triggered a phenomenal pushback and a poor response by eBay lead to a clear statement of free speech within the ecosystem. Although rules of conduct remained, such as prohibiting threats and hate speech, following this incident, participants were a lot freer to speak. To maintain ecosystem relations the Voices Program was introduced to discuss ecosystem issues, which enabled it to successfully ban the sale of alcohol and tobacco products. However, functional and pricing changes to the service also generated participant responses, such as the introduction of a listing fee and some extended system down time over the summer.

By the beginning of 2000, eBay was now the Internet's top auction service with ten million registered users, selling around \$10 million of merchandise a day. The ecosystem continued to grow, with many successful businesses now based on distribution through eBay. Shrugging off a Yahoo! acquisition attempt, it continued its strategy of partnering with firms to extend its marketing reach, as well as the provision of complementary services, such as the eBay University. Promotions continued to focus on the auction side of the business, and to maintain its lead Half.com was acquired - an auction service specialising in used goods for fixed prices. International expansion continued, launching in Taiwan, Canada, and Austria, and specialised extensions of the service were also released, such as a

business-to-business marketplace called BusinessExchange, a program for antique malls, and real estate through a partnership. As a consequence of the leadership changes from the previous year, by the summer development had sped up by more than four times, and functional improvements continued on the service such as the launch of eBay Anywhere, eBay Payments (although millions of users were already using PayPal), a Live Auction facility for Great Collections, and the 'Buy it Now' functionality. In March 2000 a major change to the feedback system, transactional feedback, was introduced with the vast majority of the ecosystem supporting the change. However relations with the ecosystem remained strained, with an open rebellion over the banning of advertising and the lack of consultation over the launch of the phenomenally successful eBay Motors.

For eBay, Phase III was ushered in June 2000 with a massive protest called the 'Million Auction March', triggered by previous missteps with the participants and an increasing dissatisfaction with the direction of the service and the plight of small sellers. Whitman defused the situation over the summer, however one side effect of the march was that it demonstrated to participants how good the eBay ecosystem was, despite moving more than a million listings to competitor services. The resolution of this crisis meant that the ecosystem participants now recognised eBay's tensions to operate as a listed company, and ecosystem conflict with the participants declined. However these lessons were not well learnt, as eBay triggered another enormous backlash when they launched a co-branded service with Disney later in the year, which heavily favoured the items from Disney. To rectify the situation Whitman announced an explicit statement of a level playing field for all participants, large or small, and internally the firm recognised that there had been a loss in capability in ecosystem management. In terms of functionality, the service continued to be enhanced, with the introduction of services to increase revenues, such as the introduction of 'Buy it Now'. eBay also continued to develop the complementary service elements of the ecosystem, making officially available an API and launching a Developers Programme. As well as actively and fully complying with the Digital Millennium Copyright Act eBay won some a key court case ensuring that it was considered a neutral vendor and was not liable for the goods sold through the service. In addition, media coverage now considered eBay a neutral vendor, and instead focused on the users doing the buying and selling.

In 2001, eBay continued its phenomenal growth, with the dotcom crash having little effect on its operations. It launched native services in Italy, Ireland, New Zealand, Switzerland and Singapore, and expanded into South America, South Korea, and France. They continued to build alliances for marketing and complementary service provision, notably with Microsoft and IBM, as well as user education through the continued development of the eBay University. Service functionality was extended, with the launch of eBay Stores and eBay Classified, the relaunch of Great Collections as eBay Premier, and the acquisition of HomesDirect. Wider society and the press now viewed eBay as a neutral venue, which was further legally established through a number of court victories.

9.3.3 Facebook

For Facebook, Phase I began in mid-December 2003 when Mark Zuckerberg addressed an issue of concern to Harvard students, the fact that their 'Facebooks' were not online. This dissatisfaction had been exacerbated by Harvard's announcement that it was going to create a centralised repository without any subsequent action. Zuckerberg developed the service known as the 'thefacebook' over a couple of days in early January 2004, and mobilising his dorm-mates to support, launched the social network internally at Harvard on the 4th February 2003. Ownership of the service at this early stage was split between himself, Eduardo Saverin and Dustin Moskovitz, his dorm roommates. As more users came on board it became popular for setting up study groups, and soon the Harvard Crimson had run a couple of articles about the service, where Zuckerberg had clearly outlined the operating principles of the service ('to be fun'). Participants began to exhibit idiosyncratic practices, such as broadcasting political views by changing photos and competing through friending competitions. Poking was also very popular, and much of the interaction had a strong sexual overtone. With no promotion, the service was a huge success, and very soon students at other universities began asking for access.

At the end of February the service was opened to Stanford, Columbia and Yale, and in early March to Dartmouth, Cornell, University of Pennsylvania, Princeton, MIT, Brown, and Boston U. As well as continually re-architecting the service to enable it to scale as all the new users came on board, an improvement in mid-March was to introduce cross-campus linking; before this time users could only see those in their own university. To maintain growth, Zuckerberg and Saverin invested another \$10,000 each at the end of March, and the operation was later formalised as an LLC in Florida. Advertising functionality was included in mid-April, and very soon they began to sell some advertisements. Despite the benefits of this cash-flow, Zuckerberg maintained strict controls on the positioning and size of the advertisements. However a number of competitors were launching, notably ConnectU who claimed that Zuckerberg misappropriated their earlier work.

In mid-June operations moved from the Harvard dorm rooms to Palo-Alto, California, installing the servers close by in Santa-Clara. Soon after arriving in Palo-Alto they met up with Sean Parker (who Zuckerberg had already met earlier in the year in New York) who became the front man for Facebook. Around this time, Saverin, who remained behind on the East Coast to find advertising revenues, cut off money from the LLC's account, resulting in Zuckerberg and family funding the company out of their own pocket. As it was unclear what the LLC actually owned at this time, Parker incorporated the company in Delaware with a new company structure and ownership distribution. In order to maintain performance, they implemented a policy that every server upgrade should be able to handle ten times more users than they had at the time of the upgrade. In addition they continued to strengthen the service for the anticipated high load when users came back from holidays. Over the summer break usage and number of users continued to grow. However this preparation did not prevent a small number of outages and slow down, so by the end of summer they were adding servers almost daily. Users were looking at

100s and 1000s of profiles a day, and the movie quotes that Zuckerberg had added in the service achieved cult status.

By the summer the first proper investment offers arrived, with Benchmark Capital unsuccessful in investing and an unsuccessful acquisition attempt by Google. At the end of August 2004, Peter Thiel (along with a couple of other angel investors) made a \$500,000 angel investment for 10.2 percent of the company and joined Facebook's board. A couple of months later they struck an agreement with WTI who provided \$300,000 and invests \$25,000 dedicate to hardware provision. Zuckerberg and Moskovitz decided not to return to university, and hired operations and product management capability to support the coming growth.

For Facebook, Phase II started with the return of college students after the summer 2004 recess. Deciding to stay focused on Ivy League universities, an automated process to add universities was established and 15 new colleges were soon added. In order to outflank emerging competitors, a 'surround' strategy of opening at as many schools in the vicinity of where another social network had begun to take root. Very soon the service lost its elitist edge as new schools began to be loaded at pace. Many new features were launched, such as Wall, Groups and Student Flyers, another type of advertisement. Advertising revenue continued to flow, and earlier in the year Y2M has been brought on board, who won a breakthrough advertising deals with Paramount and Apple.

By the beginning of 2005 the first mainstream press coverage began with the *LA Times* writing an article about the service. As usage increased, in mid-February WTI invested another \$300,000 dedicated to hardware provision, and many new servers were installed. However, at this stage they began reaching out to VC firms for some serious investment to enable growth, and although there was lots of interest from investors there was still a lot of scepticism as many were unable to view the service. After an unsuccessful acquisition attempt by Viacom at the end of March, and refusing investment from the *Washington Post*, VC firm Accel invested \$12.7 million (valuing Facebook at about \$98 million) and a partner joined the board. Saverin parted ways with Facebook acrimoniously as he was diluted from a 30 percent to 10 percent equity stake. Following this, the focus was on growth and hiring, including business development, sales, developers, graphic designers, data and infrastructure management capabilities, quite a few customer support staff to address the large backlog of customer support emails, and product marketing.

Demand from schools to join the service was so great that a waiting list was created, and it was a constant battle to keep the service operational alongside the growth of users. In July WTI lent another \$3 million, which was rapidly spent on hardware to accommodate the growing numbers of users. After purchasing 'facebook.com' domain, the service was re-launched at the end of September 2005 as simply 'Facebook', with a new look and logo. Also in September, following a long discussion, a high school version was launched, and in October to universities outside the US. Two notable additional features

introduced around this time were ‘time-sorting’, which listed the most recent activities of user in reverse order, and photo hosting; both were met with wide acclaim by users, with the latter rapidly became the most popular feature. However the requirements for photo storage meant that there was a massive requirement for space and processing. By the end of the year there was more than 2,000 colleges and 25,000 high schools on the system, and more than \$4.4 million was spent on servers alone. However serious competition was arriving with StudioVZ in Germany and Xiaonei in China, and the first criticisms of privacy published.

2006 saw the commencement of formal marketing activities with press releases responding to mixed reviews in the press, such as a critical *New Yorker* article in May and a mostly positive *Fortune* article in October. Although Zuckerberg maintained strong control over the placement and types of advertising of the service, there was much interest, and Facebook signed a significant advertising deal with Microsoft. There was also much interest in acquiring Facebook from a number of differing organisations, including News Corporation, Viacom/MTV, Time Warner and Yahoo!. In April 2006, Facebook raised another \$27.5 million, valuing the company at \$500 million, from a number of VC firms, including Greylock Partners and Meritech Capital, plus additional investments from Peter Thiel and Accel Partners.

In early 2006, to drive ecosystem growth, membership was increasingly opened beyond schools and universities. With the distinction between universities and colleges was abandoned, with the result that any user could freely establish friendships or send messages regardless of age or grade. Adoption was further boosted when their college competitor CUC Community inexplicably closed down, with many of their 250,000 users coming over to Facebook. By the beginning of summer, building on the high school success, membership was opened to add work networks to muted success. However at the end of that summer, membership was opened to anyone with a registered email address and over the age of 13. Functional development continued on the service, such as the Share and News Feed features; however as the service gained in popularity, participants began to hack the service exposing security flaws. The launch of News Feed, already controversial within the firm before its launch, brought a strong critical response from the ecosystem, only exacerbated by a condescending email written by Zuckerberg. As critical media coverage grew, Zuckerberg wrote a very contrite blog post and participated in a live public discussion, announcing new privacy controls on the service, leading to lessened criticism.

During 2007 the service was becoming increasingly visible, as were other social networks such as StudioVZ in Germany. Early in the year the term ‘ambient intimacy’ was coined to describe the dynamics of Facebook, and in the UK institutional support emerged with the Trade Unions Council actively encouraging employers to allow access, although the press continued to vigorously cover incidents of employees being fired for Facebook use. Safety and privacy issues continued to arise, with widespread criticism and lawsuit preparation over the release of the ability to publicly search for user

profiles and Beacon, a service where third party web services could include a script of Facebook to update users status updates. The service's features continued to be enhanced as well as new additions such as Marketplace, Facebook Video and a translation program so that users could translate the service into their own language. They also made their first acquisition, ParaKey, which added some useful technology and staff. To grow advertising adoption a new type of sponsored story, an extension to the Flyers functionality and Facebook Ads were launched. However advertising was also not without controversy as some firms withdraw their advertisements on discovering that they were being placed alongside pages managed by far-right groups. A notable extension to the ecosystem was the launch of the Facebook Platform which enabled third parties to develop their own applications. Launched at their first conference, called f8, many apps were demonstrated by high profile companies, and was met by an ecstatic response from the tech industry and the press. However poor management of the platform, exacerbated by many unscrupulous app developers, lead to additional security and privacy concerns. Despite strenuous efforts to control the apps on the service, such as app rating systems and the launch of an fbFund to encourage 'useful' apps, due to inexperience these efforts often impaired legitimate apps and the utility of this aspect of the ecosystem. Towards the end of the year, after publically stating their wish to remain independent, Microsoft invested \$240 million for a 1.6 percent and also contracted for the rights for international advertising, and Li Ka-shing put in \$60 million at 0.4 percent, valuing the company at \$15 billion.

In 2008 Facebook continued to become accepted, with some companies making Facebook compulsory internally to the organisation, politicians adopting the service and the courts started to recognise profiles as evidence. The press continued to find much interest in the service, focusing on user activity, functional changes and privacy. Facebook began to proactively build goodwill, participating in discussions of pro-tolerance and anti-terrorism groups cross-pollinate and building and configuring the service as communications device during Hurricane Gustav. 2008 also saw international expansion, launching in Spanish, French and German, and by the end of the year there was over 35 languages available on the service. Mid-year the service surpassed MySpace, however international competition remained. The service continued to gain features to build participant engagement, such Facebook Chat, Suggest Friends, and Facebook Connect which enabled people to log into third party services using their Facebook login, although some of these changes lead to large ecosystem backlashes. Despite new staff and a number of initiatives to control spam, the platform ecosystem was still out of control although this did not dent its popularity. Some apps, such as Scrabulous, were proving so popular that they were in the top 100 services for the year, and larger organisations were also adopting the ecosystem such as Salesforce partnering to launch Force.com for Facebook. Material support for ecosystem developers continued, with the provision of a peered data-centre for app developers, a second f8 conference in July (where they announced many new features on the Facebook Platform), and the fbFund awarding funding to 25 app developers in October, and another \$1 million to developers in

December. With the hiring of Sheryl Sandberg as its Chief Operating Officer in March, a new business model focused on advertising was adopted, leading to the launch of new type of ads - Engagement Ads. By the end of 2008, Facebook was cash flow positive for the first time, and some of the founders and early employees began to move on.

For Facebook, Phase III emerged as control was finally consolidated over the apps available through the platform, and series of measures to better formalise ecosystem activity. In addition the ecosystem became the unrivalled market leader, surpassing Orkut globally in late September, and Friendster in Asia in November. Internationalisation continued with Arabic and Hebrew introduced in March, as well as customisation for particular countries. However the service was completely blocked in China from early June. There was continued enhancement of existing functions and the addition of new ones. A new addition was the 'like' button, a new marketplace using Oodle, integration with Twitter and Xbox Connect, the OpenStream API in April, Facebook credits in May, and usernames in June. Extending functionality further, in August Facebook both acquired FriendFeed, a real-time news aggregator and improved access with the launch of Facebook light for areas without good internet access in August. However some of these enhancements were not without criticism, such as a homepage redesign which lead to a strong ecosystem pushback. There were also some minor service down incidents later in the year, but these did not damage its popularity. The service was being deeply integrated with consumer services and devices, such as the Huffington post, as well as into in a mobile phone by Hutchinson Whampoa in 2008 and in Verison broadband television in 2009.

Facebook was now becoming well integrated into society, with an academic paper noting that Facebook was fostering political engagement, a poll highlighting that employers checked Facebook before hiring, White House officials apologising for issues on the service and New York City using the service for NIH education. However a number of organisations continued to impose restraints on Facebook use, particularly in the UK and Finland, as well as the US Marines, among other government agencies. However privacy and security concerns continued. In early 2009 a change to the Terms of Use lead to a strong backlash, picked up the mainstream press, and complaints being prepared for the FTC. This resulted in the creation of a 'Bill of Rights', partnering with authorities to increase safety and launching well as a Global Advisory Board for user safety. However issues continued to arise related to the ongoing functional development of the service. For instance, despite notifying all users of a change to the default view, the actual implementation of the change lead to an outcry by users, and enormous criticism commentators and observers, as well as filing of formal complaint to the FTC by EPIC that was only resolved a couple of years later. Despite these missteps external research found that the service was tenth most trusted on the internet. Functionally, enhancements to the service now focused on continual tweaks to advertising and other value extraction techniques, as the underlying business model settled in. The stabilisation of operations was reflected in additional investment valuing

Facebook at \$10 billion. Another founder (Moskovitz) left as the service settled into control and appropriation of the value in the ecosystem.

9.3.4 Google

For Google, Phase I commenced an original idea from the doctoral work of Stanford University computer science graduate students, Larry Page and Sergey Brin. During 1996 Larry Page had decided that analysing web links was a good idea, and similar to citations, the number of incoming links was a good proxy for the value of the web page. Over 1996 this theory of links evolved into what is known as the 'PageRank' algorithm. In early 1997 Brin and Page launched a search engine called BackRub, and, with the help of their doctoral supervisor, a couple of months later they pulled together a more comprehensive search engine with elements of more conventional search technology. In September 1997, the search engine was renamed to Google and Google.com registered. The service was launched as google.stanford.edu in October, using a very simple design and the logo that is still in use today. To provide the service Brin and Page began to manufacture their own computers, operating them out of Stanford, both their work room and Page's dorm room, for over a year.

By 1998 the search service was gathering popularity through word of mouth, as students and staff began to use the service to hunt for information online. Throughout this time they were also adding new features, such as caching and search summaries, and improving performance, with occasional crashes. When Search Engine Watch was first published in November, it also began publicising the service. To assist in the growth of the service, their doctoral supervisors assisted by funding \$10,000 from the Digital Libraries Project. Furthermore, in order to grow, they tried to licence the technology to other portals and search engines, such as Yahoo!, AltaVista and Excite, however they were unable to secure the financial support of the major portal players of the day. VC firms were also not interested in search. As such Brin and Page sought out some investors to help assist in the growth of the company. In late August 1998 Andy Bechtolsheim, founder of Sun Microsystems, and friend of a Stanford faculty member, wrote a check to Google Inc. for \$100,000, and over the next month they raised another \$900,000 from family and friends.

In early September they set up a workspace in the garage in Menlo Park, incorporated Google, Inc to cash the cheque from Bechtolsheim, and hired their first employee, a fellow computer science graduate at Stanford. Around this time, they were continually investing in computers as the service was handling 10,000 search queries a day. Brin and Page soon disengaged from their studies at Stanford but remained in contact, writing a paper that warned about the dangers of advertisement-funded search engines, lecturing a class on search engines, and presenting the search engine in a class at Stanford in September. By the end of the year there was a glowing review from PC Magazine.

In 1999 the word of mouth publicity continued, and Smart Computing Magazine named them one of its 50 Hot Technologies in mid-January, driving more users to the service. As well as good

mentions in the main stream press, Search Engine Watch acted as an marketing mechanism through their coverage of the search sector, and the declining quality of search in their competitors. As they continued to add features to the service, and beginning to crawl continuously, Google.com was launched in February with 500,000 queries a day. Being named Best Search Engine by Yahoo! Internet Life in April drove more traffic to the service and soon Netscape became a customer, helping push daily traffic levels to over 3 million. In early June 1999 they secured \$25 million in equity funding from Sequoia Capital and Kleiner Perkins Caulfield & Buyers, with a general partner from each joining the board.

For Google, Phase II commenced with increasing adoption, as the size of the 1999 VC deal resulted in much news coverage and raised the profile of the service beyond devotees. Search Engine Watch continued to positively mention the service and by the middle of 1999, with no advertising spend, the 'Google' brand was becoming quite well known. This was supported by some inexpensive marketing, such as the Google Store where participants could buy branded clothes, and some low key promotional press releases. Around this time the first Google Doodles, the experimental art on the homepage, arrived which became an artefact that inspire users to visit the service. By the end of the year, momentum building actions continued through participation at the Search Engine Strategies Conference, winning accolades, and garnering positive press coverage, such as Newsweek, USA Today and Business Week. Internally there, the office was still a fun filled environment, maintaining a small company feel. Also around this time the 20 percent rule was introduced, where software engineering staff could spend at least 20 percent of their time on their own projects.

The VC investment also enabled continued investment in the core service, implementing load balancing and fail-safe software, as well as the launch of a new web service design. Also launched were WebSearch and ServiceSearch, two explicit ecosystem growth features which enabled the embedding of web searches, or the ability to search a service, into third party sites. The ecosystem began to grow rapidly, with many adopting their services across the United States, Europe and Asia. Participants were also involved in the design of the service as a new font resulted in a backlash, and others obsessively keeping an eye on the number of words on the homepage. However the company was still not making enough money, and by the end of 1999 a new strategy had emerged, to continue to produce free search results, but to profit by selling ads. This was launched in December 1999 as Google AdWords to critical acclaim. A couple of months later the advertising capability was enhanced with the introduction of a non-stop online auction.

Word of mouth marketing continued into 2000, and the number of queries continued to increase. The closing of a deal with Yahoo! to become their default search engine provider brought many more participants and activity within the ecosystem. The service was also released internationally by the end of the year, available in 26 languages. Engagement also increased with ego searches, an annual April Fools' joke, and promotional doodles that brought participants back to the service timed with societal celebrations, such as Easter and Fathers' Day. The end of June saw the proud announcement of the

billion-page index and, with 18 million search queries per day, becoming the world's largest search engine. In addition, throughout 2000 they continued to win accolades and gather positive coverage in the press, such as from *Time Digital Magazine* and a *New Yorker Magazine* article in May. Despite their growth some doubt was creeping into the press, with a negative article in *BusinessWeek* in December, as well as some privacy issues being aired.

Enhancements continued to the core service also driving more adoption, with improved WebSearch functionality resulting in more than 13,000 participating sites by March. The ecosystem was further extended with the launch of the Affiliate Programme, which enabled any service to put a Google search box and earn a small commission. To drive more advertising to the service a Self Service Ad program that could be activated with a credit card was launched, extending the advertising services to small to mid-size businesses. Technical enhancements continued on the service and to drive more ecosystem activity the service was integrated into internet infrastructure, resulting in the Google Toolbar, a highly popular innovative browser plug-in. By the end of the year there were more than 60 million searches per day.

Service adoption continued to grow throughout 2001, reaching the 100-million search mark per day, and the service itself continued to win accolades. Professional management was introduced, as Eric Schmidt became CEO and Page and Brin became President, Products and President, Technology, respectively. With Schmidt's arrival many internal operations were formalised, such as a proper financial system. Internationally, strategic partnerships and the launch of a translation console resulted in 25 services and 30 portal services in 30 countries using the service over the year. Over the year the service became more integrated in society, with the *New Yorker* noting that the word Google had become a verb, and by the end of the year variants were also to be seen in other languages. The service retained its quirkiness and participant engagement, with the introduction of the Swedish Chef and Klingon, but also gained wider societal relevance and acknowledgement, becoming an alternative news outlet during 9/11. Functionally the service continued to be enhanced, such as extending the range of searchable file types to include PDFs and images. Acquisitions included the technology assets of Outride and the acquisition of Deja provided UseNet archives from 1981 for searching. By the end of the year, with the introduction of daily web refreshes, there was 3 billion Web documents available with the archive of Usenet messages dating back to 1981. The underlying PageRank algorithm was granted a patent in September, and at the beginning of the fourth quarter of 2001, the company was profitable.

In 2002 many new participants, especially users and advertisers, joined the ecosystem. Internationally there were 77 languages and 46 language domains by the end of the year. Functionally the core search service continued to be developed, and, following the launch of a web API for the search service, its quick adoption by many other services lead to further ecosystem growth. Also released was Labs, enabling open access to their evolving search technologies and services. Both the search services and advertising businesses continued to grow. An upgraded self-service advertising system, AdWords

Select, was launched to wide acclaim, as well as a multi-year agreement with AOL. In addition Google began to support users with the launch of Google U, a series of seminars for people using their advertising services. Search Engine Watch maintained its warm reviews, and a whole new industry developed, Search Engine Optimisation, around search and advertising. To maintain ecosystem momentum and build user engagement, the firm attended Search Engine Strategies and Linux World, as well as relaunching Google Store in March and releasing Dilbert doodles. The accolades continued to pour in, and the service itself was becoming part of the culture, with references in both *The West Wing*, a television show, a *New Yorker Magazine* cartoon, and the American Dialect Society members voting 'Google' the 'most useful' Word of the Year for 2002. However, the ecosystem's increasing size and dominance was now beginning to attract some friction. Overture, an online advertising firm that commenced a couple of years earlier, sued for patent infringement, and a number of organisations, such as the Church of Scientology, sued under the Digital Millennium Copyright Act to have copyrighted material removed. This led to criticism that data was being censored – particularly as evidence was emerging that extreme web sites (such as those from the political right wing) were also excluded from searches.

In 2003 the service continued to add more languages and locations, with more than 84 country domains by the end of the year, as well as more functionality enhancements. The acquisitions of Applied Semantics provided expertise in analysing page content and Kaltix Corp. provided expertise in personalised and context-sensitive search technologies. Blog functionality was also added through the acquisition of Pyra Labs, the creators of Blogger, which was made free later in the year. Explicitly aimed at continuing to build ecosystem momentum, a new content-targeted advertising service was launched and the self-service option for AdSense augmented. Participant adoption of their advertising services continued to grow, with more than 100,000 firms advertising through the system in March. Through the affiliated program entire blog networks supported by ads, and one particular firm in the UK generated approximately 58 percent of orders through Google. The firm and its founders continued to win accolades, and the Google service was also increasingly the subject of societal dialogue, with many testimonials appearing on the power of its search, as well as a book called *Google Hacks* and a popular blog 'Google Blogoscoped' launched in March. Google was also becoming a destination for politicians with both Madeline Albright and Bill Clinton visiting the Googleplex at the end of the year.

In 2004 the service continued to be internationalised and localised, supporting more than 100 different languages. Integration into the internet infrastructure continued, becoming default settings into both Apple's Safari and the Firefox browser. By February more than 6 billion documents were indexed and the ecosystem continued to expand, particularly on the advertising side. Both the service and founders continued to win accolades; 8 Awards at 4th Annual Search Engine Watch Awards, 'Brand of the Year' for Interbrand and both Brin and Page named Fellows by the Marconi Society, as well as debuting on Forbes 400 list. However over 2004 the service also began to be less trusted, despite the

much trumpeted 'don't be evil' motto. The launch of Gmail, designed with advertising alongside the emails, led to a strong public backlash due to privacy concerns. The announcement of the book digitisation project, led to a big push-back from publishers, authors and librarians, as well as mixed press, particularly focused on the commercial dimension of the project. Finally, the unconventional approach to its IPO, which it had delayed for as long as possible, to conceal their profitability, led to a lacklustre listing. The IPO was marred by a strong pushback from SEC, a huge media response as the scale of the firm's profitability became known, doubt and criticism from Wall Street, and a magazine article that broke the mandatory media black-out.

Following the IPO, to build a lead over its competitors, a plethora of functional innovations were launched to complement the core service, with a large resultant press coverage. Of note was the acquisition of Keyhole a digital mapping company whose technology would later become Google Earth, and the launch of Desktop Search was met with a large privacy concern. Despite an initially seeming to keep up with the flood of innovation, by November the main search competitors Yahoo! and Microsoft appeared unnerved and falling behind.

For Google, Phase III commenced at the end of 2004 as it became the undisputed leader and the remaining competition (such as Microsoft and Yahoo!) were unable to maintain parity. This lead was particularly enhanced through a legal judgement that put the advertising business on a firm legal footing. After easing the policy on use of trademarks in March (perhaps to boost sales in the lead up to the IPO), the firm was sued by Geico over illegal use of their trademarks. However this case resulted in a big win when a federal judge ruled that the use of trademarks in keyword advertising was legal.

In 2005 Google continued its flood of innovation and continued to release updated and new functionality, including new services such as Google Weather, Google Video, Google Maps, Google Analytics (after acquiring Urchin), Google Reader, Google Base, Music Onebox, Google Earth and Google Talk. They also continued to open the APIs to its services, such as an AdWords API, Google Maps API, and an updated version of the Blogger API, as well as the supporting services, such as code.google.com and the Blogger Developers Network. The advertising business also gained additional functionality, such as service targeting, separate content bidding and easier sign-up, as well as new customers. Towards the end of the year Google announced the availability of first collection of public domain books, however complaints over library scanning project, now called Google Print, had continued throughout the year, resulting in a class action lawsuit launched by Authors Guild in September. The firm continued to engage with and reach out to participants, including sponsoring coding competition in India, the Summer of Code and the Google Code Jam, as well as the Anita Borg Memorial Scholarship. The media began to ask if Google would crush Microsoft, and Fortune penned a very favourable article. As Google settled into society, the accolades began to slow however Brin and Page entered the prestigious American Academy of Arts and Sciences in April.

9.3.5 Salesforce

For Salesforce, the initial idea came from Marc Benioff during the period 1996 to 1998 when he was a SVP at Oracle. Benioff saw an opportunity to deliver Customer Relationship Management (CRM) using services on the Internet, central servers to store customers' data. So in 1998, after a sabbatical, he took a leave of absence from Oracle, wrote a business plan, met up with a couple of developers from Left Coat Software, who agreed to board in November 1998. In March 1999 the Salesforce was founded, with \$6 million seeded by Benioff and based in San Francisco. The company culture was relaxed, and only in late April the formal strategy for the firm was written down.

Development started in earnest, developing the code fast and simply, and Benioff planned the product outsiders, such as Larry Ellison of Oracle and Tom Siebel of Siebel Systems. Recruitment of developers followed over the following months, leading to a series of office moves. By the beginning of April the first prototype was built, and friends and colleges were asked to test it. A month later an external company was used to further test it, and the prototype was tweaked based upon the feedback of both. In August the service was released as a free trial. This trial allowed five users access for a year, and was open to anyone who expressed interest – there was no need to speak to a sales person. By the end of August five pilot customers were using the service, called 'design partners'. BugForce was also created so that users could post bugs and they could keep track of problems and new idea, and the service was constantly refined through pilot customer contact as well through as active monitoring of customer usage.

Owing to Benioff's experience, the firm had a marketing focus, and from very early on there was a two page marketing web service, which was upgraded when a WSJ article cited Salesforce as an example of the new trend of software as a service. With a policy of responding to any lead regardless of size and the active encouragement of existing staff to bring in customers, sales staff were soon hired. With increasing number of clients signing up to the service a monthly billing plan (\$50 per month per user) was introduced, and one of the five pilot customers, Blue Martini, started paying the service soon after. Formalising the increasing number of customers trialling the service, there was an official Pilot Program Launch in early December, highlighting that some large companies had signed up. Also in early December, there was another article in the WSJ, stating that 'Salesforce takes the lead in the latest software revolution', resulting in another flood of sales leads and interest in the service. Building on this, Salesforce engaged OutCast Communications as PR and Marketing, and the distinctive 'No Software' logo was created, establishing Salesforce as 'Amazon meets Siebel Systems'. To prepare for growth, by the end of the year, Benioff raised \$17 million of angel funding and both an Advisory Board and a senior management team were in place.

For Salesforce, Phase II commenced in February 2000 with high profile guerrilla marketing at the main competitor's annual conference, as well as their own uniquely branded launch party. This was complemented with provocative advertising featuring a modern plane shooting down a bi-plane.

Together these led to a large influx of interest and a media firestorm, further inflamed when Siebel responded publically. To further drive adoption they also partnered with a range of high profile small business support web services as well as increasing the business development, marketing and sales staff throughout the year. From 1000 participants in March there had 20,000 by October. So successful was the marketing campaign that it was recognised by PR Week as Hi-Tech Campaign of the Year, as well as winning some other accolades.

Encouraged by customer feedback, the general features of the service were enhanced, as well as the ability for customisation and user extension. The API was offered for free to encourage participant adoption of the service. The service also continued to extend functionality through partnering with related services, such as a Content Partners Program where partners such as Hoover could provide dynamic data to users, and extending the service through partnering, such as with Miller Heiman to integrate their sales methodology. In October the company began to have serious cash flow issues as the dotcom crash began to squeeze the economy. To recoup the cost of sale, the billing plan was changed x from monthly to annual payments. Despite a number of customers outraged by the payment terms change, most accepted the change. This put the company on a considerably better footing, and within a year the contract terms had significant financial impact, moving from cash-flow negative to positive. To fund continued growth an additional \$35 million was raised from VC firms towards the end of 2000.

In 2001 aggressive marketing and constant strategic alliance making continued, focused on building a reputation that tempted larger firms to adopt the service. Following a review of their own marketing activities, a city 'roadshow' was launched, consisting of ecosystem participants, prospects and the press, which gathered an almost cult-like following. When Microsoft acquired Great Plains in April, an interoffice memo of Benioff's was picked up by the press and which lead to much more free publicity. The firm and service continued to pick up accolades throughout the year, such as Aberdeen Groups 'What Works' Award, a Five Star Rating from PC Magazine, named a Cool Company of 2001 by FORTUNE Magazine. Salesforce also become part of the recruitment market, with employers specifically requesting Salesforce experience, and also the first specialist Salesforce consultancies were being established. The wide publicity garnered by the adoption of high profile customers, such as Broadvision, Times Warner, Dow Jones, USA Today, Fujitsu, and Agency.com, lead to increasing participant adoption. However although Salesforce generated \$5 million over 2001 it was still made a \$31.8 million loss.

In 2002 the company launched a new vision, looking for 'global leadership', and the service was internationalised, launching in German, French, Italian, Spanish, Korean and Chinese to complement the Japanese service from the year before. By March there were 4,100 customers in more than 100 countries, and the flood of accolades continued, both for the service and individuals within the organisation. Following a review of their sales process, the free trial was removed in August and a more complex trial introduced so as to build perceptions of product value. New and improved versions of the

service continued to be launched, such as offline and wireless capabilities, and additional functions were facilitated through partners, such as data-integration and workflow, multi-channel customer service capabilities, and email lead generation. Throughout the year, as a consequence of customer feedback the development team continued to add flexibility to the product, and by June additional customisation features meant that customers could begin to create their own applications. This further led to increasing adoption and integration of participants into the Salesforce ecosystem. To fund all this another \$13 million was raised by from VCs at the end of the year. When the 'Success. Not Software.' advertising campaign was launched in December 2002 there were more than 5,400 customers.

In 2003 the firm was finally profitable, and the ecosystem continued to grow, with Salesforce achieving than 120,000 subscribers with 8,400 customers by the end of the year. A high profile new customer, which signalled the maturity and increasing adoption of Salesforce by large companies was SunGard, a Fortune 1000 company, who were looking for a way to integrate 80 different business units and saw CRM as the 'unifying glue'. Salesforce continued its taunting and guerrilla marketing, ambushing users at both the Siebel European User Week and Siebel Systems Conference in San Diego. The flood of accolades continued, both for the service and Benioff, who was appointed Co-Chair of Presidents Information Technology Advisory Committee in May and a very positive profile in the *New York Times*.

The main service was continually enhanced with new features and integration tools. Also released was Sforce, the logical extension of the customisation support that had been developing over the previous years, which provided services that developers could use to build business applications directly over the Internet. A range of complementary tool kits for a series of development environments as well as a supporting developer program was launched, leading to significant adoption by developers for new software development. The firm also began to engage with customers and developers more formally, with the first DreamForce Conference in November. This conference was the logical extension of the road shows from the previous years, bringing customers, developers and press to a single location to celebrate the service, as well customers through Customer Innovation Awards.

In 2004 Salesforce listed on the NYSE, without much press coverage as the SEC queried the IPO filing due to revenue recognition issues. There was intense media scrutiny of the IPO, as it was viewed as a litmus test for a new business model. Following the IPO the company formalised many of its operations, adding another level of management, initiating formal career development programme, introducing a tax and treasury capability. The ecosystem continued to grow with 13,300 customers and 214,000 subscribers worldwide at the end of the year. The accolades continued to arrive, in many cases winning the same award for the third time. As well as product awards, the service was the darling of industry analysts, such as winning the highest overall score in the 'Forrester Wave: Hosted Sales Force Automation' and Best Execution of a Midmarket IT Solution at a Gartner Vision Event. Ecosystem

participants also began to win awards for their implementation of Salesforce, celebrated at the second annual user and developer conference, DreamForce 2004. The service offering continued to be enhanced, with links to Microsoft Office, a support web service for customers who self-implemented, Salesforce Studio, and SupportForce. The launch of On-Demand Marketplace enabled developers to offer the applications that had developed on Sforce for sale, which was a precursor for AppExchange released the following year.

In 2005 the accolades continued to pour in for Benioff, the service and the company, with many won for the fourth time in a row. The enhancements to the service continued with a focus on customisation and integration, including experimentations with social media for customer support, leading some analysts to note that customisation and integration were key differentiators for the service. The Third DreamForce conference celebrated customers with the announcement of CRM Success Heroes Award Winners, as well as being the setting for the limited release of AppExchange. Going beyond the sForce OnDemand Exchange released the previous year, AppExchange allowed users to create their own applications and sell them to others. There was a rapturous media response, with Forbes describing AppExchange as the iTunes of business software, and BusinessWeek the 'eBay for software'. Adding to the media response was the acquisition of Siebel by Oracle on the first day of DreamForce 2005. With nearly more than eight times as many subscribers as the online offering of Siebel, CRM OnDemand, Salesforce was positively mentioned in every Siebel news story. To underline their success, Salesforce for Dummies topped an Amazon bestseller list in February, and the SEC standardised the revenue recognition as pioneered by Salesforce as the main type recognised.

For Salesforce, Phase III commenced at the end of 2005 as the service reached the limits of its scalability, and some serious service disruptions followed which damaged trust and potentially threatened the viability of the service. Although uptime was 99 percent and the service was more reliable than normal software, because it was provided remotely any disruption was maddening to ecosystem participants. At the end of December the service went down for almost a day, followed by some other outages in January 2006. It was apparent there was a fundamental problem with the technology model and much work needed to be done to rectify it. Rather than address the issue head on, Salesforce.com tried to maintain a low profile, resulting in a very quick and vigorous press response. Ecosystem participants were outraged to the continued silence, until the firm began a rich and frequent dialogue with customers following the realisation that communication was the best policy. This was finally formalised in trust.salesforce.com, a systems status service that provides real-time and historical system performance information and updates, incident reports and maintenance schedules across all its key system components. By the end of March the company proudly announced 99.999 percent availability for that month. Press interest began to wane as the software service model was accepted as viable.

In 2006 the accolades continued to pour in, both for the service and for Benioff, and in August the firm trumpeted the fact it delivered 50 million transactions in a single day. Adoption by government

was made simpler through the award of a GSA contract with reseller agreement. Internally, there was a shift to value appropriation with the hiring of staff to focus on revenue collection, and release of monetisation strategy documents. In particular there was the instigation of both a worldwide revenue department and an internal push to systematise and standardise process, practices and programmes. As if to underline their success, a small start-up SaaS company now protested outside DreamForce, echoing their stunt with Seibel many years earlier.

The core service continued to be developed, and the ecosystem was extended through partnership with additional management consultancies. DreamForce 2006 in October was not only used to promote the new releases of the service, but also to celebrate the success of AppExchange, with the announcement of Appy Award Winners. The addition of Apex (a special programming language) and ApexConnect formalised and extended the mechanisms by which the service coordinated and controlled the ecosystem, further supported by an incubator dedicated to AppExchange applications. Throughout the year many companies wrote apps that became available on the platform. Soon the press was trumpeting companies that ran their entire business on Salesforce's AppExchange.

9.3.6 Wikipedia

For Wikipedia, Phase I commenced towards the end of 1999, when the founder of Wikipedia, Jimmy Wales, got the idea for a free online encyclopaedia after being inspired by the Open Directory Project of Netscape. At the time Wales was employed at the company he had co-founded a couple of years earlier, Bomis Inc. As Bomis was a commercial company focused on web-advertising, the idea for the free online encyclopaedia was to fund themselves (and make money) from advertising. At the beginning of 2000 Lawrence Sanger, then a doctoral student in philosophy, was hired by Bomis to oversee the creation of this. Nupedia, as the first incarnation of this online encyclopaedia was called, featured expert-written and peer-reviewed content. Despite much effort, and support from a limited set of qualified participants, such as PhDs, professors, and highly experienced professionals, by the end of 2000 there were only 24 published articles. In early January 2001 it was decided that a separate service, where anyone could contribute to without editorial review, would be set up as a feeder project for Nupedia. Launched very soon after as the Nupedia Wiki, and despite activity commencing almost immediately, there was large push-back from the Nupedia Advisory Board. To meet their concerns, Wikipedia was launched as a separate service on the 15th January, and after an exchange of emails between Wales and Stallman, the service adopted the GNU Free Documentation license (GFDL).

Almost immediately, the Wikipedia service took on a life of its own, and began to eclipse the activity on Nupedia. Mailing lists were set up to coordinate activities with contributors. As the project began to pass 1,000 articles, in February some rules were proposed which became the basis for most of the operating principles of the service into the future. These included a policy not to eject anyone except for the most extreme cases, a rule to 'ignore all rules', and, to ensure that only single articles worthy of an encyclopaedia were created, a policy for only a single article for any topic and a 'not a dictionary'.

At the beginning of April 2001, Wales, reformulating the Nupedia 'non-bias' principle, formally defined a key principle of the service, NPOV, or Neutral Point of View, as a non-negotiable editorial policy. In May, 'Administrator' or 'SysOp' functionality was introduced to address an issue with deletion, as copyright violations, libellous speech and inappropriate private information required information to be completely destroyed and wiped from the public space.

Low level marketing activity, such as the authoring of online articles by key contributors, soon lead to progressively larger influxes of participants. The news that online access to Britannica was becoming a pay service in July 2001 also incentivised participants to publicise their free alternative. The many new users who came from Slashdot and the community-edited technologies and culture web service Kuro5hin, appreciated the open nature of the service. However behaviour on the service was chaotic, and to address these issues participants began to organise impromptu response groups to deal with issues. Ongoing technical development ensured that baseline wiki functionality was enhanced to support the requirements of an online encyclopaedia, in the process evolving the underlying service away from a true wiki structure.

For Wikipedia, Phase II commenced in mid-2001 with escalating media attention, rapidly increasing the number of contributors and the arrival of specialised tools and services to assist in editing. The mainstream press began to take notice of Wikipedia with an 'Australian PC World' article in July, a feature in 'Wales on Sunday' (a UK newspaper in August), followed by a *New York Times* article in September which was re-published in the *International Herald Tribune*. Towards the end of the year, Wikipedia began to win some accolades, and the *New York Times Magazine* ran an article about wikis and an Associates Press story prominently mentioned 'Wales' Wikipedia encyclopaedia' in December. By the end of 2001 there were over 20,000 articles in 18 languages – a rate of over 1,500 articles per month. In contrast Nupedia was not growing at anywhere near that rate, despite commencing its own wiki and setting up an approval mechanism for Wikipedia articles. Bomis began to reduce their financial support.

To deal with the increasing influx of traffic, ecosystem participants established the Wikipedia Militia, a loose collection of users committed to converging and managing the service. The rate of growth and new influx of participants provoked much discussion about the future of Wikipedia, as these new participants also brought a new dynamic, with many essays and rants appearing on the service. These were making it difficult, despite the existing policies, to find an encyclopaedia on the service, as much content that was not appropriate for an encyclopaedia. A constant problem that had emerged was vandalism, where a user would deface a page and it needed to be reinstated. These was addressed over the months by a comprehensive 'What Wikipedia is Not' page, a Wikiquote page, a Statement of Principles and a new statement of NPOV. Complementing this, towards the end of September collaboration by case matter, called WikiProjects, was introduced, and meta.wikipedia.com was established to move discussion and essay-writing to a separate service. The new arrivals were also

resistant to change, not only pushing back strongly on increased centralised authority, but also ensuring that existing policies, such as the expulsion policy, were impossible to change. A conflict between anarchy and authority raged on the service, driven in part by an increasing sense of stakeholdership.

Technically the service was having difficulty in scaling and suffered outages and slowdowns until new wiki software and a load balancing solution lead to increased stability and scalability. Towards the end of the year functional improvements were added so as to improve the quality of articles and the Wikipedia experience. Other functionality enhancements also responded to needs of users, with the 9/11 attacks resulting in a breaking news stories section on the homepage, as well as information boxes linking related articles. After a call by many participants for a new logo, this was launched in December. By the end of the year the first third party tools had arrived to support users on their use of the service, such as a free Wikipedia plug-in (GNU) for word processor Abiword.

In January 2002 the first formal press was released, and the rate at which the service was linked to and mentioned in the press continued to escalate. The service was given a major upgrade, although sporadic performance issues remained, with the service either running slow or with reduced functionality as bugs and performance issues were addressed. Other functional enhancements to the service included a Featured Articles section, improved traffic graphs, improved search and a variety of tools to manage the service. A range of complementary service tools were also released by third parties throughout the year as were bots, used to import content.

Also at the beginning of the year Sanger was officially made redundant from Bomis, and Wales became the primary face of Wikipedia. With Bomis also soon to cease funding of Wikipedia, there was some public musing about putting advertising on the service. This caused a massive shock amongst participants, leading to the Spanish Wikipedia leaving and starting their own service ('Enciclopedia Libre'). Eventually Wales publically confirmed that Wikipedia would never run commercial advertising, and to underline this the service moved to Wikipedia.org in August. Despite the introduction of a First Formal Manual of Style and other policy enhancements, issues continued with problem participants throughout the year. With these ongoing issues, participants collectively organised to stop vandalism, and also supported one another through dedicated pages to their efforts. A particular type of troublesome participant was called a 'troll', who put up masses of rants and screeds on both Wikipedia and meta-wiki making the service difficult to use. How to deal with trolls caused a much controversy, and eventually a 'WikiLove' policy emerged, based around reasoning with the troll and only removing them from the project after a long and painful discussion. Throughout the rest of the year Sanger continued to push for an 'approved' version of the service and an expert-controlled approval process independent of Nupedia and Wikipedia to address these issues. By the end of year, Sanger broke with Wikipedia altogether.

In 2003 wikis began to gain more interest in the press, with Wikipedia held up as a prominent example, raising its profile and increasing the influx of users. Wikipedia was covered by First Monday, Wired News, *The Guardian*, CNN and *Time Magazine*. In addition Wikipedia was named one of the Top 10 reference services by The UK *Daily Mirror* and by May the service had reached the traffic rank of Britannica.com and surpassed Slashdot itself in traffic rankings by December. The number of articles rose from 100,000 earlier in the year to a little less than 500,000 articles by the end. With the influx of new users Spanish Wikipedia overtook Enciclopedia Libre, new users not being aware of the fork in the previous year. By the end of the year Nupedia finally went off-line.

However with the continuing influx of users and user activity, the service was not stable, despite database reorganisations, load-balancing, new software, new databases and web servers. Despite this effort throughout the year on an almost monthly basis there was downtime and slowdowns. Functionally, throughout the year there were enhancements to improve the service, such as with TeX math formulas support, new layouts and features on the editing pages, and other functionality was added to assist users in maintaining the service. In October following a vote, a new (the current) Wikipedia logo was ratified and adopted. Third parties continued to provide complementary assets, with the popular open-source editor Vim releasing a new syntax highlighting file specialised for Wikipedia. In addition a number of sister projects were launched, such as Wikiquote, Wikibooks and Wikisource.

Ecosystem participants continued to collaborate in the management and operation of the service, and many norms and customs developed. Emphasis was placed on the communal nature, with some participants giving permission for their own photos to be used on the service, and others continuing to serve in standing action groups, such as the Wikipedia Militia, soon renamed to Volunteer Fire Department, and the Wikipedia Typo Department launched in November. Issues continued with rogue users, and a page protection feature and a Votes for Deletion Page were set up to make it more difficult for users to deface a page quickly. In May 2003 the first informal Wikipedia meet-ups began to occur, and in October the first formal meeting of Wikipedians occurred in Frankfurt. The constant activity on service was taking its toll, and some participants were now starting to leave. As many of these participants had interacted and built strong relationships with one another, as well as a Wikipedian identity, a Missing Wikipedians page was launched in an effort to commemorate and reach out to these participants. New policies supported the ongoing generation of articles, including the Verifiability (V) policy, a No Original Research (NOR) policy, and a prohibition against editing one's autobiography.

In June 2003 the formal governance of the service was passed over to the Wikimedia Foundation, as Bomis was winding down. A formal governing board was appointed, to grumbling from participants that half Board Members had been appointed from Bomis Inc. Following a media focused launch in August, Wikipedia began to formally ask for donations, maintain an open approach, publicising their account balances online in December.

In 2004, with Alexa Internet flagging Wikipedia as a reference service and Yahoo! approving a data feed which drove many more participants to the service, the ecosystem continued to grow. In February 2004 there were more than 500,000 articles in 50 languages and by September 1,000,000 articles in 100 languages. The press coverage continued and accolades began to arrive, such as a Top 100 Top Webservices for PC Magazine, winning a number of Prix Ars Electronica (Golden Nicas), a Webby Award, and the Web User Magazine Award in UK. The ecosystem also continued to gain wider societal acceptance, with an internationally-renowned Harvard physicist editing string theory articles, the service cited and quoted in a court case, studied as part of a university course, appearing in a television show, and was viewed as key news source during the 2004 Indian Ocean Tsunami in December. However the service was not without criticism, such as an article from ex-editor of Britannica gained much press about how much one can trust the articles, as well as criticisms from other commentators.

Over the year the issues with service performance began to stabilise, with the introduction of system balancing processes, performance tweaks and new servers. To support this technical outlay the Foundation continued to have fundraising drives. The first formal meet-ups with WikiMedia staff occurred in mid-2003, and groups of users also continued to collectively organise to maintain the service, such as the official establishment of the RC Patrol combat Vandalism and the establishment of a voluntary association and forum for Encyclopaedic Standards. Around this time there were also some nascent attempts to focus on content quality, with the first formal projects to deliberately balance content and correcting syntax. However the growth of the service was not without conflict. A growing issue, which had started late in the previous year, were ‘edit wars’, where differing participants could not agree on text and kept on reverting the others edits. A number of governance structures were attempted to control this issue and after much conflict by November the 3RR (‘Three Reverts Rule’) rule was introduced which was generally accepted and calmed the edit wars. Another governance mechanism introduced in early 2004 was the Arbitration and Mediation Committee System and the assume Good Faith rule to address the ongoing issues with trolls and conflicts occurring between participants.

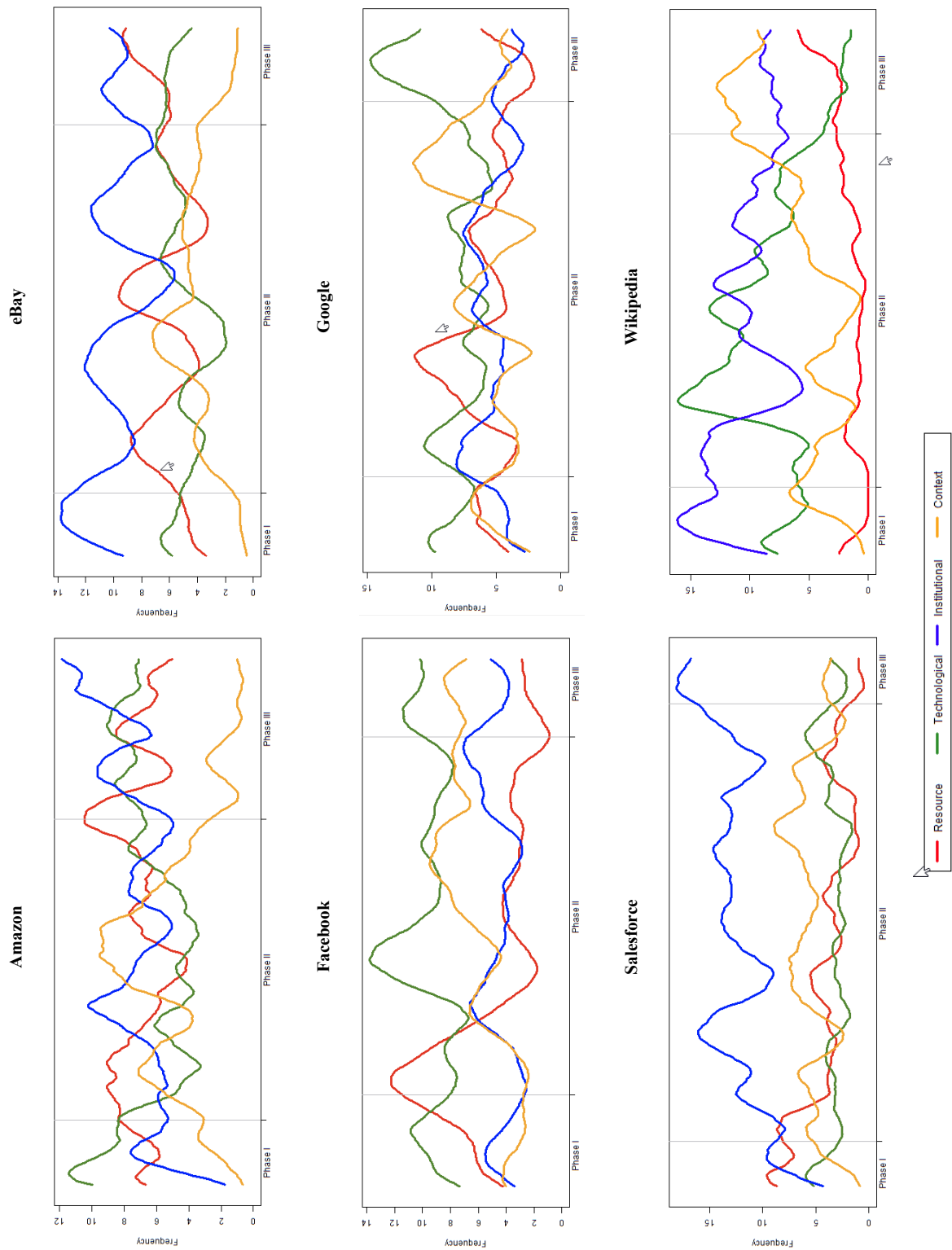
By 2005 the service had reached 500,000 English articles in March, and continued to gain in stature with the award of some high profile accolades, particularly winning awards internationally and winning some for the second year in a row. In a landmark review, towards the end of the year a peer review by Nature magazine concluded that Wikipedia was comparable to Encyclopaedia Britannica in terms of accuracy. The press continued to follow the service and the failure of the *Los Angeles Times* ‘Wikitorials’ emphasised the uniqueness of the service and ecosystem. However, criticism continued throughout the year, with criticism on quality of articles from the British edition of Vogue, and a campaign launched for personal privacy and accountability targeted specifically at Wikipedia starting

in October. These criticisms were exacerbated by the revelations of a fake charity promotion, QuakeAID, and a fake war hero.

For Wikipedia, Phase III began with the Seigenthaler incident in late 2005, caused by a participant editing John Seigenthaler's biography and falsely implicating him in the assassinations of John F Kennedy and R Kennedy. As a veteran journalist, he authored an op-ed piece in USA Today where he thoroughly upbraided Wikipedia and what it stood for. Following much self-examination within the ecosystem, Wikipedia tightened editorial control. This reduction of editorial privileges, in contrast to previous attempts, was welcomed by an ecosystem tired of the previous scandals and edit wars. The first official conference, WikiMania, occurred in Frankfurt in August 2005, further establishing the new editorial regime. Also around this time stress meters began to appear on users' pages indicating the pressure some of them were feeling with their participation.

By 2006, with the English Wikipedia reaching the million article mark, the system was performing well, and minor functional improvements continued. The accolades continued, and Wales was named one of *Time Magazine's* 100 most influential people. The editorial focus on quality continued, and press coverage over the exposure of a fake Duke of Cleveland sex-offender and the Congressional Aides Biography did little to damage the ecosystems improving reputation. The Wikipedia Foundation formalised its fundraising process, raising US\$94,000 in February, more than \$200,000 in September and over \$390,000 by the end of the year, as well as some private donations. The Foundation also registered the Wikipedia trademark set up a Communications Committee. In addition some organisations, namely Kennisnet in the Netherland and Korean Yahoo!, made donations in kind of server capacity. By 2007 the service remained stable and there were no notable stability or performance issues, reaching over 5 million registered editor accounts and 2 million English articles. The ecosystem continued to manage the service, notably failing to agree a single set of core policies. The release of the Wikimedia Tool Server provided a platform for third party complementary tools to be hosted, formalising the relationship of complementary services to the core service. Voted a Top global brand, Wikipedia continued to be adopted by wider society and win accolades, despite the occasional scandal. As Wales moved into a support role, fundraising raised US\$1.5 million and the future looked rosy.

9.4 Appendix D – Moving average frequency analysis



9.5 Appendix E – Variance of code frequency from overall frequency by phase

Table 33 – Phase I code frequency variance cross case comparison

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Resource	2.21 (29.76%)	-7.81 (17.54%)	5.81 (24.10%)	1.30 (23.75%)	24.82 (40.00%)	-1.43 (5.62%)
Technology	14.25 (39.29%)	8.01 (26.32%)	0.27 (34.94%)	7.92 (41.25%)	6.35 (18.33%)	0.80 (30.34%)
Institutional	-8.15 (22.62%)	9.57 (52.63%)	2.89 (26.61%)	-8.86 (13.75%)	-15.93 (36.67%)	14.54 (55.06%)
Context	-8.31 (8.33%)	-9.77 (3.51%)	-8.97 (14.46%)	-0.36 (21.25%)	-15.24 (5.00%)	-13.91 (8.99%)

Numbers in parentheses are actual frequency; these may not sum to 100% due to rounding.

Table 34 – Phase II code frequency variance cross case comparison

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Resource	0.02 (27.57%)	-0.13 (25.23%)	2.08 (20.37%)	1.85 (24.30%)	-0.43 (14.75%)	-2.74 (4.31%)
Technology	-5.31 (19.73%)	-1.19 (17.12%)	-1.95 (32.72%)	-5.71 (27.62%)	-0.15 (11.84%)	7.75 (37.28%)
Institutional	-2.66 (28.11%)	-2.52 (40.54%)	-1.09 (22.53%)	2.45 (25.06%)	-2.17 (50.43%)	0.22 (40.73%)
Context	7.95 (24.59%)	3.84 (17.12%)	0.95 (24.38%)	1.41 (23.02%)	2.74 (22.98%)	-5.23 (17.67%)

Numbers in parentheses are actual frequency; these may not sum to 100% due to rounding.

Table 35 – Phase III code frequency variance cross case comparison

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Resource	-0.73 (26.82%)	4.55 (29.91%)	-9.81 (8.47%)	-6.57 (15.87%)	-11.48 (3.70%)	7.55 (14.59%)
Technology	2.93 (27.97%)	-0.55 (17.76%)	5.16 (39.83%)	12.70 (46.03%)	-2.72 (9.26%)	-19.81 (9.73%)
Institutional	6.40 (37.16%)	2.74 (45.79%)	0.96 (24.58%)	-1.98 (20.63%)	20.55 (73.15%)	-7.54 (32.97%)
Context	-8.60 (8.05%)	-6.74 (6.54%)	3.69 (27.12%)	-4.15 (17.46%)	-6.35 (13.89%)	19.80 (42.70%)

Numbers in parentheses are actual frequency; these may not sum to 100% due to rounding.

9.6 Appendix F – Direct inspection analysis for each case

PHASE I – Initiation

Consists of the initial idea and digital service development, resource gathering and early operation. Early operation consisted of initially restricted access, sense- and rule-making, low levels of promotion, little press coverage, and insignificant competitor activity.

Amazon

Commenced with the decision to create an online bookshop to take commercial advantage of the emerging internet; Jeff Bezos established operations in Seattle, hired developers and began creating the digital service. Initial access was to friends and family, and after they had tested the functionality, was the service released for general availability with ecosystems participants finding out about the service through word of mouth. At this time there was a sense of community around the site, with some describing the service as an early social network with the ability to add book reviews, comment and interact.

eBay

Commenced with the decision to create the perfect market; Pierre Omidyar wrote the initial service, then called AuctionWeb, and launched it direct to general availability on his homepage along with his other projects. With little marketing, the ecosystem began to grow through word of mouth, and a commission for use, with payments based on trust, was only established for a couple of weeks of operation when the internet service provider dramatically increased their prices due to escalating web traffic (the ecosystem was profitable from the start). Early on, the administration of the ecosystem was handed over to participants through the establishment of bulletin boards and many of the early policies and site policing was done through participants. During this time a strong sense of community developed, with participants generally involved in changes to the digital service.

PHASE II – Momentum

The ecosystem begins to grow rapidly, characterised by increasing numbers of participants (driven by positive network effects), aggressive marketing, much press and societal interest, as well as competitor activity.

Following an investment round, Phase II commenced with an explicit change in ecosystem strategy from incremental organic growth to market domination. Business development staff were hired, an advertising firm engaged, an aggressive advertising campaign launched, and explicit ecosystem building measures such as Affiliate Program launched. The core digital service continued to be enhanced with new features and functionality, as well as new products (such as Music and DVDs). Also during this phase, after an unsuccessful foray into auctions, zStores was launched, where any vendor could sell through the site an addition to the ecosystem. In addition there was other significant fund raising and wide ranging strategic alliances with associated services.

Commenced as participants began to pour in, driven by positive network effects (participants called this period the 'eBay Flood'), with the result that the service was unable to scale to meet demand and continually crashed. Despite (or because of) these technical issues, a strong sense of community began to prevail, and specialised sites (such as discussion forums and help sites) as well as complementary software appeared. Often eBay's attempts to shape the direction of the ecosystem resulted in strong pushback and mobilisation from the ecosystem, such as the banning of the sale of guns. Once the technical problems were resolved, a more aggressive growth strategy was pursued, with the hiring of business development staff, engagement of an advertising agency, a rebranding (to eBay) and marketing campaigns taking advantage of societal trends, such as Beanie Babies. Rapidly eBay became the main internet venue for the sale and exchange for goods, and gathered much press and societal interest due to prank sales and fraud issues.

PHASE III – Control

The focus of activity moves from expansion to control and value appropriation. With the ecosystem established as the undisputed leader focus now shifts to closer control of the activities of ecosystem participants and value appropriation.

Began with an explicit shift to profitability and value appropriation. Staff were made redundant, unprofitable lines of business closed down, and functions and programs of the digital service changed to drive profitability.

The resolution of the Million Auction March, an (successful) protest attempt by ecosystem participants to move one million transactions to competing auction services, ushered in Phase III. The resolution meant that the ecosystem participants now recognised eBay's tensions to operate as a listed company, and conflict between the ecosystem and the hub firm declined. Functionality of the service were enhanced to increase revenues, such as the introduction of 'Buy it Now', and wider society and the press now viewed eBay as a neutral venue.

PHASE I - Initiation

Facebook

Began when Mark Zuckerberg addressed an issue that had been bothering Harvard students for a while, the fact that their 'Facebooks' were not online. Zuckerberg developed the site over a couple of days, and mobilising his dorm-mates for support, launched the social network internally at Harvard. With no marketing, the service was a huge success, with idiosyncratic behaviours emerging amongst users (such as promoting one's political affiliation through the profile photo and friending competitions), and soon access was opened to other elite universities. A major focus was on design so that the service would be able to scale, and very early on an advertising capability was built into the site.

PHASE II – Momentum

Commenced with the return of college students after the summer recess, as additional universities were added, with active measures (known as the 'surround strategy') to grow faster than the emerging competitors. Access to the site was also broadened, soon opening to high school students, work networks and eventually completely opened. After an investment rounds, hiring commenced, both for development and business development. Technically the service continued to be enhanced and strengthened, opening up the Facebook Platform to app developers'. However there was little control over the rapidly increasing number of app developers and some of these functional changes led to conflict with the ecosystem. The ecosystem also began to be covered closely by the press and wider society, particularly as privacy concerns arose.

Google

The initial idea came from the doctoral research of Sergei Brin and Larry Page who, along with their doctoral supervisor, developed early versions of the search service and eventually released it internally at Stanford. Popularity grew by word of mouth, functional enhancements continued, and more and more servers were required to keep the service running (from the beginning Brin and Page manufactured their own computers). After some angel funding, the service was opened beyond Stanford, and driven by word of mouth marketing, the media began to take notice. After no other sites seemed interested in licensing their search technology, Brin and Page launched keyword driven advertising.

PHASE III - Control

Emerged as control was finally consolidated over the apps available through the platform, as well as formal acknowledgement of the wide ranging privacy concerns. A particular action here was opening up the terms of use to a vote for the users. In addition, internally operations had coalesced around a particular logic of value co-creation, and advertising and other value extraction techniques were now mature and with continual tweaks to enhance revenue.

Emerged as the site became the undisputed leader and the remaining competition (such as Microsoft and Yahoo!) were unable to maintain parity. Socially the service was now embedded in society, although there was an increasing wariness as to privacy. The emphasis of value appropriation was underlined with a court case which allowed trademarked terms to be used as keywords.

Commenced with a wider awareness of the service beyond the cognoscenti due a large VC investment, as well as increasing media coverage and the winning of many accolades. As advertising was so profitable additional rounds of funding were not required, and an IPO was delayed for as long as possible so as not to give signals to competitors. Functionally the site continued to be developed, with explicit ecosystem growth features such as affiliate programs for search and advertising. In particular the release of self-service for advertising spurred many more advertisers on the site. The service continued to be trusted and popular, still remaining on word of mouth marketing, and tweaks such as Google Doodle. However the ecosystem suffered a crisis with the release of Gmail, which caused a privacy storm, resulting legislation and litigation, and bad press. However despite the furor and a mediocre IPO, the ecosystem continued to gain momentum.

	PHASE I – Initiation	PHASE II – Momentum	PHASE III - Control
Salesforce	The initial idea came from Marc Benioff, who wished to provide business software through the internet. After seeding the new company with his own and some angel investment, hiring developers, the firm soon launched a beta service to select organisations. The capabilities of the beta service continued to be enhanced and access was gradually widened to accept more and more participating organisations. A funding round, more staff and constant office moves characterised resource acquisition, and despite being in beta, the press soon began to follow the service. Towards the end of the phase the distinctive logo ('No software') and branding was launched as well as a generally available version of the service.	Commenced with high profile guerrilla marketing at the main competitor's annual conference, as well as their own uniquely branded launch party. Aggressive marketing and constant strategic alliance making then followed; an element of the marketing was a city 'roadshow', consisting of users, prospects and the press, which gathered an almost cult-like following. This soon evolved into formal conferences, but maintained the high level discourse and identity building that characterised the roadshows. After a re-pricing of the service when the dotcom crash adversely affected cash flow, there was explosive growth accompanied by fawning press coverage and the award of many accolades. Technically the service was continually enhanced, progressively opening the service to increased user customisation and then eventually the support of 3rd party app development (such as sForce and AppExchange). A consulting industry also emerged around the service. With this growth the service soon reached the limits of its scalability, and some serious service disruptions followed which damaged trust and potentially threatened the viability of the service.	Emerged with the rectification of the technical issues that had caused serious service delivery, and launch of trust.salesforce.com, a service that publically detailed the status of the service delivery. Press interest began to wane as the software as a service model was accepted as viable. In addition, there was a shift to value appropriation with the hiring of staff to focus on revenue collection, and release of monetisation strategy documents.
Wikipedia	Began with Jimmy Wales' and Larry Sanger's idea of improving the article creation rate of an existing online encyclopaedia, Nupedia, through the introduction of a wiki format. After pushback from the existing Nupedia editors, the service was rebranded to Wikipedia and introduced to the Nupedia users, running on the servers of a for profit organisation, Bomis Inc. Low level marketing activity, such as the authoring of online articles by key contributors, soon led to progressively larger influxes of participants. Ongoing technical development ensured that baseline wiki functionality was enhanced to support the requirements of an online encyclopaedia, and participants began to formalise rules for participation and as well as impromptu response groups to deal with issues. However behaviour on the site was chaotic with vandalism and an ongoing battle between centralised authority and ecosystem based governance. In addition, towards the end of the phase the press began to take notice of the site.	Characterised by escalating media attention, rapidly increasing number of contributors and the arrival of specialised tools to assist in editing. Technically the service was having difficulty in scaling and suffered outages and slowdowns until new wiki software and a load balancing solution lead to increased stability and scalability. Due to the wiki nature of the site, there was much discourse and conflict, with vandalism remaining an issue, as well as edit wars. To combat malicious behaviour, and also to provide structure for the rapidly growing ecosystem, ecosystem participants developed editorial policies and codes of behaviour, as well as explicit governance activities (such as suspension and expulsion). During this phase there was also an adjustment to the underlying resource base, with the underlying corporate resource, Bomis, winding down operations, the establishment of the Wikipedia Foundation, and the first appeals (and receipt) for substantial donations.	Emerged from the media crisis of the Seigenthaler incident, who wrote an op-ed piece in USA Today, entitled 'A False Wikipedia Biography'. This crisis lead to an imposition of tighter editorial control, which in contrast to previous attempts, was welcomed by the ecosystem tired of the previous scandals and edit wars. In addition the Wikipedia Foundation formalised its fundraising process and technologically the service was stabilised.

9.7 Appendix G – Ecosystem creation optimal matching analysis

Table 36 – Complete sequence optimal matching comparison for hub / ecosystem interaction

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	-0.020 (0.370)	0.000 (0.000)				
Facebook	0.015 + (0.407)	0.016 (0.388)	0.000 (0.000)			
Google	-0.001 (0.357)	-0.018 (0.346)	0.030 ** (0.400)	0.000 (0.000)		
Salesforce	0.031 *** (0.621)	0.039 *** (0.530)	0.014 + (0.489)	0.046 *** (0.589)	0.000 (0.000)	
Wikipedia	0.065 *** (0.516)	0.051 *** (0.452)	0.041 *** (0.436)	0.077 *** (0.508)	0.038 *** (0.444)	0.000 (0.000)

Note: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001; numbers in parentheses are actual distances.

Table 37 – Within case cross phase comparison for hub / ecosystem interaction

Amazon				eBay			
	Phase I	Phase II	Phase III		Phase I	Phase II	Phase III
Phase I	0.000 (0.000)			Phase I	0.000 (0.000)		
Phase II	0.000 (0.785)	0.000 (0.000)		Phase II	0.000 (0.852)	0.000 (0.000)	
Phase III	0.000 (0.718)	-0.011 (0.361)	0.000 (0.000)	Phase III	-0.004 (0.540)	0.000 (0.679)	0.000 (0.000)
Facebook				Google			
	Phase I	Phase II	Phase III		Phase I	Phase II	Phase III
Phase I	0.000 (0.000)			Phase I	0.000 (0.000)		
Phase II	0.000 (0.646)	0.000 (0.000)		Phase II	0.000 (0.800)	0.000 (0.000)	
Phase III	0.215 *** (0.619)	0.000 (0.674)	0.000 (0.000)	Phase III	0.024 (0.442)	0.000 (0.704)	0.000 (0.000)
Salesforce				Wikipedia			
	Phase I	Phase II	Phase III		Phase I	Phase II	Phase III
Phase I	0.000 (0.000)			Phase I	0.000 (0.000)		
Phase II	0.000 (0.895)	0.000 (0.000)		Phase II	0.000 (0.820)	0.000 (0.000)	
Phase III	0.513 *** (0.955)	0.000 (0.831)	0.000 (0.000)	Phase III	0.097 *** (0.639)	0.000 (0.608)	0.000 (0.000)

Note: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001; numbers in parentheses are actual distances.

Table 38 – Phase I optimal matching case comparison for hub / ecosystem interaction

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	0.036 (0.477)	0.000 (0.000)				
Facebook	0.023 (0.429)	0.029 *** (0.571)	0.000 (0.000)			
Google	-0.063 (0.333)	-0.028 (0.419)	0.068 * (0.468)	0.000 (0.000)		
Salesforce	-0.230 * (0.352)	-0.141 (0.420)	-0.023 (0.484)	-0.221 ** (0.323)	0.000 (0.000)	
Wikipedia	-0.182 * (0.318)	-0.041 (0.405)	0.121 ** (0.571)	-0.142 * (0.333)	-0.014 (0.417)	0.000 (0.000)

Note: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001; numbers in parentheses are actual distances.

Table 39 – Phase II optimal matching case comparison for hub / ecosystem interaction

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	-0.014 (0.356)	0.000 (0.000)				
Facebook	-0.015 (0.366)	0.002 (0.378)	0.000 (0.000)			
Google	0.000 (0.356)	-0.006 (0.361)	-0.025 + (0.005)	0.000 (0.000)		
Salesforce	-0.012 (0.498)	0.013 (0.508)	0.005 (0.505)	-0.005 (0.498)	0.000 (0.000)	
Wikipedia	0.001 (0.435)	0.003 (0.413)	0.012 (0.413)	-0.010 (0.439)	0.079 *** (0.500)	0.000 (0.000)

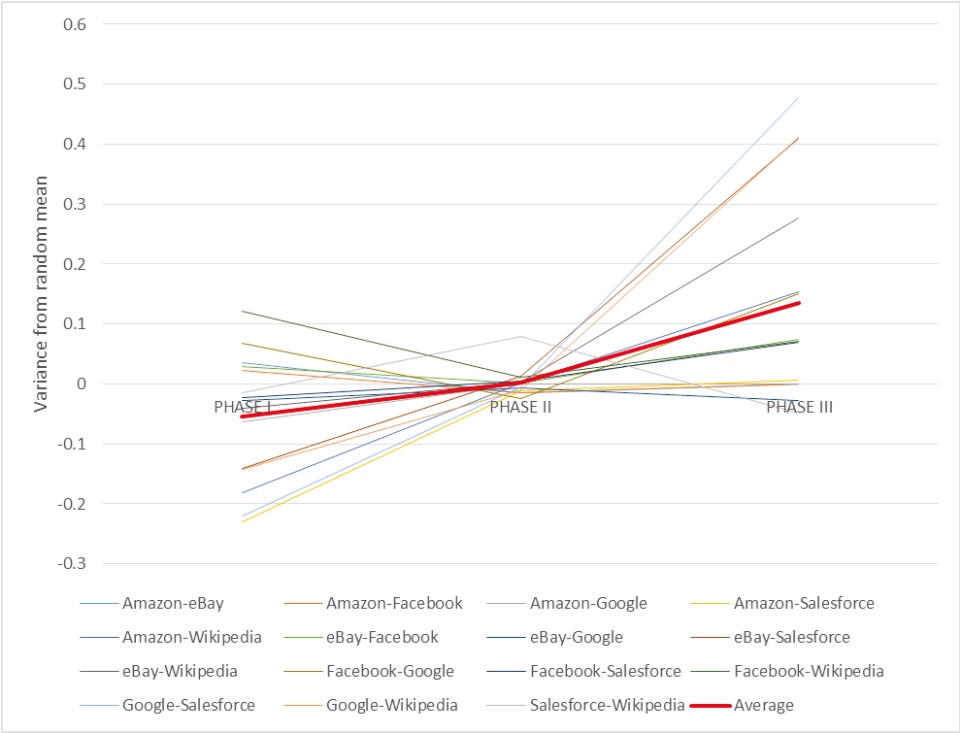
Note: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001; numbers in parentheses are actual distances.

Table 40 – Phase III optimal matching case comparison for hub / ecosystem interaction

	Amazon	eBay	Facebook	Google	Salesforce	Wikipedia
Amazon	0.000 (0.000)					
eBay	0.000 (0.596)	0.000 (0.000)				
Facebook	0.000 (0.628)	0.075 * (0.476)	0.000 (0.000)			
Google	0.000 (0.558)	-0.027 (0.362)	0.151 *** (0.551)	0.000 (0.000)		
Salesforce	0.006 *** (0.651)	0.410 *** (0.960)	0.070 (0.612)	0.477 *** (1.022)	0.000 (0.000)	
Wikipedia	0.154 *** (0.638)	0.277 *** (0.705)	0.071 ** (0.508)	0.411 *** (0.836)	-0.048 * (0.393)	0.000 (0.000)

Note: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001; numbers in parentheses are actual distances.

Figure 8 – Variances from random mean with average variance for hub / ecosystem interaction



9.8 Appendix H – Ecosystem creation moving average frequency analysis

