Journal of Business Research 68 (2015) 109–118

Contents lists available at ScienceDirect

Journal of Business Research

Disentangling the influence of technological process and product innovations

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ARTICLE INFO

Article history:
Received 1 March 2014
Received in revised form 1 April 2014
Accepted 27 April 2014
Available online 14 May 2014

Keywords:
Organizational innovation
Technological innovation
Resource-based view
Innovation
Socio-technical approach
CIS data

ABSTRACT

Organizational innovation and its effects, and the influence on them of technological innovations, have been under-researched. In this paper the specific impacts that technological product and process innovations have on organizational innovation performance are disentangled. Analysis of 9369 organizational innovators drawn from CIS data shows the impact of each type of technological innovation on organizational innovation performance. Technological process innovations strengthen the impact of organizational innovation whereas the introduction of technological product innovations diminishes it.

1. Introduction

The Oslo Manual (2005) classifies four main types of innovation, divided into product, process, organizational and marketing innovations. Nonetheless, most research focuses on the impact of individual innovative practices in isolation (Battisti & Stoneman, 2010:200), or on solely understanding technological innovation (e.g., Damanpour, Walker, & Avellaneda, 2009). As Damanpour et al. (2009: 651) argue, "Historically, research on innovation types has followed a technological imperative focused on a narrow definition of product and process innovations associated with the R&D function in manufacturing organizations …Studies of organizational or administrative innovations have been relatively scarce." Although organizational innovation receives less attention by the academia (Battisti & Iona, 2009; European Commission, 2008: 8; Mol & Birkinshaw, 2009), its adoption is a potential source of competitive advantage (Battisti & Iona, 2009; Ichniowski, Shaw, & Prennushi, 1997).

Due to this under research, the study of the joint adoption of technological and organizational innovations has not been fully developed and, therefore, counts with scant analyses (Battisti & Stoneman, 2010; Evangelista & Vezzani, 2010; Polder, van Leeuwen, Mohnen, & Raymond, 2010). The present paper addresses this subject and aims to disentangle the specific impacts on the implementation of organizational innovation that result from the introduction of either a technological product innovation or a technological process innovation. The main question this paper focuses on is the following: is the performance of organizational innovation influenced by the introduction of technological innovation? For this study the Oslo Manual's description of organizational innovation is considered: "the implementation of a new organizational method in the firm's business practices, workplace organization or external relations" (OECD, 2005:51).

Hitherto, the study of the additional benefits resulting from technological and organizational innovation concurrence is limited to the analysis of i) how organizational innovations impact on technological capabilities, and thereby on product, process and firm performance (Camison-Zornoza & Villar-López, 2012; Foss, Laursen, & Pedersen, 2011); ii) how organizational innovation influences the probability to engage in product or process innovations (e.g. Evangelista & Vezzani, 2010; Laursen & Foss, 2003) innovations (Gallego, Rubalcaba, & Hipp, 2012); and iii) how the joint adoption of organizational innovation and technological innovation influences productivity, as measured by total factor productivity (Polder et al., 2010), sales (Evangelista & Vezzani, 2010) or by added value (Battisti & Stoneman, 2010). Not much has been studied on how technological innovation influences organization-related innovative performance, that is, the performance of organizational innovation.

There are some pioneering reports (Damanpour & Evan, 1984; Kimberly & Evanisko, 1981), as well as a recent increase in studies addressing organizational and technological innovation concurrence (Battisti & Stoneman, 2010; see Birkinshaw, Hamel, & Mol, 2008; Camison-Zornoza & Villar-López, 2012; Evangelista & Vezzani, 2010; Foss et al., 2011; Gallego et al., 2012) although, as mentioned previously,

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http://dx.doi.org/10.1016/j.jbusres.2014.04.010
0148-2963/

the performance of organizational innovation is currently under-researched. This fact is emphasized by Mol and Birkinshaw (2009: 1270) "there is little evidence of the empirical relationship between the introduction of organization innovation and its performance".

This paper analyzes the influence of technological innovation in the performance of organizational innovation. The dependent variable in this case is neither a technological innovation capability nor a technological outcome but, rather, a non-technological organization-based innovation performance. Therefore the approach to the study of technological innovation's effects is presented from a new perspective. This study is accomplished by applying the information about the effects of organizational innovation provided by the CIS data (collected using the 2005 Oslo Manual version). In addition, this paper presents predictive validity, rather than just fit validity, providing robust evidence.

The effects that each specific kind of technological innovation has on the performance of organizational innovation are revised. Are product and process innovations influencing the performance of organizational innovation to a similar degree? Despite the recognition of the value of a joint adoption or integrative approach (e.g. Evangelista & Vezzani, 2010), deeper analysis suggests that not all pairs of technological and organizational innovations improve performance. In fact, it is reported (Ettlie, 1988; Ettlie & Reza, 1992) that positive effects of joint adoption come mainly from the integration of technological *process* innovations and organizational innovations (Edquist, Hommen, & McKelvey, 2001; Ettlie & Reza, 1992; Womack, Jones, & Roos, 1990), whereas as suggested by Polder et al. (2010: 24), "testing for complementarity and substitutability shows that organizational and product innovations are substitutes". This study analyses whether *specific* technological innovations (product or process) improve organizational innovation performance: which technological innovation mode, if any, improves the importance of the organizational innovation effects?

Overall, this paper responds to the call for "…a greater emphasis to the integration of technological and organizational factors" (Battisti & Stoneman, 2010: 203) and also presents an empirical approach that validates the positive returns generated from the joint adoption of technological and non-technological (organizational) innovation modes (Evangelista & Vezzani, 2010).

This paper contributes to three main developments in the field of study. Firstly, the knowledge about the relationship between organizational and technological innovations analyzed by focusing on specific pairs of joint innovation practice is increased. Secondly, this paper looks beyond technological performance and provides evidence about the specific effects of organizational innovation. Thirdly, in order to look at the additional effects consequent upon combining technological and organizational innovations, an integrated and comprehensive cross-disciplinary theoretical framework is developed.

The paper draws from the CIS data from Spain and selects a sample of 9369 manufacturing and service firms which introduce organizational innovations. Through the analysis of these organizational innovators, empirical evidence of the additional effects that the adoption of technological innovation exerts on the outcomes of organizational innovation is found. Using CIS data denotes generalizable results that are comparable with studies in other countries.

The paper is organized as follows: after the Introduction, Section two presents a literature review and sets out hypotheses; Section three describes the empirical research; the results are presented in Section four; in Section five, conclusions and their implications are discussed.

2. Literature review and hypotheses

2.1. A conceptualization of organizational innovation

The term "organizational innovation" (Trist & Bamforth, 1951) or "management innovation" (Birkinshaw et al., 2008), encompasses the introduction of new organizational (e.g. Armbruster, Bikfalvi, Kinkel, & Lay, 2008) and managerial (e.g. Birkinshaw et al., 2008) activities. Administrative or social innovation (Damanpour, Szabat, & Evan, 1989; Kimberly & Evanisko, 1981) is a similar concept, which refers to strategies not directly related to technical innovation, but pertaining to recruitment policies, the allocation of resources, and the structuring of tasks, authority and rewards (Damanpour & Evan, 1984; Evan, 1966; Kimberly & Evanisko, 1981).

The above definitions are rooted in organization theory, and either address practices and policies, or structures and processes. The former relate to the organizational routines mentioned by Simon (1945: 46): "factors that will determine with what skills, values and knowledge the organization member undertakes his work". The latter address, as stated by Child (1972: 2), the "formal allocation of work roles and the administrative mechanisms to control and integrate work activities".

For better consensus and clarity, the suggestion of Damanpour and Aravind (2011: 35) is followed and the definitions of administrative, organizational and management innovation are viewed as broadly similar, although the distinctive nuances are relevant. For example, while the OECD (2005), Mol and Birkinshaw (2009) and Battisti and Stoneman (2010) include in their conceptualizations of management innovation the introduction of new marketing innovations, Armbruster et al. (2008), Camisón and Villar-López (2014), and Damanpour and Aravind (2011) do not. See Table 1 for a short compilation of definitions of the construct.

Occasionally, the innovation literature uses the term "organizational innovation" regardless of the type of innovative outcome developed or introduced in an organization (including technological and organizational types). In contrast, Lam (2005) defines organizational innovation as a precondition for any kind of innovation in organizations. In her opinion, the relevant and key organizational characteristics of a firm need to be studied, as they enhance a firm's ability for innovation (e.g. Hall, 1992, 1993; Henderson & Cockburn, 1994).

Larraza (2013: 184) states that distinguishing clearly between organizational innovation and organizational change is critical. She highlights the importance of the two characteristics that the Oslo Manual (OECD, 2005) attributed to organizational innovation, namely: "the novelty of the organizational method implemented and the strategic reasons for its deployment." These two features, she points out, "help to differentiate organizational innovation from mere organizational change." Moreover, for an organizational change to be considered an organizational innovation, it must be completely new to the organization. The mere formulation of management strategies in a document is not proof of organizational innovation; its implementation in a firm's activity is a basic requirement (Larraza, 2013). Other studies introduce a differing criteria: to be considered an organizational innovation, the innovation needs to be driven by a strategic motivation (Poole & Van de Ven, 2004; Van de Ven, 1992), including the improvement of competitive advantage and economic performance (Som et al., 2012).

One possible barrier to the development of the concept organizational innovation is its own "ambiguity and (the) lack of consensus on the definition of the term" (Lam, 2004: 31–32). However, in this paper the Oslo Manual's (OECD 2005:51) definition is followed, and it states that organizational innovation is: "The implementation of a new organizational method in the firm's business practices, workplace organization or external relations."

2.2. Fundamentals of concurrent technological and organizational innovation

Studies addressing organizational innovation adhere to three main approaches. First, those related to taxonomies, definitions and theoretical foundations of the construct, and its systemic implications for innovation (e.g. Birkinshaw et al., 2008; Damanpour, 1991; Evan, 1966; Hamel, 2006; Lam, 2004; Wolfe, 1994). Second, those concerned with issues related to the drivers or antecedents of the adoption of organizational innovation (Damanpour & Evan, 1984; Damanpour, 1987; Kimberly & Evanisko, 1981; Mol & Birkinshaw, 2009). Third, those