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Paths, events and resource use: New developments in understanding innovation processes

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ABSTRACT

The purpose of this paper is to investigate innovation paths, their events and resource use for a wave energy development within the renewable energy sector. An in-depth single case study mixed-method methodology was used to examine a detailed typology of events and develop innovation paths where one category of resources is predominant (technical and commercialization), or where the resources are evenly combined (ambidextrous). The case results highlight the early presence of a new innovation path type (ambidextrous), offer a better understanding of the different resources used along each path type, and show that co-occurrence of events (common events) across paths influences path convergence. As a practical implication, the paper underlines the benefits of ambidexterity and the multifaceted role of government within the business network, requiring the focal organization to re-consider its interactions with various government departments and other agencies.

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1. Introduction

Innovation occurs when actors re-configure network resources to develop novelty and creativity (Lichtenstein & Brush, 2001). Small innovative organizations and entrepreneurs often lack the ability to access internally all resources required, rather relying on their business network to be able to mobilize required resources (particularly knowledge) (Ostendorf, Mouzas, & Chakrabarti, 2014; Rusanen, Halinen-Kaila, & Jaakkola, 2014; Ståhl & Waluszewski, 2007; Villanueva, Van de Ven, & Sapienza, 2012). Moreover, it is not just which resources are accessed from the network, but also how resources are deployed within innovation processes (Purchase, Olaru, & Denize, 2014). In particular, there are contradictory results on the success of ambidextrous innovation strategies (Ambos, Mäkelä, Birkinshaw, & D'Este, 2008; Simsek, Heavey, Veiga, & Souder, 2009). Ambidextrous innovation strategies use resources to develop both exploratory and exploitative knowledge, even though very different skills and capabilities are required. This research investigates how different categories of resources exchanged during innovation events influence innovation development. In particular, it is investigating how resource use during innovation processes via different common events, influences innovation paths.

This research incorporates the notion of multiple innovation paths occurring sequentially and/or in parallel over time (Araujo & Harrison, 2002; Makkonen, Aarikka-Stenroos, & Olkkonen, 2012). An innovation path is a sequence of innovation events that are time dependent (Makkonen et al., 2012). Thrane, Blaabjerg, and Møller (2010) previously highlighted two types of paths: technical and commercialization. This research signals the critical role of another type: ambidextrous path. Compared to the first two types, an ambidextrous path has additional benefits because it uses knowledge, financial, and social capital in approximately similar amounts, thus enhancing flexibility. We use the term ambidextrous as the organization is using multiple resources together, rather than using a single resource type that dominates the path.

Investigating innovation through event analysis allows the research to incorporate dynamics and longitudinal perspectives (Chou & Zolkiewski, 2012), which represents a current gap in the innovation literature (Dagnino, Levanti, Minà, & Picone, 2015). Van de Ven, Polley, Garud, and Venkataraman (2008, p. ix) indicate that 'an appreciation of the temporal sequence of events is [...] fundamental to managing innovation'. Building on previous innovation event analysis research (e.g. Van de Ven et al., 2008), this research links events, to build innovation paths. Previous research on innovation paths (e.g. Garud, Gehmanb, & Giuliani, 2014; Simmie, Sternberg, & Carpenter, 2014; Thrane et al., 2010) has not necessarily adopted an event analysis perspective, although Makkonen et al. (2012, p. 294) argues that it helps in analysing the 'plot type' (e.g. innovation paths).

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Given the gaps highlighted above, three research questions encapsulate our research aim:

1. What types of innovation events and paths are shaping the development of the wave energy innovation?
2. How does resource use influence the types of innovation paths?
3. How do common events within multiple paths influence future paths?

A mixed methodology investigation is adopted to analyze data from the renewable energy sector, using a case study of development of a wave energy device in Australia. Content analysis of reports and interviews is followed by quantitative analysis of events and resources, to provide complementing evidence to the qualitative examination.

This investigation makes a number of contributions:

- depending on the innovation paths, resources are reconfigured and recombined continuously, with common patterns identified for three innovation path types: predominantly technical or commercialization, and ambidextrous;
- ambidextrous innovation paths require 'balanced'/joint use of all resources, rather than one resource category dominating;
- common critical events across paths reinforce future path convergence.

The remainder of this article is structured as follows: Section 2 presents the literature review in resource use, innovation events and time, along with a description of the innovation paths. These concepts are then linked together to highlight how they contribute to innovation processes. Section 3 details the methodology adopted for the study and describes the case study. Following the results (Section 4), the final section presents the results, findings and implications for theory and practice, as well as ideas for furthering the research.

2. Literature review

2.1. Resources deployed within innovation processes

Resource 'bundles' rather than a single resource category are important within innovation processes (Lichtenstein & Brush, 2001; Purchase, Olaru, et al., 2014). For example, financial capital can be used to acquire knowledge resource and develop social capital and vice versa (Rusanen et al., 2014). Exploitative knowledge and social capital successfully deployed lead to the accumulation of financial capital in terms of sales (Ostendorf et al., 2014). Previous research found the following three broad resource categories were particularly important within innovation resource bundles: financial capital, social capital and knowledge (Gupta & Govindarajan, 1991; Lichtenstein & Brush, 2001) and are the focus of our research.

Soft intangible resources or social capital have been previously associated with improved knowledge acquisition and integration leading to improvement in innovative capabilities (Pérez-Luño, Cabello Medina, Carmona Lavado, & Cuevas Rodríguez, 2011). Social capital is described here as 'the sum of resources that a firm can access or mobilize by virtue of possessing a durable network of relationships' (Yli-Renko, Autio, & Tonnti, 2002, p. 282). The ability to finance innovation development is important in shaping the innovation trajectory (Dosi, 1982) and allows for a greater amount of experimentation, which leads to improved novelty and consequently higher long-term innovation performance (Partanen, Möller, Westerlund, Rajala, & Rajala, 2008). Therefore, both social capital and financial capital are included in this investigation.

Knowledge is an important input and output of innovation relationships (Baraldi & Waluszewski, 2007) and different types of knowledge have been identified. Rusanen et al. (2014) differentiated between

tacit knowledge, organizational routines, confidential information and general information. Waluszewski and Håkansson (2007) categorized knowledge into specialist and general knowledge use, while others consider exploratory and exploitative knowledge (e.g. Land, Engelen, & Brettel, 2012; Lin, McDonnough, Lin, & Lin, 2013; Purchase, Olaru, et al., 2014; Simsek et al., 2009; Van de Ven et al., 2008). Exploratory knowledge is described as knowledge aligned with the technological experimentation, while exploitative knowledge is knowledge aligned with technological extension and refinement (Land et al., 2012). There are numerous motivations to mobilize knowledge, including economic, technical and strategic (Waluszewski & Håkansson, 2007) and the use of knowledge within actor interactions is constantly evolving. Innovation paths constrain what types of knowledge develop, while alleviating uncertainty (Ståhl & Waluszewski, 2007). Moreover, the heterogeneity of knowledge resources developed influence innovation paths via decisions and processes (Ståhl & Waluszewski, 2007).

Ambidexterity is 'an organization's ability to perform differing and often competing strategic acts at the same time' (Simsek et al., 2009, p. 865). In relation to innovation processes ambidexterity is often aligned with the use of exploration and exploitation innovation processes happening simultaneously or sequentially (e.g. Lin et al., 2013; Simsek et al., 2009; Sullivan & Marvel, 2011). Given that these two processes have differing requirements on resource use, particularly knowledge, organizations need to make trade-offs in allocating resources and prioritize decision-making (Lin et al., 2013). Previous research on the outcomes of ambidexterity is inconclusive, with some results indicating improved innovation performance (e.g. Lin et al., 2013; Raisch & Birkinshaw, 2008), while others indicating non-significant improvements (e.g. Sullivan & Marvel, 2011).

2.2. Innovation events

Events are defined as 'temporally specific outcomes of performed acts by actors' (Hedaa & Törnroos, 2008, p. 324) that require resources (Chou & Zolkiewski, 2012). Events are interdependent as they are performed in anticipation of a future event or a response to a previous event (Håkansson & Snehota, 1995). Events have also been described as critical junctures (Vohora, Wright, & Lockett, 2004); episodes (Ostendorf et al., 2014) or activities (Makkonen et al., 2012). Events vary according to the innovative context (Chou & Zolkiewski, 2012) and criteria includes: activity type (Ostendorf et al., 2014; Van de Ven et al., 2008; Vohora et al., 2004); importance to the process under investigation (Chou & Zolkiewski, 2012; Halinen, Törnroos, & Elo, 2013), and alignment to focal innovation processes or context (Makkonen et al., 2012).

Makkonen et al. (2012, p. 293) highlights that network processes are 'overloaded with relevant and irrelevant actions, events and actors'. Previous research focuses on the most important events, though this approach risks overlooking critical network processes (Halinen et al., 2013). Thus, critical, related and background events all need to be included within the analysis (Halinen et al., 2013). *Critical events* are key actions/activities that drive the progression of the innovation or are points of departure from current process directions (Tidström & Hagberg-Andersson, 2012). *Related events* are actions or activities that directly trigger or result from critical events, but do not carry significance to the innovation process by themselves. *Background events* relate to the context in which the innovation is embedded, such as macro-environmental context and institutional forces.

This research also includes *lock-in* events, described as events that constrain future events (Arthur, 2009). Although the focus here is on events, many different types of components in the innovation process have been shown to display lock-in effect. Examples include: technological paradigms (Dosi, 1982), institutional constraints (Arthur, 2009; Simmie et al., 2014), historical accidents (Simmie et al., 2014), introducing complementary technologies (Araujo & Harrison, 2002; Dosi, 1982),

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