Understanding emergent innovation ecosystems in health care

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Abstract
Convergent technologies have the potential to address some of healthcare's challenges. These bring new complexities to product development requiring integration of ecosystem and business model requirements into the innovation process. This case study research takes an integrative approach to investigate innovation and the required business model and value network capabilities.

Keywords: Convergence, Innovation, Complex Systems.

Introduction

Health care represents a significant part of the economy for many countries, typically representing between 6 and 17% of GDP (OECD, 2013, p. 157). Health systems around the globe face major challenges to meet the ever-increasing care demands and to control costs. Consequently, Abbasi (2013) identifies that most major economies are reviewing and transforming their health care systems

The solutions have the potential to change health delivery, and to drive a greater convergence of medical and other technologies (Burns, 2012; Sharp et al., 2011). Convergence will not just occur in technology but will likely happen at every stage in the value chain (Eselius, et al, 2008). The changes have a consequential impact on the upstream value chain actors:

- An increasing move towards payment for outcomes, as opposed payment for product or service (C. M. Christensen, et al, 2009; Porter, 2010)
- A move to more patient centric treatment and care delivery services requiring increased personalisation and precision (Herzlinger, 2001)
- Convergence of medical technologies to create value adding new products, to simplify and reduce cost in the providers' delivery value chain (Burns, 2012).

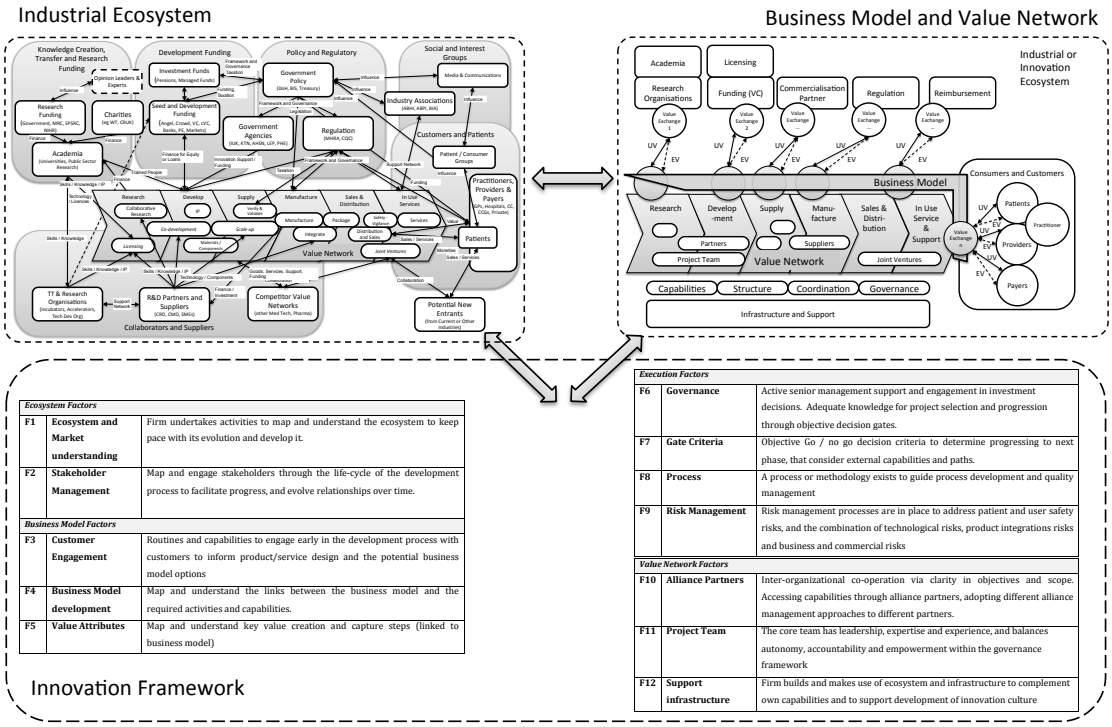
Sabatier *et al*. (2012) identified a number of '*new healthcare philosophies'* including personalized medicine and nanobiotechnology, all involving convergent technologies and '*incumbents from other sectors'*. The industrial environment is made more complex as new alliance partners are likely to have divergent cultures, capabilities and perceptions in terms of time, risk, investment, cost, and regulation. The complexity is further amplified as the innovations have the potential for wider systemic effects (Hellström, 2003) elsewhere in the ecosystem.

Research aims

The practice challenges stem from the rapidly changing industrial environment, the ability of 'producers' to identify, create, deliver and capture 'value' in the new environment. Emerging research question is thus:

- *How do organizations develop convergent technology products for the emerging health care industrial ecosystem?*

In addressing this, a more 'systemic approach' will be taken, using an integrated framework for convergent product development and a model will be developed that links the industrial ecosystem stakeholder and customer 'value perspectives' via a business model to the value network and required capabilities (see Figure 1).



Ecosystem Factors		
F1	**Ecosystem and Market understanding**	Firm undertakes activities to map and understand the ecosystem to keep pace with its evolution and develop it.
F2	**Stakeholder Management**	Map and engage stakeholders through the life-cycle of the development process to facilitate progress, and evolve relationships over time.
Business Model Factors		
F3	**Customer Engagement**	Routines and capabilities to engage early in the development process with customers to inform product/service design and the potential business model options
F4	**Business Model development**	Map and understand the links between the business model and the required activities and capabilities.
F5	**Value Attributes**	Map and understand key value creation and capture steps (linked to business model)

Execution Factors		
F6	**Governance**	Active senior management support and engagement in investment decisions. Adequate knowledge for project selection and progression through objective decision gates.
F7	**Gate Criteria**	Objective Go / no go decision criteria to determine progressing to next phase, that consider external capabilities and paths.
F8	**Process**	A process or methodology exists to guide process development and quality management
F9	**Risk Management**	Risk management processes are in place to address patient and user safety risks, and the combination of technological risks, product integrations risks and business and commercial risks
Value Network Factors		
F10	**Alliance Partners**	Inter-organizational co-operation via clarity in objectives and scope. Accessing capabilities through alliance partners, adopting different alliance management approaches to different partners.
F11	**Project Team**	The core team has leadership, expertise and experience, and balances autonomy, accountability and empowerment within the governance framework
F12	**Support infrastructure**	Firm builds and makes use of ecosystem and infrastructure to complement own capabilities and to support development of innovation culture

Figure 1 – Exploratory Integrated Framework

Literature Review

The literature centres on innovation management, considering industry and ecosystem evolution with a focus on convergence, business models and value appropriation, underpinned by a 'systems approach' using complex system and stakeholder theory.

Industry and Business Evolution

An emerging industry is often associated with disruptive technologies and business models (Probert et al, 2013). Understanding the environment is an important step in any strategy formation process (Grant, 2010, p. 11). Health systems and their 'producers' are similar to any other industry, but have additional complexity in terms of the customer structure, payers and intermediaries (Burns, 2012).

Industry changes are rooted in industrial evolution, a combination of incremental change (Marshall, 1921), punctuated with waves of 'creative destruction' (Schumpeter, 1939, 1947). The role of technological innovation and change has been the source of much research (Devezas, 2005; Dosi, 1997; Malerba, et al, 1999). Tushman (1986), concluded that breakthroughs, or technological discontinuities, significantly increases environmental uncertainty. The concept of disruptive innovations was re-popularised by Christensen (1997), exploring the impact of sustaining and disruptive change. Drawing from biology, in holobiont evolution it is not just the organism that evolves, but the associated microorganism community (Rosenberg, et al 2007). The analogy in business is that it is not just the focal firm that evolves, but also the entire value network or ecosystem.

Ecosystem Structure and Evolution

The structural analysis of industries and industrial ecosystems has largely focussed on mature industries (Dicken, 2003; Porter, 1980). Moore (1993, 1996) describes ecosystem life cycles as stages, with evolving competition and cooperation.

The term 'convergence' in relation to industries and technologies has been used for decades, but multiple definitions exist for 'convergence' (Rikkiev & Mäkinen, 2013). Most prior research is in semiconductors, computing and communications technology, which saw waves of convergence in the 1990s and early 2000s (Fredrik Hacklin, 2005; Stieglitz, 2003). There are limited studies in automotive (Bernabo et al., 2009a) and biotechnology (Bernabo et al., 2009b; Eselius et al., 2008; Shmulewitz, et al, 2006).

Intercompany collaboration is one of the primary strategies (Bores, et al, 2003) with most innovation happening at the boundaries between disciplines (Hacklin & Wallin, 2013), that can create disruptive innovations in the others through four different stages: (1) 'knowledge convergence', (2) 'technological convergence', (3) 'applicational convergence', and (4) 'industrial convergence' (Hacklin, et al, 2010). Technology convergence itself can be classified as either 'substitution' or 'complementarity' (Stieglitz, 2003), from this Rikkiev *et al.* (2013) considered convergence in either the product or technology focussed, defining four convergence types (see Table 1).

Table 1 – Types of Industry Convergence (from Stieglitz)

	Substitution	**Complementarity**
Technology-based convergence	Technology substitution	Technology integration
Product-based convergence	Product substitution	Product complementarity

For medical technologies, convergence can be classified as 'technology-based convergence' and either 'substitution' or 'complementary' in nature. In this paradigm making correct choices amongst many technologies is important, together with a strong ability to integrate those technologies (Iansiti & West, 1997).

Taking a 'social' perspective, different alliances need different capabilities as different types of partners connect (Rikkiev & Mäkinen, 2013). Hacklin et al (2013), identified the 'disciplinary distance' between a firm's own knowledge and other integration knowledge as key, and that the integration challenge lies mainly in individual or group-level learning.

Approaches to innovation have been extensively reviewed (Tidd & Bessant, 2013) and have mapped an evolution from linear, networked, 'open' to systemic. New product development risks consist of technical, management and market risks (Zhang & Yongbo, 2011). In convergence, additional management risks exist in achieving integration across alliance partners (Rikkiev & Mäkinen, 2013).

A general problem with a 'capabilities approaches' however is, as noted by Bowman and Ambrosini (2000), that 'neo-classical' RBV approaches, alone, do not explain value creation and capture and this represents theoretical gap.

Business Models

Interest in business models accelerated with the advent of e-business, which required models that could not adequately be expressed by classical strategy and value chain models (Amit & Zott, 2001). Early research was in e-business (Zott, Amit, & Massa, 2011), however, the approaches are now more broadly accepted (Osterwalder & Pigneur, 2013; Zott & Amit, 2013). The concept of a business model as a 'model' has developed recently and, Baden-Fuller (2010) provides a comprehensive summary of different models seeing it as a 'system' that defines customers, engaging with their needs, delivering satisfaction and monetizing value.

Zott and Amit have undertaken considerable research on business models (Amit & Zott, 2001, 2012; Zott et al., 2011; Zott & Amit, 2013), describing recent developments as a "*holistic-system level approach*". Their model is described as an "*activity system"* with a set of interdependent organizational activities centred on the focal firm. Baden-Fuller and Morgan's model (2010), consists of: Customer Identification, Customer Engagement, Value Chain Linkages and Monetization. Daellenbach (2005, pp. 87–88), based upon the work of Little (2004) proposed the following general criteria for a model: simple, complete, easy to manipulate, adaptive, appropriate for situation and relevant for decision making.

For this research it is proposed to use Richardson model (2008) as this most closely meets the above criteria, but is (slightly) modified by separating out the value network from the value creation component; the resulting model (Figure 2) is:

- **Value Proposition** – its customers, what the organisation delivers to those customers and why they are willing to pay
- **Value Creation** – how the firm will create and deliver value, and the alignment to its **Value Network** (to create capabilities and competitive advantage)
- **Value Capture** – revenue sources and economics of the business

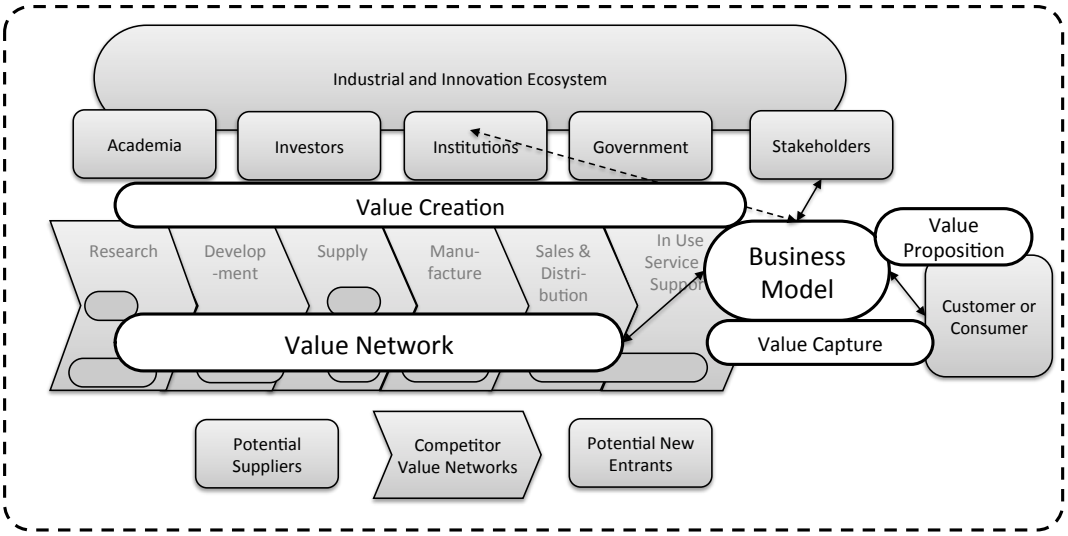


Figure 2 – Business Model linkage to Value Network model

Value, Creation and Capture

In the analysis of business models, the concept of 'value', its creation and capture are constant themes. Until recently there has been little agreement about what is 'value', with Bowman and Ambrosini (2010) suggesting that a prime cause was that 'value' means different things to different people. To resolve this, 'value' has been defined (Bowman & Ambrosini, 2000; Lepak, et al, 2007) in terms of 'value creation' and 'value capture' and between 'use value' (UV) and 'exchange value' (EV). This concept can then be extended to explicitly link the key actors in the industrial or innovation ecosystem, as shown in Figure 3.

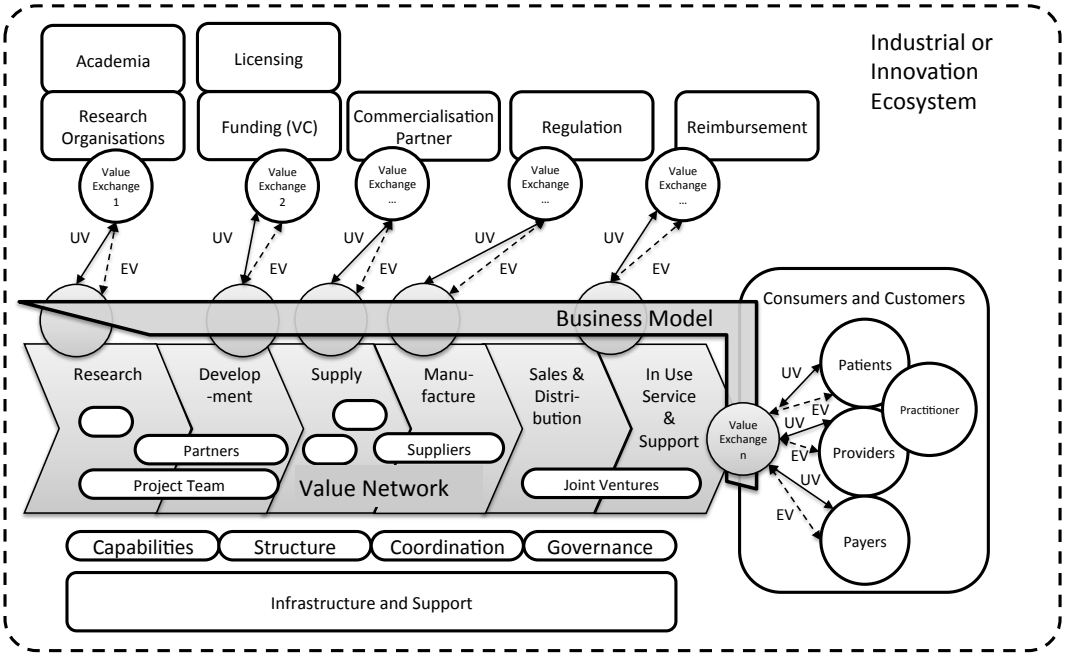


Figure 3 –Linking Ecosystem, Business Model and Value Network

This approach provides a mechanism to make *explicit* linkages between the customers and stakeholders in the ecosystems, identified as important in 'technology integration'

convergence (Rikkiev & Mäkinen, 2013). The proposed framework and model provide a mechanism to *explicitly* link the activities of value creation and capture and the required capabilities in the value network, addressing the previously identified gaps in the literature.

Exploratory Integrated Framework

The resulting frameworks are depicted in Figures 3 and 4 and Table 2.

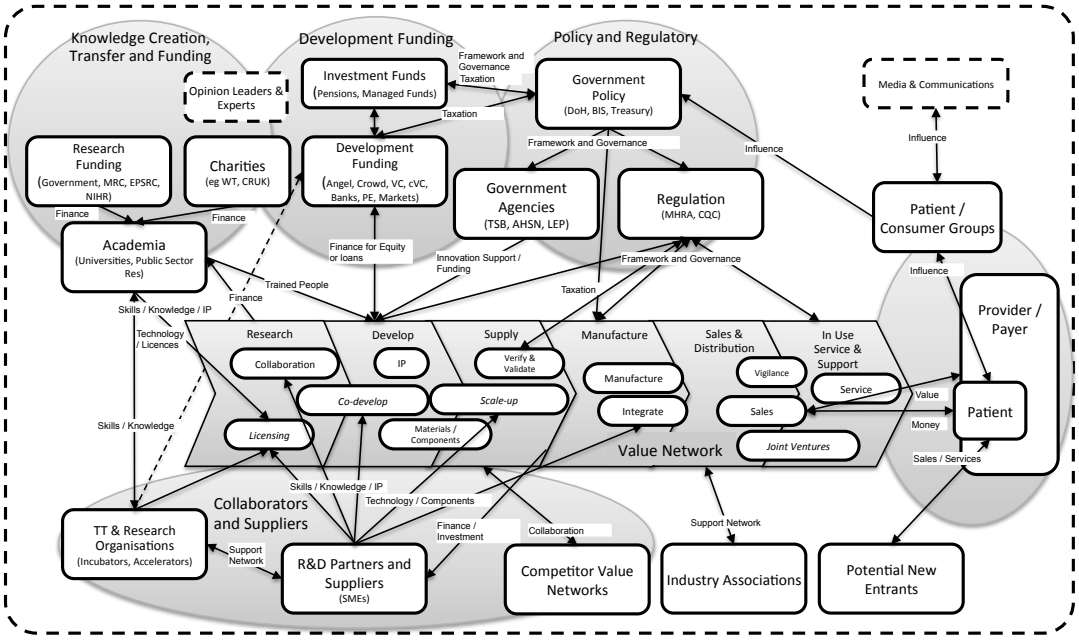


Figure 3 –Industrial and Innovation Ecosystem

Table 2 – Preliminary Framework for Convergent NPD

	Factor	Example
Ecosystem Factors		
F1	**Ecosystem and Market understanding**	Firm undertakes activities to map and understand the ecosystem to keep pace with its evolution and develop it.
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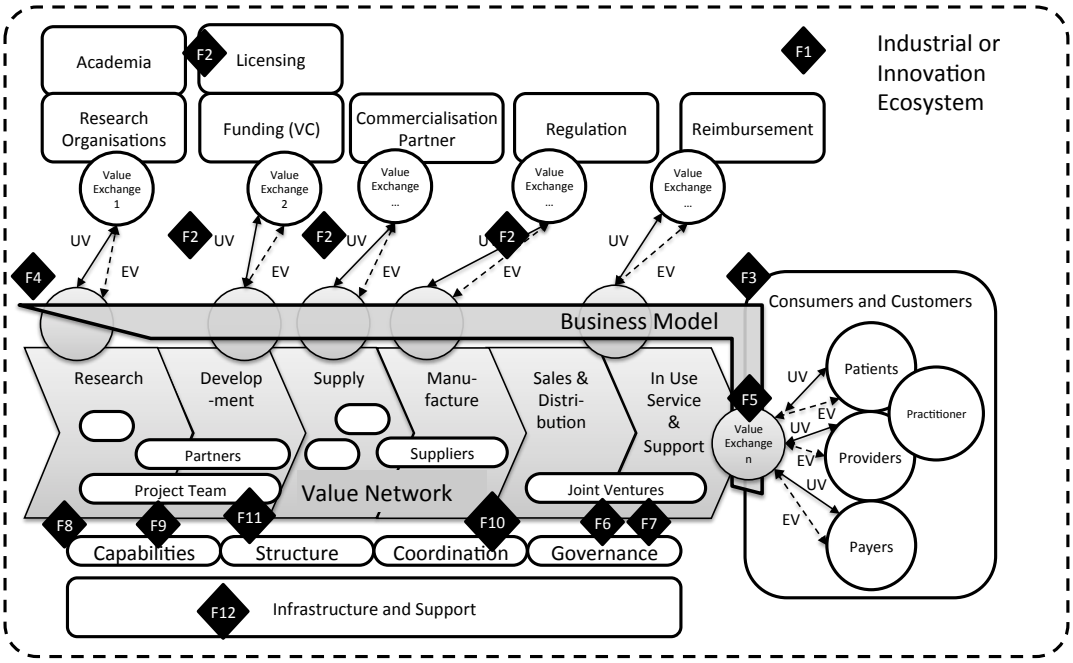

Figure 4 - Framework linking ecosystem to business model and value network

Future Work

A number of preliminary case studies (2) and interviews (27) have been completed that corroborate the ecosystem challenges and the factor identified in the model and framework. The next phase of the research is focussed on in-depth case studies that span the convergence areas.

Acknowledgments

Funding for this research is provided by the EPSRC funded Centre for Innovative Manufacturing in Continuous Crystallisation and Manufacturing (CMAC). Additional data related to this publication cannot be released; the raw data contains personal/sensitive information and materials covered under confidentiality agreements.

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