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A framework for measuring open innovation maturity levels

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Abstract
There is a requirement for assessing performance levels of open innovation activities. The purpose of this paper is to highlight the usefulness of using dynamic capabilities as a framework for doing so. This paper identifies the need to uncover the processes involved in open innovation, with a view to measuring their effectiveness. Limitations of this work are correlated towards the lack of prior research incorporating dynamic capabilities to investigate open innovation activities. This paper is the first to use dynamic capabilities for measuring open innovation maturity.

Keywords: Open innovation, dynamic capabilities, maturity

Introduction
There is no escaping the fact that governments across the Eurozone are struggling with austerity as our respective economies trudge through a long and drawn-out recovery process (Fontanella-Khan, 2013). Yet, despite the crisis, there is strong recognition that innovation can help to regain competitiveness (Teece, 2007). This research paper contributes towards the need to help firms improve the inbound open innovation process. In terms of significance, this research is timely as it comes at a point when there is a call for open innovation performance measures (Huizingh, 2011). In addition, as a contribution to knowledge, no other research has combined dynamic capabilities in the context of open innovation to measure open innovation maturity levels. We provide a platform for future empirical research.

This paper is outlined as follows. First, we provide a description of what is meant by open innovation, discussing both the inbound and outbound concepts. Next, an identified gap in the literature is presented before the notion of dynamic capabilities is considered at length. After using the sensing, seizing, and transformational activities as a foundation for research on open innovation, the paper provides a template for measuring the effectiveness of open innovation activities. Finally, conclusions are

drawn towards the suitability of using such a tool, and the direction of future research is set.

What is open innovation?

Before delving into a discussion about a potential framework for investigating a specific phenomenon, it is important to be clear about what is meant by the term open innovation. Upon reviewing the literature on over 160 articles related to open innovation, the definition by Chesbrough (2006) still remains the most popular. Alas, the lack of alternative definitions may go someway towards explaining this. Nevertheless, Chesbrough (2006: 1) stated that, 'Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively'. Broadly speaking, this contests the traditional mode of commercialising technology via the internal R&D pipeline approach, and argues that the focal firm should not only use internal expertise during the innovation process, but they should also incorporate external knowledge and technology into current and future developments. Overall, providing support for adopting much more collaborative approach to innovation. However, it should be made clear that this is kind of openness implies an engagement with externals, not a reliance on them (Chesbrough and Teece, 1996). Furthermore, this process is usually referred to as inbound open innovation (Beelaerts van Blokland *et al.*, 2012). As noted by Bianchi *et al.* (2011), typical organisational modes of inbound open innovation include: joint ventures, acquisitions, in-licensing, R&D contracts and research funding, purchase of technical and scientific services, minority equity investments, and non-equity alliances.

Conversely, open innovation has an outbound process, which argues that firms should take an active stance towards intellectual property (IP). Instead of allowing patents to sit in filing cabinets and not be used, the firm should take stock of the IP they own, carefully evaluate their suitability to the firm's current business model, and if it does not fit and there is limited risk of such IP damaging the competitive position of the focal firm if it was in the hands of others, they should try to sell that IP. Yet, this is only one aspect of the outbound open innovation approach. Again, Bianchi *et al.* (2011) provided a useful list of examples that form outbound open innovation: spin-outs, licensing out IP, joint ventures for technology commercialisation, sale of innovation projects, supply of technical and scientific services, corporate venturing investments and non-equity alliances. Essentially, the outbound process is concerned with the focal firm seeking out an external organisation that has a more suited business model to commercialise the selected technology (Beelaerts van Blokland *et al.*, 2012).

Accordingly, one may ask the question why such a topic is important to operations management. As noted by Berchicci (2013), due to the ever evolving business environment, firms are trying to make the necessary adaptations to their operations so they can stay competitive. To do this, firms are looking for solace in the external knowledge domain. By opening up their boundaries, many firms are realising the benefits of incorporating external knowledge and technology into current operations. At this period in time when there is increasing research and development (R&D) costs, shorter product life-cycles, and greater technological complexities, it is not feasible for firms to solely focus on internal R&D (Berchicci, 2013). Noted in the literature that innovation is the key to sustained competitive advantage, Bititci *et al.* (2012) ask whether or not innovation activities need to be measured and managed in such an open environment. This paper believes that it is imperative for managers to be aware of

current performance levels with regards to open innovation practices. Consequently, there needs to be a suitable mechanism that allows them to do so.

As the literature has shown, we are aware of the many activities that encompass open innovation. However, there is a gap in knowledge concerning the process firms use to identify, bring in, and integrate external knowledge and technology within internal operations. Moreover, by utilising the framework below, it is possible to assess how effective a firm's open innovation process is. Already recognised by Ridder (2011), a dynamic capabilities perspective provides an extremely useful foundation for investigating open innovation. Similarly, Enkel *et al.* (2011) has shown support for performance measurement in the context of open innovation. The following section will now discuss dynamic capabilities, with a view to articulating its benefits for research on open innovation maturity. Taking inspiration from Slack *et al.* (2006), if management have a greater understanding of current performance levels in open innovation, they will be better placed to make the necessary operational adaptations so that the gap between current and desired performance can be reduced. Therefore, this understanding may go someway in assisting managers throughout the economic recovery process.

Dynamic capabilities as a means to explore open innovation

Resulting from the dissatisfaction of the resource-based view's (RBV) (Wernerfelt, 1984, Barney, 1991) static and theoretically incontestable nature, dynamic capabilities is an alternative approach that seeks to explain why some firms are better at achieving sustained competitive advantage than others (Easterby-Smith and Prieto, 2008). Introduced by Teece *et al.* (1997: 516), dynamic capabilities refer to 'the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments'.

Early writings on dynamic capabilities showed that the literature was fraught with confusion and general inconsistency. One of the most important areas to be rectified was around the source of competitive advantage. Initial reviews suggested that competitive advantage was not derived through tangible or intangible assets, or organisational processes or routines, but in the ability of the firm to develop new capabilities (Leonard-Barton, 1992). Now, it is agreed that distinguishing between operational level capabilities and dynamic capabilities (Easterby-Smith and Prieto, 2008, Pavlou and El Sawy, 2011) is a sensible approach. Operational capabilities can be perceived as the daily functions that are necessary to keep the business running (Collis, 1994), whereas dynamic capabilities represent how operational routines and processes are rearranged and upgraded to meet changing environmental conditions (Eisenhardt and Martin, 2000). Significant work on the Manage Processes by Bititci *et al.* (2011) proposed that it is the operational and support processes that deliver performance presently, but it is the management of such processes that sustain performance in the long term. However, since there is limited understanding of the operational processes involved in open innovation, there is a requirement to uncover these first. Only then will we be in a position to study how these processes are managed. Therefore, using the three distinct areas of dynamic capabilities as noted by Teece (2007) (sensing, seizing, and transforming), this paper is the first in open innovation literature to adopt them as a means to measure the maturity of open innovation processes.

Sensing opportunities and threats

To begin, Teece (2007) proposed that the very nature of capabilities is based on the firm's ability to sense opportunities and threats. This potentially has its roots in the comments made by March and Simon (1958) who highlighted the importance of the firm's aptitude for scanning. This EurOMA paper recognises that Teece (2007) uses the word, sensing, however, for the purpose of this article it is more appropriate to use the term 'search activities' as open innovation is concerned with finding new knowledge and technology. Another early and notable reading to emphasise the role of search activities is that of Nelson and Winter (1982). This text emphasises that the firm's search activities can lead them to uncovering diverse sources of knowledge. At this point it is useful to remember that searching can occur in two dimensions – internally as well as externally. Katila and Ahuja (2002) conducted a study that investigated the correlation between search depth and search scope, and whether or not this had a bearing on a firm's ability to develop new products. For this, they defined search depth as how deeply a firm reuses its existing knowledge and search scope as how widely a firm explores new knowledge (Katila and Ahuja, 2002).

On the other side, and a paper that is more frequently associated with open innovation is that of Laursen and Salter (2006). In contrast to Katila and Ahuja (2002), the paper by Laursen and Salter (2006) focuses on external search activities. However, similarly, they too adopt terms for searching – search breadth and search depth. The first concept is related to volume, which is essentially the number of external sources the firm draws upon for innovative purposes. The latter concerns the intensity to which the firm extracts knowledge from various external sources. The purpose of creating these two terms was so that they could use data from the 2001 UK Innovation Survey to show what effect external searching had on innovative performance. Findings indicate a positive relationship between external searching and innovative performance. However, the graph produced a curvilinear line, indicating that over searching can have a negative impact on innovative performance (Laursen and Salter, 2006). Therefore, caution should be taken when searching the external environment for new knowledge and technological opportunities.

As an extension to the work of Laursen and Salter (2006), Chen *et al.* (2011) marked the importance of a firm's search orientation. In their study, they provide a distinction between innovation modes of *science, technology and innovation* (STI) and *doing, using and interacting* (DUI). The STI mode is more focused towards scientific knowledge, whereas the DUI mode is more reliant on experience-based learning and know-how (Jensen *et al.*, 2007). Their research essentially proposes that the orientation of the focal firm is an important factor in deciding whom they will try to partner with from the external environment. Like Laursen and Salter (2006), Chen *et al.* (2011) find that there is an optimal number of partners a firm can collaborate with until it becomes counterproductive – this number sits at 8.7 partners.

Continuing this trend towards partners, March (1991) proposed an interesting concept concerned with search strategy. March (1991) noted that the firm has various strategic options when it comes to external searching and partnership. According to Dittrich and Duysters (2007), companies that follow an exploration strategy will look for external companies outwith their core field of expertise. Additionally, Granovetter (1973) recognised that such alliances will be characterised by weak ties. While on the other hand, firms adopting an exploitation strategy will be more inclined to establish

strong ties, and will often look to partner with externals that hold similar technical capabilities.

Now, going along the line that is much more strongly associated with open innovation, Bessant and Tidd (2008) stress the importance of not only searching for new knowledge or technology in local and closely related industries to that of the focal firm, but also broadening search activities across unchartered waters. This may require the firm looking in distant and unfamiliar industries for sources of inspiration. Only until a firm does this, are they giving themselves a fighting chance at creating something truly radical. Teece (2007) also supports the decision to look beyond the immediate business periphery. By incorporating these valuable contributions under the sensing opportunities and threats stream of dynamic capabilities, it provides a useful starting point for assessing the maturity of search activities in the context of open innovation. As stated by Ridder (2011), search processes facilitate seizing opportunities.

Seizing those identified opportunities

Another key feature of dynamic capabilities has its essence in entrepreneurship – the drive and ability to capitalise upon a sensed opportunity. Here, this is termed seizing opportunities (Teece, 2007). In a recent paper, Jantunen *et al.* (2012) underlined the conceptual similarity between seizing and knowledge integration to that of absorptive capacity. The main aspect of absorptive capacity is related to the level of prior related knowledge. Cohen and Levinthal (1990) argued that if an individual has a high level of prior related knowledge in a field, they will have a greater ability to evaluate and utilise external knowledge than someone without that prior related knowledge. This 'prior related knowledge confers an ability to recognize [sic] the value of new information, assimilate it, and apply it to commercial ends' (Cohen and Levinthal, 1990: 128). One option to create absorptive capacity is to engage in R&D. Through deepened learning and knowledge exchange, Lane *et al.* (2006) claim that firms will be better positioned to predict market trends and exploit external pre-commercialisation stage research by offering products to customers that are aligned to future market requirements.

Moreover, it is not only absorptive capacity that can benefit the seizing process. Simply, the importance of being well networked cannot be underestimated. This is emphasised by Lee and Cavusgil (2006) who argue that competitive advantage is derived through the strength of a firm's network as well as its internal capability. As a result, the knowledge base that a firm is linked with can have an impact on innovative performance (Salavisa *et al.*, 2012) if the firm chooses to partner with that institution. When discussing networks, the notion of diversity has been repeatedly stated (Burt, 1992), thus echoing the sentiment previously said about search activities. Highlighted by Nooteboom (1999), the benefits knowledge exchange will be greatly enhanced if individuals engage with others from varying backgrounds. Consequently, to improve the open innovation process, firms are encouraged to make connections with a wide variety of individuals as it may lead to collaboration in the future.

Persisting with the idea of networks, this section is more concerned with how the firm organises themselves internally for innovation. Concepts such as champions (Schön, 1963), promoters (Witte, 1973), and technological gatekeepers (Allen and Cohen, 1969) are already familiar concepts within the literature. Therefore, we concentrate on a more recent offering that was purposefully created for open innovation. Published in the MIT Sloan Management Review, Whelan *et al.* (2011) introduced the

notion of idea scouts and idea connectors. Idea scouts act as the firm's antennae to the external world, picking up interesting technological developments; they are probably more heavily associated with search activities. However, idea connectors are strongly linked to the seizing process, as they are well-networked individuals within the firm that have connections with key decision makers. Consequently, if an idea scout knows who the idea connectors are, the firm is better placed to capitalise upon the identified opportunities. To help bring about this mind-set and organisational culture of bringing in external ideas into the business (Zahra and George, 2002), integrating processes (Ridder, 2011) such as corporate values, effective communication, and reward and incentive mechanisms can help achieve this (Teece, 2007). Overall, the above concepts help to provide substance when developing a maturity model to measure open innovation effectiveness.

Transformational activities

The third feature of dynamic capabilities proposed by Teece (2007) is concerned with the integration of internal and external resources. Effectively matching up the necessary tangible and intangible assets in order to innovate is the primary goal, as this should help to achieve competitive advantage. Yet, having read the work on Manage Processes (Bititci *et al.*, 2008, Bititci *et al.*, 2011), it is important to be aware that it is the effective management of the open innovation process (operational activities) that will help the firm endure success. Therefore, as it is outwith the scope of this paper, an option for future research would be to assess whether effective management of open innovation processes can be considered a dynamic capability. As such, attention here must be focused on measuring open innovation maturity levels.

Maturity assessment of open innovation

By condensing an activity into its constituent parts, it is possible to measure the effectiveness of the overall process. The business process perspective (CIM-OSA, 1989, Childe *et al.*, 1994) in terms of Operate Processes is generally thought of as occurring in a sequential manner i.e. get order, develop product, fulfil order, and support product. However, for open innovation this is obviously not an appropriate way to think, despite our interest in uncovering the operational processes involved. Fortunately, by utilising the dynamic capabilities framework above, it is possible to integrate these concepts into a maturity model to measure open innovation effectiveness.

For their study on open innovation maturity, Enkel *et al.* (2011) made use of the 5 level model that was initially developed for use within the software industry. The model developed by Paulk *et al.* (1993) has subsequently been used in various other contexts such as project management, R&D, and innovation. However, no research has developed a maturity model for open innovation that is grounded in dynamic capabilities which makes use of the 'basic', 'intermediate', or 'advanced' scale (as shown in table 1).

Table 1: Inbound open innovation maturity template (adapted from Strathclyde Institute for Operations Management (2008))

	Basic			Intermediate			Advanced		
	1	2	3	4	5	6	7	8	9
Sensing									
Seizing									
Transforming									

Once the tool has been used to measure current performance, individuals are then in a position to document the processes adopted during open innovation. As expressed by Adams *et al.* (2006), benchmarking is a useful exercise that enables firms to see their performance relative to other industry players. Overall, this paper has contributed to theory by advancing the dynamic capabilities literature into open innovation. In addition, we provide a theoretical contribution towards measuring open innovation activities.

Conclusion

This paper puts forth the idea that the dynamic capabilities framework (Teece, 2007) can act as a very useful foundation for conducting research on open innovation. Already acknowledged by Ridder (2011), we extend the use of dynamic capabilities in open innovation by arguing that it is important to be able to measure the performance of open innovation processes. In combination of using the sensing, seizing, and transformation aspect of dynamic capabilities, adopting the maturity assessment tool used by the Strathclyde Institute for Operations Management (2008) for their work on Manage Processes (Bititci *et al.*, 2011) provides an alternative means for measuring open innovation effectiveness. Although a maturity model for open innovation already exists (Enkel *et al.*, 2011), we believe that our model, which is grounded in dynamic capabilities provides a greater theoretical underpinning for investigating processes related to open innovation activity.

The significance of this work is rooted in the fact that it marks the first step in a much larger research project. Now that there is a solid theoretical framework in place, this gives an opportunity to conduct empirical work in an area that is significantly under researched. Initial studies on open innovation tended to focus on early adopters, which provided various accounts of open innovation journeys e.g. Procter & Gamble (Huston and Sakkab, 2006, Dodgson *et al.*, 2006), Nokia (Dittrich and Duysters, 2007), Columbia Steel (Aylen, 2010), and Italcementi (Chiaroni *et al.*, 2011) to name a few. Therefore, the time has come to take research on open innovation to the next level and increase the number of empirical studies. In line with this research, Huizingh (2011) argued that next stage studies on open innovation should include performance measures. He also proposed that case study research is an extremely useful approach for increasing understanding of important concepts and phenomena e.g. effective open innovation practices.

As a contribution to the field, no other study has adopted dynamic capabilities for measuring open innovation maturity. In that regard, this paper is considered novel. Moreover, the future of this research is directed towards utilising this theoretical framework and conducting an empirical investigation measuring open innovation maturity levels with a selection of firms from the oil and gas industry. To do this, we will utilise the maturity assessment tool as done in the Manage Processes work (Strathclyde Institute for Operations Management, 2008, Bititci *et al.*, 2011). From this, it will be possible to 'footprint' various levels of open innovation, thus acknowledging the comments made by Schroll and Mild (2011) who highlighted the limited number of studies available on open innovation adoption. We are also intent on finding out the processes employed for sensing, seizing, and transforming activities. Therefore, one output of the forthcoming research project will be to get individual project teams to map the processes adopted, thus aligning to an operations business process perspective. By

doing this, we will be advancing knowledge beyond our initial understanding of what constitutes inbound open innovation.

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