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Technological coevolution in the electric energy sector

Coevolução tecnológica no setor de energia elétrica

Coevolución tecnológica en el sector de la energía eléctrica

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Abstract

This article analyzes the co-evolution of technological capabilities of electric companies' subsidiaries and Small and Medium Enterprises (SMEs) connected through common Research and Development (R&D) projects. The analysis is based on the following variables: learning, network and autonomy, which together form the construct of Embeddedness, i.e. the level of involvement these companies develop. In order to achieve the objectives, the authors conducted interviews aiming to identify the characteristics of each variable. As a result, an evolution in the technological capabilities was found, in both the subsidiaries and the partner companies, after the development of the projects. This accumulation is achieved through the relationship with the levels of Embeddedness (learning and network); and such relationship is directly proportional in the beginning of the projects and inversely proportional in the end. The change in the relationship between variables highlights the companies' capacity to absorb and accumulate the acquired knowledge even when the partnership has already ended.

Keywords: Coevolution; Technologic capabilities; Electric energy

Resumo

O artigo objetiva analisar como ocorre a coevolução das Capacidades Tecnológicas de subsidiárias de energia elétrica e Pequenas e Médias Empresas (PMEs) que se relacionam a partir da execução de projetos de Pesquisa e Desenvolvimento (P&D). A análise é baseada nas seguintes variáveis: aprendizado, *network* e autonomia, as quais, juntas, formam o constructo *Embeddedness* referente ao envolvimento que estas empresas estabelecem entre si. Para alcançar o objetivo proposto, os autores realizaram entrevistas visando diagnosticar as características presentes dentro de cada variável. Como resultado encontrou-se uma evolução nas capacidades tecnológicas tanto das subsidiárias como das empresas parceiras após o desenvolvimento dos projetos. Este acúmulo é conseguido através da relação com os níveis de Envolvimento (aprendizado e *network*); relação esta que se apresenta diretamente proporcional no início dos projetos e inversamente proporcional ao final deles. Esta mudança na relação entre as variáveis destaca a capacidade que as empresas desenvolvem em absorver e acumular o conhecimento adquirido mesmo quando já finalizada a parceria.

Palavras-chave: Coevolução; Capacidades tecnológicas, Energia elétrica

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Resumen

El objetivo en este artículo es analizar cómo se produce la coevolución de las capacidades tecnológicas de filiales de energía eléctrica y pequeñas y medianas empresas (PyMEs) que se relacionan a partir de proyectos de Investigación y Desarrollo (I&D). El análisis tiene como base las siguientes variables: aprendizaje, redes y autonomía, que forman el constructo de *Embeddedness* referente a la relación que estas empresas establecen entre sí. Para lograr el objetivo propuesto, los autores han llevado a cabo entrevistas con el fin de examinar las características presentes en cada variable. Como resultado, se encuentra una evolución en las capacidades tecnológicas tanto de las filiales como de las empresas asociadas después del desarrollo de los proyectos. Esta acumulación se logra por medio de la relación con los niveles de *Embeddedness* (aprendizaje y redes); una relación que se muestra directamente proporcional al comienzo de los proyectos e inversamente proporcional a su término. Este cambio en la relación entre las variables destaca la capacidad que las empresas desarrollan para absorber y acumular el conocimiento adquirido, incluso cuando la asociación o colaboración ya ha terminado.

Palabras clave: Coevolución; Capacidades tecnológicas; Energía eléctrica

Introduction

Researchers are increasingly addressing studies of multinational subsidiaries (Achcaoucaou & Miravitlles, 2012; Bartlett & Goshal, 1986; Birkinshaw, Hood, & Young, 2005; Cantwell & Mudambi, 2005; Lee, 2010), in the area of strategy and international negotiations. This growth is based on the fact that subsidiaries are organizations that could have a strong impact on their host economy, due largely to the fact that these companies have easy access to resources from their parent-companies, sometimes sharing valuable assets such as knowhow among the different units, incorporating the relations of the countries in which they are based and thus facilitating intra-knowledge and inter-firm flow (Almeida & Phene, 2004).

Since they are immersed in a new environment, often at a certain cultural distance, the subsidiaries endeavor to partner with local companies to set up networks. This includes those aiming for technological development in order to reach a higher level of organizational performance since, according to Liu and Chaminade (2010), network links are positively related to the performance of technological innovation.

Moreover, to achieve this performance of technological innovation, companies still aim to develop what we know as technological capabilities, which are nothing but the resources required to generate and manage technical change (Bell & Pavitt, 1993), in other words, the innovation process.

According to Polanyi (1944) these partnerships built up by companies can be understood as embeddedness, which is characterized as an immersion of these players (companies) in social relationships in their own sphere. Uzzi (1996) adds to this idea saying that these social links created with various players in their environment could contribute to achieving performance.

When subsidiaries build these partnerships with local small and medium-size enterprises (SMEs), the study of such interplay also becomes more relevant to the extent that: (i) there is sparse literature on the success of innovations in this context and the study of capabilities required to further such a process and (ii) the incentive given to innovation of this type of enterprise is a significant part of the effort of technological innovator policies developed in emerging countries, since they believe in the key role of these policies in national economic development (Forsman, 2009; Lee, 2010; OECD, 2005).

Numerous papers in literature are concerned with the role of subsidiaries of multinational corporations (MNC) in their host countries, mainly in the relationship formed with local economies (Cantwell & Mudambi, 2005; Chang, Mellahi & Wilkinson, 2009). Several subjects are addressed constantly adopting this viewpoint, such as creating knowledge (Almeida & Phene, 2004); performance (Andersson, Forsgren, & Holm, 2002; Birkinshaw et al., 2005); innovation (Kokko & Kravtsova, 2008); networking (Achcaoucaou & Miravitlles, 2012) and so on.

It is noticeable in the past few years that studies have intensified regarding the development of innovative and technological corporate capabilities, including papers addressing the question in the international sphere from the viewpoint of technological evolution of these companies and investigating the role of subsidiaries in the creation and accumulation of such technological capabilities (Almeida & Phene, 2004; Ariffin & Bell, 1999; Birkinshaw & Hood, 1998; Chang et al., 2009; Lee, 2010).

However, many studies that address the behavior of subsidiaries portray the reality of businesses mostly located in Asian countries, namely China, Malaysia and Taiwan (Chang et al., 2009; Lee, 2010), thereby revealing the specificities of these places, creating a gap in geographical coverage in literature. There are many differences between countries in the Far East and the West and this is reflected in the economy, technology and innovation in those countries. So it is important that the role of MNC subsidiaries is also studied more in the emerging countries in the West, so that a comparison can therefore be made of these two contexts.

One example of these studies is by Chang et al. (2009) who present characteristics of the embeddedness process between the multinational and subsidiary, when the latter plunges into a new environment. In this case, Taiwan multinationals exert strong control over their UK subsidiaries. Another example is the work by Ariffin and Bell (1999) who studied some subsidiaries located in Malaysia: the results concern the mechanisms of technological learning, which these companies now use and provide a prior condition to joining R&D-based innovation.

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