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Research paper

Organizational and human resource management and innovation: Which management practices are linked to product and/or process innovation?

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ABSTRACT

We examine the determinants of firms' innovation success, using the firm-level data from the Japanese National Innovation Survey. We focus on the relationship between organizational and human resource management practices for research and development (R & D) and product/process innovation. We find that interdivisional cooperation/teams and the creation/relocation/integration of R & D centers are positively associated with both product and process innovation. Having board members with an R & D background is positively associated with product innovation, implying that top-down R & D decision-making may be important for firms to introduce new products. Among the factors examined, personnel assessment reflecting R & D outcomes appears to have an especially strong relationship with product innovation. Moreover, the positive relationship between the creation/relocation/integration of R & D centers and innovation success suggests that drastic organizational changes can work as a clear signal of firms' determination to pursue an innovation-oriented strategy and help to accelerate innovation success.

1. Introduction

Innovation has long been recognized as the most important source of economic development and firms' growth (Schumpeter, 1934; Penrose, 1959). Consequently, how to boost innovation has been of central interest to both policy makers and entrepreneurs.

In the academic field, market competition is considered to be an important determinant of firms' incentive to innovate, and research examining the relationship between competition and innovation both from a theoretical and an empirical perspective spans back more than half a century (e.g., Arrow, 1962; Gilbert and Newbery, 1982; Cohen and Levin, 1989; Aghion et al., 2005; Vives, 2008). However, the degree of competition among firms in a particular product market is not necessarily the main or key factor determining the probability of innovation success.

Teece (1996), for instance, argues that an important determinant of innovation is firm organization and that scholars need to understand the importance not only of market structure and the business environment but also of the formal and informal structures of firm organization. There is some quantitative evidence indicating that such organizational aspects indeed are important determinants of innovation inputs and output. For example, estimating patent production

functions, Pakes and Griliches (1984) found that the magnitude of the coefficient on research and development (R & D) investment fell drastically when firm-specific effects are controlled for. Meanwhile, Scott (1984) found that firm fixed effects explained about 50% of the variance in R & D intensity. These results imply that there are unobserved firm-specific factors which greatly affect innovation activities. One possible explanation of the results is that firm-specific organizational practices play a role in determining firms' innovation output and inputs.

Against this background, the literature has increasingly focused on various features of organizations, including (1) the design of incentive systems; (2) firms' ability to manage spillovers of knowledge; and (3) firms' choice of organizational structure. However, although there is a burgeoning literature on organizational and human resource management issues (for a survey, see, e.g., Bloom and Van Reenen (2011), Laursen and Foss (2014), and Seeck and Diehl (2017)), most studies do not focus on management practices for R & D units or R & D personnel. Instead, they investigate, for example, the relationship between innovation and firm-wide management practices such as the role of teams, payment schemes, and training for workers overall, without specifically focusing on management practices with regard to researchers and/or research units.

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Yet, as pointed out by [Azoulay and Lerner \(2013\)](#), most of our knowledge on this relationship does not stem from the mining of traditional datasets such as large sample survey datasets or census-type datasets, but from small-sample surveys and case studies. Moreover, previous empirical studies using firm-level innovation survey data or patent-inventor linked data, as we will detail in the next section, have not yet provided conclusive evidence on the relationship between R & D human resource management and R & D outcomes.

This means that there are still very few empirical examinations of organizational management and R & D activities based on large-scale firm-level databases.¹ Moreover, as the literature surveys by [Laursen and Foss \(2014\)](#) and [Seeck and Diehl \(2017\)](#) highlight, the possible differential roles of management practices depending on the phase of the innovation process or the type of innovation, i.e., product or process innovation, have not yet been sufficiently investigated in previous empirical research.

Therefore, the aim of the present study is to empirically examine the relationship between firms' R & D-related organizational and human resource management on the one hand and innovation output on the other hand. For the analysis, we use the firm-level data underlying the Japanese National Innovation Survey conducted by the Ministry of Education, Culture, Sports, Science and Technology in 2009. This survey is the Japanese equivalent of the Community Innovation Surveys (CIS) conducted by the European Union. Using the data enables us to define two different types of firm-level innovation output: product innovation, which is defined as the successful introduction of new products or sales from innovative products; and process innovation, which is defined as the successful introduction of new or significantly improved production processes. The data also enable us to take the technological superiority of product innovations (breakthrough innovation) into account by using information on the time required by rivals to catch up. Moreover, using the data, we can obtain firm-level information on within-firm R & D organizational changes as well as on assessment schemes for researchers. The novelty of our study is that it examines the link between the management of researchers or research units and firm-level innovation using firm-level information on innovative products/processes. Moreover, we examine whether there is a difference in the link between management practices and innovation depending on the type of innovation. We explicitly investigate what kinds of management practices are positively associated with product or process innovation and breakthrough product innovation.

Our findings suggest that implementing more than one management practice at the same time is associated with a higher probability of innovating new products. Particularly for product innovation, management practices such as interdivisional cooperation, board members with an R & D background, personnel assessment reflecting R & D outcomes, and restructuring of R & D centers have a strong and positive link with innovation success. Among these practices, personnel assessment appears to have an especially strong relationship with product innovation. However, in the case of process innovation, human resource management practices are less likely to be significantly positively linked with innovation success. Meanwhile, the importance of board members with an R & D background and the restructuring of R & D centers suggests that top-down R & D decision making and drastic organizational changes can serve as a definitive signal of firms' intent to pursue an innovation-oriented strategy and can accelerate innovation success.

The remainder of this study is organized as follows. Section 2 provides a survey of the related literature and highlights the importance of organizational factors as determinants of innovation success. Based on the literature review, we present our hypotheses on the link between

various management practices and success in product/process innovation. Section 3 describes the dataset used in this study and discusses various characteristics of the innovation management practices of Japanese firms. Section 4 then examines complementarities between organizational and human resource management practices. Next, Section 5 explores effective management practices in more detail and investigates practices particularly effective for breakthrough innovation. Finally, Section 6 concludes.

2. Related literature

[Teece \(1996\)](#) argues that the formal and informal structures of a firm have an important bearing on the strength of innovation activity. He highlights seven key properties of technological innovation. Specifically, innovation tends to be characterized by uncertainty, path dependency, and technological interrelatedness, it tends to be cumulative in nature and exhibit irreversibilities, knowledge is often tacit, and innovations can be difficult to appropriate. Given these underlying properties of technological innovation, he identifies the organizational requirements for innovation success: (1) joint research projects or alliances with other firms to obtain better access to capital; (2) cooperation and coordination across business units or divisions to mitigate various types of uncertainties; (3) horizontal and/or vertical integration of organizational subunits such as R & D, manufacturing, and marketing, in order to attain economies of scope and successfully commercialize innovations; and (4) human resource management practices to develop corporate norms and instill them in employees.

Based on [Teece's \(1996\)](#) discussion, this study – mainly reflecting data availability – focuses on the following three broad types of management practices: (1) cooperation and coordination across business units or divisions at the firm as a whole; (2) human resource management with regard to R & D personnel; and (3) restructuring the organization of R & D. The remainder of this section reviews findings of previous empirical studies related to these types of management practices.²

2.1. Cooperation and coordination across business units or divisions

First, cooperation and coordination across business units or divisions is expected to increase knowledge spillovers within a firm and to improve firm performance. As argued by [Shipton et al. \(2005\)](#), for example, transfer of knowledge within an organization is one important stage of the organizational learning cycle through which innovation is promoted. [Jones \(2009\)](#), for example, using a large micro dataset of inventors and focusing on organizational management practices, shows that teamwork becomes more important over time. However, the impact of teamwork may differ depending on team members' cognitive style, i.e., whether the team contains members that are creative, conformist, and/or attentive to detail, etc. [Miron-Spektor et al. \(2011\)](#) find that creative team members are essential for team radical innovation, while attentive-to-detail members had a negative influence on team radical innovation.

2.2. Human resource management

As for human resource management, a topic that has received considerably more attention is the role of incentive systems such as pay for performance. Studies on pay for performance have produced mixed results, however. While some show that compensation based on the pay-for-performance principle induces higher levels of effort and productivity (e.g., [Lazear, 2000](#); [Shearer, 2004](#)), other studies highlight the distortions associated with incentive pay schemes (e.g., [Bloom and Van](#)

¹ A few exceptions which analyze the relationship between internal organization and R & D activities using firm-level data include [Laursen and Foss \(2003\)](#), [Argyres and Silverman \(2004\)](#), [Lerner and Wulf \(2007\)](#), [Arora et al. \(2014\)](#), and [Kanama and Nishikawa \(2017\)](#).

² For a discussion of the importance of managing the organizational context when managing innovation, see [Phillips \(2014\)](#).

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