



## Research collaboration and R&D outsourcing: Different R&D personnel requirements in SMEs

Peter Teirlinck<sup>a,\*</sup>, André Spithoven<sup>b</sup>

<sup>a</sup> Hogeschool-Universiteit Brussel and KU Leuven, Brussels, Belgium

<sup>b</sup> Belgian Science Policy Office, Brussels, Belgium

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### ABSTRACT

The literature on 'open' innovation emphasises the need to engage in external knowledge relations in order to innovate. Particularly for SMEs, research cooperation and R&D outsourcing can offer possibilities to complement the often limited internal research resources. However, they also bring in their wake requirements in terms of absorptive capacity and managerial skills of the internal R&D personnel.

The paper focuses on the different requirements in terms of availability and training of research managers and R&D experts for research cooperation versus R&D outsourcing in SMEs. An empirical analysis of micro-level data provided by the OECD business R&D survey for Belgium reveals that the relation between R&D personnel requirements and research collaboration and R&D outsourcing depends upon the SME size. Therefore, to study this subject appropriately a distinction between very small, small, and medium-sized firms is relevant. Very small firms engage significantly less in research cooperation than medium-sized firms and the propensity to engage in research cooperation is positively associated with the share of PhD holders among the research managers and R&D experts. For R&D outsourcing a lower involvement is noted in medium-sized firms, and the propensity to outsource increases with the formal qualification level of the R&D personnel and with R&D training. Among the SME, small firms are most engaged in research cooperation and in R&D outsourcing. In the case of research cooperation they rely on highly qualified experts. For R&D outsourcing activities both the presence of research managers and R&D experts is important.

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### 1. Introduction

Research cooperation and R&D outsourcing are important ways to explore new research areas with relatively low capital and lower risk involvement in case of failure. However, decisions to engage in these activities make firm boundaries permeable in order to attract and use external knowledge and technology. They bring in their wake important implications for the organisation of innovation processes (van de Vrande et al., 2009) and should be seen in relation to the management, research expertise and qualification and training of internal R&D personnel. Based on initial work by Narula (2001) it can be expected that there are marked differences in terms of internal firm requirements for R&D management between activities related to research collaboration on the one hand and R&D outsourcing on the other hand. These differences can be situated both at the level of managerial

resources and in terms of in-house capacity in order to utilise the results (Veugelers, 1997; Narula, 2001; Lucena, 2011). Aspects which are of particular importance for SMEs since these are faced with scale limitations and, in a context of open innovation, increasingly have to devote resources to other aspects of the value chain in order to effectively market the internally developed and externally sourced knowledge (van de Vrande et al., 2009).

Both research cooperation and R&D outsourcing in SMEs involve challenges to handle the increasing complexity and management of innovation and extend beyond the traditional R&D department (van de Vrande et al., 2009). This can be related to the crucial importance of human resources for R&D activities in firms (Allen and Katz, 1992). Innovation adoption in SMEs is particularly affected by the people around them and by the skills and knowledge of the internal personnel (Sawang and Unsworth, 2011). For the time being, in a context of open innovation and for SMEs, the management of innovation is rather going through a process of trial and error than that it is part of professional management (Gassmann et al., 2010).

The focus of this paper is on the identification of differences in the internal requirements of SMEs in terms of research managers

\* Corresponding author.

E-mail addresses: Peter.Teirlinck@hbrussel.be (P. Teirlinck), André.Spithoven@belspo.be (A. Spithoven).

and R&D experts as well as their qualification and training according to firm engagement in R&D outsourcing versus research collaboration. Moreover, the research takes into account the heterogeneity of SMEs by differentiating between very small, small, and medium-sized enterprises. The focus on external knowledge relations in SMEs, the role of human resources for R&D, and size differences among SMEs are underdeveloped items in the literature on open innovation (Gassmann et al., 2010; Spithoven and Teirlinck, 2010).

The paper is structured as follows. Based on a literature review on research cooperation and R&D outsourcing in SMEs and the requirements in terms of research managers and R&D experts, Section 2 formulates the research question, Section 3 describes the dataset, and in Section 4 the empirical findings are presented. Section 5 highlights the main conclusions.

## 2. Literature review and research hypotheses

### 2.1. Research collaboration and R&D outsourcing

The growing complexity, huge budgets and risks related to innovation, the increased knowledge intensity, and the mounting competitive pressure for developing new products and processes, forces the R&D active company to look outside the firm's boundaries to complement its internal R&D efforts (Chesbrough, 2003; Coombs et al., 2003; Howells et al., 2003; Huang and Rice, 2009). External networking is an important way to do so and can take different forms of which research cooperation and R&D outsourcing are two prominent ones (von Hippel, 1988; Colombo and Garrone, 1996; Lazarcic and Marengo, 2000; Chesbrough et al., 2006).

Research cooperation refers to both formal collaborative projects and informal networking activities with individuals and organisations (Chesbrough et al., 2006). It involves both knowledge generation contributing to the internal knowledge base (Cohen and Levinthal, 1990) and knowledge exchange of internally developed knowledge (Arora and Gambardella, 1994; Veugelers and Cassiman, 1999; Chiesa, 2001; Coombs et al., 2003). Firms may engage in cooperation in order to acquire missing knowledge, complementary resources of finance, to spread risks, to enlarge social networks, or to reduce costs (Hoffman and Schlosser, 2001; Mohr and Spekman, 1994). The firm's propensity to engage in research cooperation tends to increase with the internal R&D budget (Veugelers, 1997).

R&D outsourcing is also at the heart of the open innovation paradigm which emphasises that firms cannot (and should not) conduct all R&D activities internally and have to capitalise on external knowledge which can be licensed or bought (Gassmann, 2006). Veugelers (1997) highlights that the technology strategy of a company needs to emphasise the link between in-house development and external acquisition. In the absence of it, in-house R&D groups may hamper rather than stimulate effective external linkages. The choice between internal and external R&D is connected to the centrality of the technological competences to the firm's activities and R&D outsourcing is undertaken where doing so is cost-effective and does not threaten the competitive advantages of the company (Narula, 2001, 2004).

Research cooperation and R&D outsourcing are amply studied as facilitators to explore new research areas with relatively less capital and lower risk involvement in case of failure. However, far less is known about differences between research cooperation and R&D outsourcing in terms of requirements regarding occupation, qualification, and training of R&D personnel. To investigate these discrepancies differences in knowledge acquisition through research cooperation and R&D outsourcing are taken as a starting point.

To deal with knowledge acquisition one should, firstly, consider the nature of knowledge. Knowledge 'complexity' and 'tacitness' (Gosain, 2007; Simonin, 1999) are the most cited underlying dimensions of the nature of knowledge. Knowledge complexity can be defined as 'the number of interdependent routines, individuals, technologies and resources linked to a particular knowledge' (Simonin, 1999, p. 470). Knowledge tacitness (Gosain, 2007, p. 259) refers to 'how easy or difficult it is to codify and articulate the information that needs to be transferred for specific knowledge'. Both dimensions exert a strong influence on the ease of knowledge acquisition (Narteh, 2008).

A resource-based view of the firm can be used to demonstrate how innovation depends on the development and accumulation of specialised internal capabilities. To stimulate the development of internal capabilities the firm needs organisational integration: a set of relations that creates incentives for employees who participate in hierarchical and functional divisions of labour to apply their skills and efforts to the innovation process (Helper et al., 2000). To absorb knowledge from the external environment, firms need organisational integration in which employees function as interfaces with the environment. These employees have to possess the skills to screen, interpret and assimilate knowledge and transfer it through internal communication and diffusion on the work floor. At the same time, the acquisition of external R&D can be considered a knowledge-based transaction often characterised by complexity and contractual problems (Anand and Khanna, 2000).

Inspired by the OECD Frascati Manual (OECD, 2002) and Spithoven and Teirlinck (2010), the relation between R&D personnel and knowledge acquisition can be considered in terms of expertise and qualification; training; and management.

First, the role of experts should be seen in relation to the acquisition of complex and tacit knowledge which is closely related to absorptive capacity. Absorptive capacity refers to the ability of the recipient to utilise externally held knowledge by means of recognising and understanding potentially valuable new knowledge, assimilation of valuable new knowledge to transformative learning, and application of the acquired knowledge to create new knowledge and commercial outputs through exploitative learning (Cohen and Levinthal, 1990). If the external knowledge is actively used as a problem-solving capability it supports a skill (compared to experience) if it is tacit, and it becomes know-how (compared to information) if it is coded (Kogut and Zander, 1992). As such, a higher level of internal knowledge is helpful for firms to understand and acquire external knowledge. This external knowledge acquisition can help firms to accumulate relevant experiences and routines for knowledge sharing and interpretation, which in turn can promote the firm's absorptive capabilities (Eisenhardt and Martin, 2000). Veugelers (1997) used R&D departments with personnel holding a doctorate degree (as a measure for absorptive capacity) and found that their presence positively influences the effect of contracting on internal R&D. She also stresses that the complementarity between in-house R&D and external know-how depends on an optimal tuning to absorb effectively external know-how of in-house R&D groups. High qualified employees can be associated with higher R&D investment levels (Roach and Sauerermann, 2010) and education and training are found crucial to innovation (Lam, 2005). High educational levels can be supposed facilitating the detection and management of relevant external knowledge flows (OECD, 2008), which are key ingredients in absorptive capacity (Roach and Sauerermann, 2010). In particular in the case of doctorate degrees the body of research supporting this view is considerable (Stuart and Ding, 2006; Bercowitz and Feldman, 2008; Baba et al., 2010).

Second, training (and especially on-the-job-training) is considered an effective mechanism for transferring less-complex and

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