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Additional Information

The effect of managing different types of work on open innovation: a micro-organizational perspective

1. Introduction

The general objective of this study is to link the micro-organizational dimension of the firm to open innovation. The aim is to examine the elements that explain the efficiency and effectiveness of the organization together with the contributions to knowledge and innovation derived from external firms or agents. This issue is recurrent in open innovation studies. However, this study introduces three novel elements. The first relates to the micro-organizational dimension. The approach in this study is of a micro-micro nature, and an analytical approach to types of work is adopted. This approach corresponds to Perrow's (1967) model, which looks into micro-organizational levels in greater depth than is usual in the open innovation literature (Chesbrough, 2003a, 2003b, 2010). The second novel element relates to drawing upon the proposal of *organizational economics* of using outsourcing or spin-offs of qualified work to align incentives and then incorporating external innovations (Williamson, 1985, 2013). This element is also missing from the literature. The third novel element relates to the empirical method, namely qualitative comparative analysis (QCA). The use of QCA enables the identification of relationships between types of qualified work, employee motivation, the firm's risk tolerance, and open innovation policies. The two sources (internal and external) of efficiency and effectiveness of the firm are thereby linked.

This approach is consistent with the view of work as a contingency factor (Donaldson, 2001; Perrow, 1967, 1970; Woodward, 1965), using a micro-organizational framework (Helfat and Peteraf, 2015; Teece, 2014) to explain strategy or the process of strategy formation (Achtenhagen *et al.*, 2013; Johnson *et al.*, 2003; Vaara and Whittington, 2012; Whittington, 2015). The conclusions of this study provide a platform for future research that combines strategy and organizational design. In its broadest interpretation, this paper contributes to the literature in which strategy formation is viewed as a somewhat emergent process in which organizational characteristics play an essential role (Andersen, 2000, 2004a, 2004b; Brews and Hunt, 1999; Donate *et al.*, 2016; Hart, 1992; Johnson *et al.*, 2003; Mintzberg, 1973; Mintzberg and Waters, 1985; Whittington, 2015).

The different types of work used by the organization at the micro-organizational level arise because of the different tasks that the company must perform to deliver its products or services. These types of work are *forms of work made mandatory by the product and/or services offered by the company, without which the company itself would not exist*. Nevertheless, the definition and characteristics of work depend not only on the tasks that must be carried out but also the way in which work is managed (Raffiee and Coff, 2016). The same tasks in jobs that are subjected to high levels of formalization and

centralization or close control or in jobs where autonomy and decision-making are delegated give rise to different types of work (Galbraith, 2014; Hoorn, 2018). An efficient organization requires work features to correspond to the characteristics of the tasks that must be performed (Tailor, 1911; Perrow, 1967, 1970). However, the need to adapt to the tasks allows for some freedom regarding forms of management and work organization (Weick and Roberts, 1993; Peris-Ortiz *et al.*, 2012). This issue is particularly important in innovation-related work and open innovation, which is subject of this paper. More specifically, this research examines the relationships between qualified professional and creative types of work (Perrow, 1967; Donaldson, 2001) and open innovation (Chesbrough, 2003a, 2003b, 2004; Chesbrough *et al.*, 2018). These types of work are necessary to cooperate with other companies and external agents so that innovation can take place. Alternatively, these types of qualified professional and creative work might be outsourced to avoid the difficulties involved in their assessment and to lower control costs (Williamson, 1985, 2013). This outsourcing or spin-off covers a side of open innovation that differs from the one described by Chesbrough (2010).

As mentioned earlier, these ideas are part of a framework built on three aspects of the literature on organizations. The first aspect refers to the micro-organizational dimension of the firm and covers multiple approaches. The first approach relates to *contingency theory* (Donaldson, 2001; Perrow, 1967; Woodward, 1965), which underscores how contingencies or circumstances related to the task at hand mean that certain work has certain characteristics and must be handled in a certain way. At the other temporal and conceptual extreme of the approaches focused on the micro-organizational dimension is the *activity-based view* (ABV; Johnson *et al.*, 2003; Whittington, 2015). This approach has become prominent in the last two decades. From its strategic focus, it underlines the need to have sufficiently detailed knowledge about the activities or tasks performed by the company. The other approaches that lie in between these two—but that are no less focused on knowledge of the micro-organizational dimension of the firm—are *knowledge management* (NM; Nonaka, 1994; Spender, 2008), the *resource-based view* (RBV; Eisenhardt and Bingham, 2005; Wernerfelt, 1984), the *dynamic capability view* (DCV; Eisenhardt *et al.*, 2010; Teece *et al.*, 1997), and *learning theories* or *learning management* (LM) and the capacity to absorb knowledge (Cohen and Levinthal, 1990). Each of these approaches encompasses different aspects of resources, capabilities, and organizational activities (all forms of addressing organizational complexity and performing work tasks). Therefore, all approaches contribute to understanding which tasks should be performed and how to achieve the required levels of efficiency and effectiveness.

The second aspect from the literature on organizations that also has a bearing on the knowledge of micro-organizational levels is *organizational economics*. In this case, the interest lies in achieving

efficiency by aligning incentives (Jensen and Meckling, 1992; Williamson, 1985, 2013). This explains the advisability of outsourcing or spinning off activities of qualified work or qualified and creative work, especially innovation activities, that could thus become a source of open innovation. Finally, the third aspect of the literature that bears a relation with this study is open innovation strategy, whose theoretical framework straddles strategic, organizational, and technological approaches (Chesbrough and Appleyard, 2007; Felin and Zenger, 2014). The reasoning presented for the micro-organizational dimension of the firm is also present, albeit less explicitly, in classic studies of open innovation (Chesbrough, 2003a, 2003b, 2004). Chesbrough *et al.* (2018, p. 930) affirmed that some of the innovation theories prior to open innovation that have been “deemed unspecified and unmanageable can be specified and managed in the open-innovation model.” Thus, Hossain *et al.* (2015, p. 4) affirmed that Chesbrough “conceptualized a new logic of open innovation that embraces external ideas and knowledge in conjunction with internal R&D and, consequently, provides novel ways to create value.” In other words, consistent with the approach in this study, Chesbrough’s view is that some proportion of the abilities of the firm that are necessary to create value through open innovation lies in the internal abilities of R&D experts and technicians. This corresponds to some of the types of work analyzed in this study. As regards the empirical study, the use of QCA enables identification of the paths that link micro-organizational variables (qualified and creative types of work and employee motivation) and open innovation variables (policies that open the firm to external knowledge and outsourcing or spin-offs of qualified work).

Section 2 examines the different work types based on the micro-organizational model described by Perrow (1967) and Peris-Ortiz *et al.* (2012). Section 3 links types of qualified work to open innovation and presents the hypotheses. Section 4 presents the empirical study based on qualitative comparative analysis (QCA). Section 5 discusses the results of the empirical study. Section 6 explores the conclusions and presents the main managerial implication, namely that the success of open innovation and indeed the company itself depends on the motivation and incentive alignment of the employees who perform qualified professional and creative work.

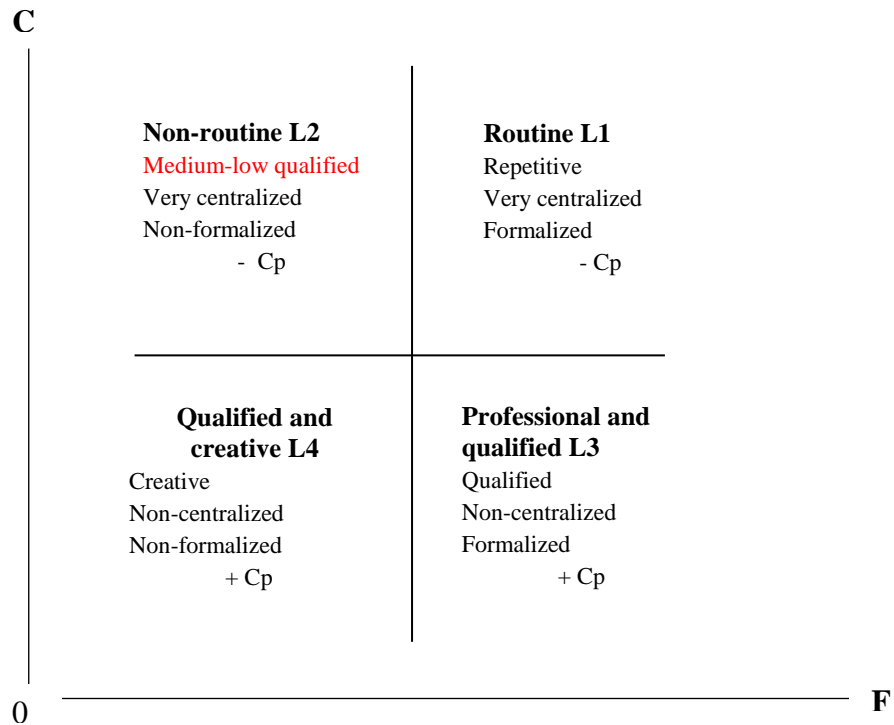
2. Managing different types of work: a micro-organizational model

Awareness of the different types of work in an organization and knowledge of the characteristics of each of these types of work is essential to ensure fit with the organization and to achieve the effectiveness and efficiency that depend on this fit. In this section, a model of types of work is developed. This model is primarily based on research by Perrow (1967, 1970) and Peris-Ortiz *et al.* (2012). The studies by Perrow (1967, 1970) relate to bureaucracy, structure, types of work, and

technology. Peris-Ortiz *et al.*'s (2012) study is more general, exploring human resources policies (Becker and Huselid, 2006; Huselid, 1995), the need for control (Alchian and Demsetz, 1972), and the importance of socialization in certain types of work and organizational forms (Donate, Peña and Sánchez de Pablo, 2016). As mentioned earlier, the characteristics of work vary according to the products and services that the company provides. Similarly, different types of work influence the organization, the way it is managed, and its strategy (Perrow, 1967, 1970; Johnson *et al.*, 2003; Whittington, 2015). Given these two considerations, the model presented herein is critical to the study of organizations and their relationship with open innovation. Perrow's (1967) proposal gave rise to a model of types of work consisting of the following types: routine, engineering, medium-low or low qualification but subject to change, and non-routine.

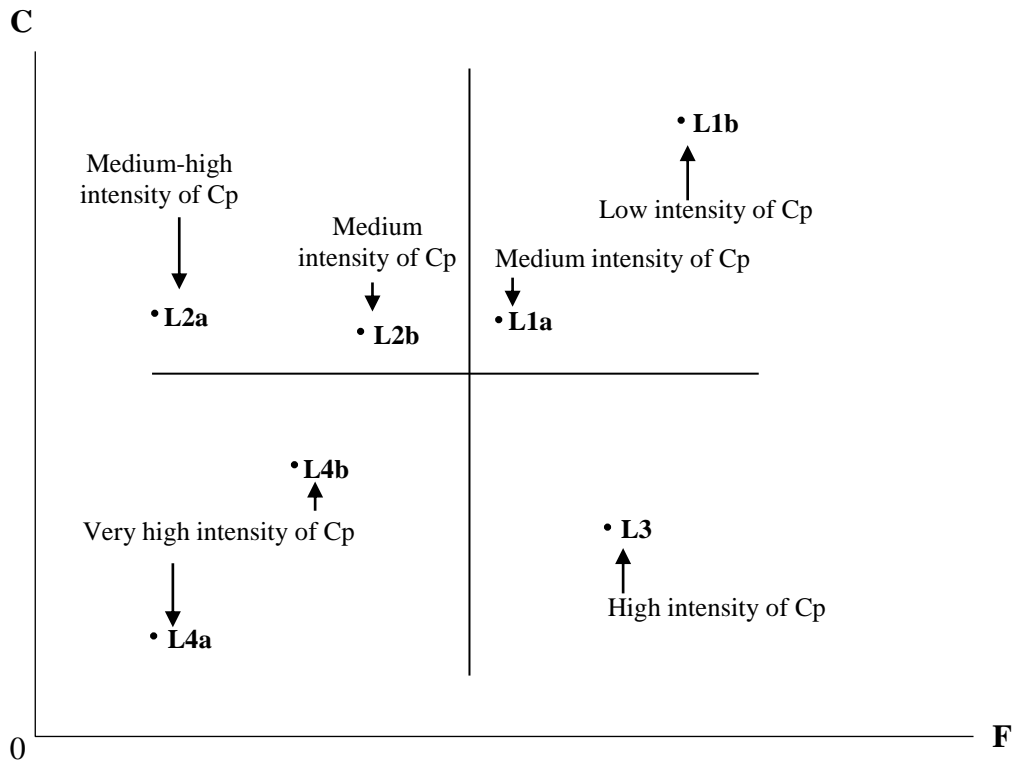
Figure 1 illustrates a version of Perrow's model. This version of the model relates the four basic types of work to three essential organizational variables: formalization (F), centralization (C), and complementary human resources policies (Cp). In this article the names of these types of work are routine and repetitive work requiring medium-low or low qualification (L1), non-routine work requiring medium-low or low qualification (L2), qualified professional work (L3), and qualified creative work (L4). This nomenclature was proposed by Moreno-Luzón *et al.* (2001) and Peris-Ortiz *et al.* (2012).

Figure 1: Types of work



The importance of centralization, formalization, and human resources complementary policies (Cp) should be stressed. These variables underpin everything that is done within the organization. However, they are not the only key variables. Work specialization and teamwork are also required to explain innovation (Nonaka, 1994), completing the set of variables that shape the foundations of open innovation (Chesbrough, 2003a, 2011, Chesbrough *et al.*, 2018; Mina *et al.*, 2014). Figure 2 illustrates work specialization in an intuitive way. For L1, the points L1a and L1b show the exact levels of formalization and centralization required for the given work specialization. The arrows indicate complementary human resources policies (Cp), displaying the required intensity of these incentive policies. When work specialization is defined as L1a, with medium levels of formalization and centralization, complementary human resources policies are important. In the extreme case of L1b, the high levels of formalization and centralization of the type of work ensure measurement and control and render complementary human resources policies largely unnecessary.

Figure 2: Work specialization



In the L2 quadrant, which corresponds to types of work that require medium or low qualification, the definition or specialization in L2b is more formalized than in L2a. Thus, at the corresponding levels of formalization and centralization, a medium intensity of human resources policies is sufficient for control. On the other hand, for L2a, which has a very low level of formalization, the specialization of this type of work consists of handling tasks with multiple exceptions (e.g., a salesperson in a car dealership). Thus, as Figure 2 shows, complementary human resources policies are important.

For L3, which corresponds to qualified professional work, and L4, which corresponds to qualified creative work, the existence of autonomy and delegation in employees' decision-making when performing tasks is a necessary condition for employees to develop their intelligence and know-how. Thus, a high level of decentralization is necessary, which makes the application of complementary human resources policies important to provide the required incentives to manage behavior and meet objectives. This scenario is relevant to the quadrant L4, particularly as regards L4a, where the levels of formalization and centralization are very low and everything depends on complementary human resources policies.

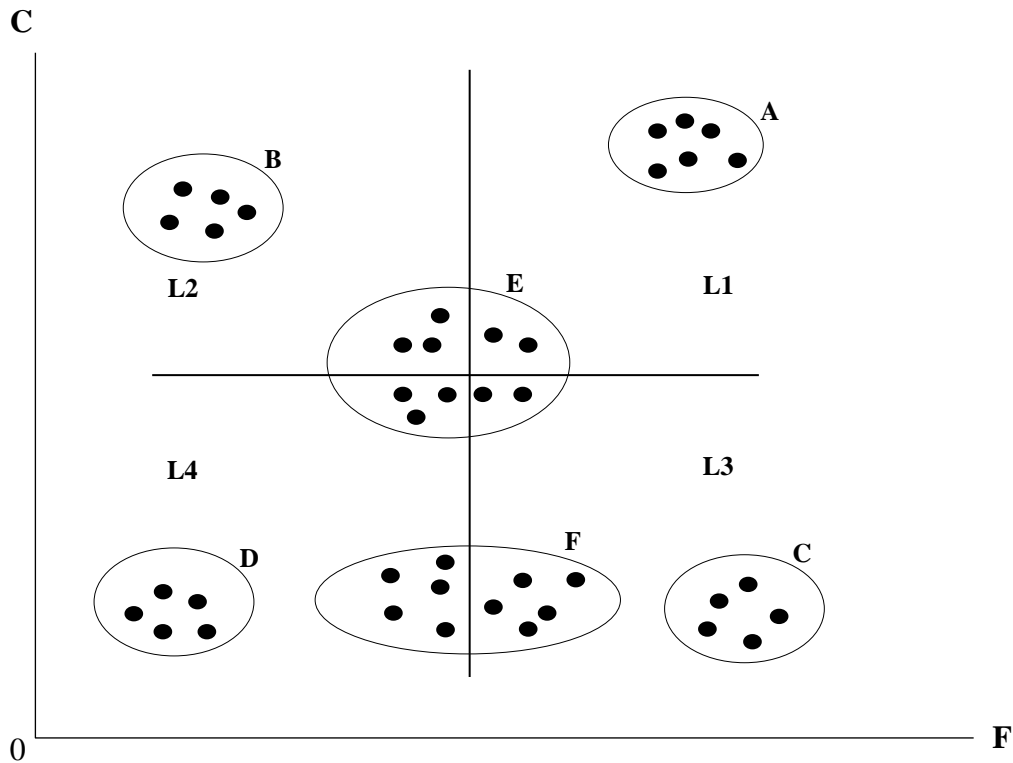
Work types L3 and L4 are especially important for a company's innovation because these work types are responsible for the company's principal R&D tasks. On the other hand, as mentioned earlier in reference to open innovation, the role of L3 and L4 is important. This has been shown to be the case, albeit implicitly, by authors adopting this approach. Examples include Cheng and Huizingh (2014),

Chesbrough (2003a, 2004, 2011), and especially Chesbrough *et al.* (2018, p. 931), who argue that, “for a participant, value is not only driven by the value created through the collaborative exchange process but also by the participants ability to capture the value of other actors’ value creation efforts in subsequent phases of the innovation process.” This matter can only be carried out by qualified type-L3 or -L4 professionals.

Another key issue, which links open innovation to other types of highly qualified work, relates to the problems of measuring or evaluating these types of work. This is difficult, especially when they are vital for innovation-related research. Thus, it may be advisable to outsource these tasks through spin-offs backed by the company itself or through other forms of agreement that transform low-power incentives typical of organizations into high-power incentives typical of markets (Williamson, 1985, 1996, 2013). Both transaction cost theory and agency theory (Jensen and Meckling, 1992) explain that only ownership of assets ensures the complete alignment of incentives. Thus, the outsourcing of innovation work in autonomous business units takes place through agreements that orient research toward company objectives. It can thus be argued that high-power incentives can offer the optimum solution, which corresponds to a form of open innovation.

Innovation work is usually done in a team (Nonaka and Takeuchi, 1995) or group (Galbraith, 1994, 2014). The team- or group-based nature of innovation work is another work design variable that can be included in the model of types of work (Figure 3). By grouping areas of work by type, groups A, B, C, and D permit other forms of work management. For the groups, forms of work management can provide ways to measure results, thereby encouraging mutual control or promoting greater productivity of members through self-control (Arruñada *et al.*, 2000). However, the most relevant groups for innovation are E and F. Group E brings together employees or specialists from all areas of the company in a way that is similar to how different types of work are related in the socialization stage of the SECI model (Nonaka and Takeuchi, 1995). As the authors postulate, this is the essential stage of the continual knowledge creation process in a knowledge-creating company.

Figure 3. Work teams



However, in reference to open innovation, the essential work team is group F. This group combines different types of qualified professional and creative work whose innovation-related research requires greater decentralization and whose freedom to experiment when tackling unforeseen problems actually means it has lower levels of formalization. Here, assessment of performance is difficult, especially when it involves innovation. Moreover, there are no reference patterns to measure results. Some open innovation studies have started considering aspects such as those discussed in this paper (Felin and Zenger, 2014; West *et al.*, 2014).

According to organizational economics, it may be useful to outsource these work teams through spin-offs or other agreements that involve the establishment of the specific high-power incentives of markets (Williamson, 1985, 1996, 2013). The company, which grants loans on favorable terms, and the agreement, which creates a long-term stable relationship, promote the business independence of the researchers' team to link research success to the value of the assets that the researchers now own. For Alchian and Demsetz (1972), Williamson (1985, 2002, 2013), and Fama and Jensen (1983, 1985), this is the only complete way to align incentives in these jobs, which are difficult to measure and assess. However, Ouchi (1980) and Nonaka *et al.* (2000) describe another way: socialization. If enough socialization takes place, which is difficult to verify, the innovation process can function effectively within the company.

Regarding the relationship between this theoretical framework and the issues that are empirically tested in this study, work types L1 and L2 are suitable primarily because of their collaboration in continual incremental innovation, which is generally carried out internally (Jugend *et al.*, 2017; Rangus and Slavec, 2017). Therefore, the empirical study is limited to work types L3 and L4. Nevertheless, when a company subcontracts its manufacturing processes and attempts to improve or innovate in this area, work types L1 and L2 may play a role, and there may be cooperation with the same type of external work.

One issue that has not been mentioned in the theoretical framework but that is relevant to the empirical study is the role of a risk-tolerant management philosophy or company culture in reference to the different forms of innovation. The existence of this management philosophy or culture is fundamental because agreements that provide the framework for open innovation are difficult to govern and adapt to unforeseen circumstances (Williamson, 1985, 2013).

3. Work types L3 and L4, open innovation, and hypothesis formulation

As discussed earlier, the difficulty in measuring or assessing performance in research jobs provides the motivation for several forms of innovation outsourcing and even some forms of open innovation. Here, two issues are important. First, it is important to establish the type of innovation that cannot be outsourced under any circumstances and consequently cannot form part of open innovation. Second, open innovation is itself a form of strategic cooperation by the company, regardless of the suitability of outsourcing jobs that are difficult to assess.

Regarding the first issue, Williamson's (1985, 1996, 2002) essential contribution to organizational research was to show that all organizations are idiosyncratic at their core. This idiosyncrasy differentiates organizations and determines what cannot be outsourced, namely their management thinking and the vision under which they formulate their strategy. Everything that the company can outsource or receive from external sources is ancillary to this essential core. This idiosyncratic core can also extend to specific technologies or the lines of R&D that constitute a company's capacity to differentiate itself and build competitive advantages (Barney, 1996; Eisenhardt *et al.*, 2010; Helfat and Peteraf, 2015; Prahalad and Hamel, 1990).

However, outside this idiosyncratic core of vision, strategic thought, and perhaps some technology linked to essential competencies, companies can associate themselves with research projects that are already backed by other companies, contributing ideas and finding solutions that would never have been achieved alone. Alternatively, they can reach cooperation agreements with other companies in the same sector (i.e., competitors) to increase the extent or depth of the research in exchange for an

equal share of the benefits from any discoveries for all companies that are part of the agreement. Thus, the companies that cooperate in R&D agreements gain an advantage over companies in the same sector that are not part of the agreement or increase their advantage over companies that produce substitute goods in similar sectors (Carroll and Helfert, 2015).

When open innovation is involved, the two causes under this strategy are typically confidence, which can be obtained from the major success of the innovation when the company is supported by external partners, and the comparative costs that make this form of cooperation more attractive. As discussed earlier, open innovation, or the outcome of cooperation between external agents (Chesbrough, 2003a, 2003b, 2010; Chesbrough *et al.*, 2008, 2018), occurs for one of the following two reasons: (1) outsourcing or the spin-off of one group of employees (technicians or experts in L3 or L4) with whom cooperation will continue afterwards or (2) the strategic suitability of cooperating or associating with other companies whose knowledge, competencies, and know-how complement or substitute (through incremental or radical innovation) specific know-how. The first case overcomes issues of control, measurement, and assessment of internal research activities, and, through the spin-off, provides better alignment of incentives (Williamson, 1985, 2013). The second case allows companies to benefit from the existing knowledge in the market of companies in a specific sector or other sectors (Jugend *et al.*, 2017) under the framework of the technological constraints that influence these forms of collaboration (Brettel *et al.*, 2011; Stock *et al.*, 2013).

The following two hypotheses summarize the theoretical arguments presented in this section. They enable verification of whether open innovation effectively takes place because of an interest in cooperating with external sources of knowledge or because of an interest in aligning incentives.

H1: Work types L3 and L4 support open innovation through cooperation with external organizations or external agents.

H2: A key component of work types L3 and L4 gives rise to open innovation through outsourcing and subsequent cooperation with the company.

These issues are examined in detail in the empirical study.

4. Empirical study

4.1. Sample and data

The sample was drawn from the Valencia Chamber of Commerce directory. The region of Valencia generates 20% of Spain's exports and 10% of total GDP. Valencia's economy is based on services. Tourism is also strong, and industrial activity is well established. The selection of firms for the sample was based on sector (operational activities carried out by qualified professionals with different levels

of complexity and dynamism to cover all types of work shown in Figure 1). The data for this study were collected between January and February 2018. A total of 45 firms were contacted, 23 of which agreed to participate in the study. The first step in the data collection was to explain the goal of the study to the manager. Managers were also asked for the most knowledgeable key informant with the necessary experience to answer the questions. The researchers collected data through individual interviews within the 23 firms that agreed to participate. The respondents covered the full range of job profiles shown in Figure 1 (researchers, consultants, engineers, managers, translators involved in R&D activities, qualified administrative officers, and highly qualified mechanics). The respondents' ages ranged from 37 to 51 years. The respondents had been at the business for 6 years or longer. Four out of five respondents were male. The interviews were carried out in Spain. Face-to-face interviews offered a suitable data collection method to ensure that the respondents fully understood the issues at hand and provide an objective assessment of the concepts under study. All variables (conditions and outcome) of the study were measured on a 7-point Likert-type scale (Appendix I). Table 1 shows the conditions that were measured and their correlations.

Table 1. Correlations between conditions and the outcome (open innovation)

<i>Conditions</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>
1. Innovative work									
2. External work	.51*								
3. Employee autonomy	.79**	.48*							
4. Employee promotion	-.10	.06	-.28						
5. Employee remuneration	.30	.30	.26	.15					
6. Employee training	.41	.50*	.52*	-.35	.40				
7. Employee motivation	.07	.16	.07	.85**	.08	-.13			
8. Firm's risk tolerance	.15	.336	.06	.03	.01	-.02	-.03		
9. Firm's OI promotion	.60**	.55**	.49*	.17	.03	.29	.32	.19	
10. Open innovation	.74**	.37	.51*	.14	.13	.01	.17	.47*	.51*

* $p < 0.05$; ** $p < 0.01$ (two tailed); *autonomy* represents free movement in relation to both centralization and formalization; OI = open innovation.

4.2. Analysis and results

Qualitative comparative analysis (QCA) was used to analyze the different configurations that lead to open innovation. The characteristics of the job, the basic human resources policy, and the firm's policy on open innovation were considered. The results of the analysis of correlations between conditions (Table 1) reveal complex relationships. A direct correlation was observed only between a few conditions. Only innovative work had a significance level greater than 99%. More relationships

were completely hidden. If the theoretical framework suggests that strong effects of the conditions on the outcome are not shown in the data, this may be due to complex causality and asymmetric relationships. QCA enables detection of configurations (combinations of variables) that are necessary or sufficient to cause an outcome (Woodside, 2013). The necessary conditions for the presence and absence of open innovation are shown in Table 2.

The consistency values for all conditions except for innovative work were below the minimum threshold of 0.9 (Schneider *et al.*, 2010), as was expected given the correlations in Table 1. Employee autonomy, which is unimportant according to the correlation with the outcome of open innovation, had a high consistency in the analysis of necessary conditions (0.89; Table 2). Thus, innovative work and employee autonomy are necessary conditions for open innovation.

Some relationships complicate the model unnecessarily. For instance, all innovative work has high employee autonomy. Employee motivation is highly influenced by employee autonomy and promotion. All cases with high work autonomy and high open innovation concern highly innovative work. Therefore, employee autonomy was removed from the model.

The truth table of all possible combinations (after excluding employee autonomy) offers several consistent configurations. Table 2 shows the minimal sufficient configuration after applying the Quine-McCluskey algorithm to reduce the number of rows.

The coverage shows the empirical relevance of each solution. The consistency reflects the degree to which cases sharing the same configuration share the same outcome (Ragin and Fiss, 2008).

Consistent paths to open innovation appear in Table 3. As shown in Table 3, there are three possible combinations that lead to positive results in open innovation. In all of these combinations, the work characteristics must correspond to innovative work (essentially L4) with extensive employee autonomy. In the first case (path 1), innovative work is combined with the positive employee motivation and risk-tolerance of the company, regardless of the company's open innovation policies. However, in the second and third cases, innovative work, outsourced work, and open innovation policy are not sufficient unless they are supported by other factors such as a risk-tolerant culture (path 2) or motivated employees (path 3).

Table 2. Analysis of necessary conditions

<i>Conditions</i>	<i>Output (Open innovation)</i>		<i>~Output (No open innovation)</i>	
	<i>Consistency</i>	<i>Coverage</i>	<i>Consistency</i>	<i>Coverage</i>
Innovative work	0.97	0.67	0.53	0.38
~ Innovative work	0.10	0.17	0.55	0.96

External work	0.65	0.67	0.46	0.48
~ External work	0.50	0.47	0.69	0.67
Employee autonomy	0.89	0.61	0.61	0.44
~ Employee autonomy	0.18	0.31	0.46	0.82
Employee promotion	0.76	0.57	0.62	0.49
~ Employee promotion	0.32	0.45	0.46	0.67
Employee remuneration	0.69	0.58	0.62	0.54
~ Employee remuneration	0.47	0.54	0.53	0.64
Employee training	0.78	0.50	0.82	0.54
~ Employee training	0.28	0.60	0.23	0.52
Employee motivation	0.79	0.62	0.65	0.53
~ Employee motivation	0.41	0.53	0.53	0.72
Firm's risk tolerance	0.91	0.65	0.64	0.47
~ Firm's risk tolerance	0.26	0.41	0.52	0.86
Firm's OI	0.77	0.65	0.56	0.49
~ Firm's OI	0.39	0.46	0.59	0.73

Note: OI = open innovation.

Table 3. QCA: Antecedent configurations leading to open innovation

<i>Sol.</i>	<i>Path</i>	<i>Raw coverage</i>	<i>Unique coverage</i>	<i>Consistency</i>
1	InnoWork*EmploMoti* Firm's Risk Accep→ O	0.72	0.30	0.93
2	InnoWork* Firm's Risk Accep *ExteWork*FirmOI→ O	0.5	0.09	0.85
3	InnoWork* EmploMoti*ExteWork *FirmOI → O	0.46	0.04	0.84

Notes: Solution coverage = 0.85; Solution consistency = 0.82; Outcome = open innovation.

The results corroborate hypotheses H1 and H2. Combinations 2 and 3 in Table 3 show that hypothesis H2 holds. Combination 1 in Table 3 shows that hypothesis H1 holds.

5. Discussion of results

The empirical analysis reveals three combinations of concepts (or configurations) that lead to open innovation and that support hypotheses H1 and H2. In the first configuration (path 1 in Table 3), innovative work (L3 and L4) corresponds to high motivation (good incentive alignment) and a company culture of risk tolerance. Consequently, the company has no incentive to use outsourcing or spin-offs for some of the qualified work, and its risk-tolerance culture encourages it to innovate in an open way with companies that can provide new knowledge or greater know-how. The open innovation benefits here are due to suitable motivation and cooperation of L3 and L4 both internally and with the external companies or agents. These results thereby support hypothesis H1. In the second configuration (path 2 in Table 3), innovative work (L3 and L4) does not correspond to

high motivation. Consequently, some part of it is outsourced or spun off to prevent control costs, thereby leading to open innovation. In this configuration, the company culture of risk tolerance and active open innovation policies reinforce open innovation. These results support hypothesis H2.

In the third configuration (path 3 in Table 3), innovative work (L3 and L4) corresponds to high motivation (or good incentive alignment). Nevertheless, the company develops policies that encourage outsourcing or spin-offs. Hence, this is another form of open innovation based on the value of creating autonomous management conditions for L3 and L4. These results thereby support hypothesis H2.

Notably, these findings are consistent with the theoretical framework and hypotheses H1 and H2. Regarding hypothesis H2, if employees are not sufficiently motivated and the firm accepts the risks of open innovation (path 2), the firm will outsource some L3 and L4 positions and any subsequent cooperation. As mentioned earlier, this finding corroborates H2. Regarding path 3 (Table 3), if workers in work types L3 and L4 are sufficiently motivated but the firm seeks to outsource to simplify and streamline internal management, this also corroborates hypothesis H2. In this case, a closer and more trusting relationship with outsourced employees counterbalances the risks inherent in open innovation, which is not present in path 3.

In open innovation with external firms (H1), L3 and L4 are just as important. Without full, sufficiently motivated participation from employees in these qualified professional or creative jobs, firms are able to effectively incorporate new knowledge and technology.

6. Conclusions

The most general and relevant contribution of this study as regards theory is that it draws upon three separate theoretical frameworks. In this study, these three frameworks are consistent and complement one another. The first of these frameworks is the organizational theory derived from sociology, represented here by Perrow's (1967) model and other approaches such as the ABV. The second framework is organizational economics, which compares internal and external efficiency (firm vs. market) to perform different tasks according to transaction cost economics. Here, the key element is the alignment of employee incentives (Williamson, 1985, 2013). The third framework is built on the management literature on open innovation as a strategy to enable innovation in firms that open the innovation process to the market (Chesbrough, 2003a, 2003b, Chesbrough *et al.*, 2018).

However, the open innovation literature that discusses using the market to capture innovation that cannot be achieved internally (or at least cannot be achieved at the same cost or over the same period) does not consider the outsourcing of certain highly qualified employees (L3 and L4) to more

efficiently align incentives and achieve greater innovation effectiveness. Similarly, the literature does not explicitly consider the micro-organizational level to match the design of qualified work with the innovation strategy, as recommended by Johnson *et al.* (2003). This point is important in relation to the implementation of the strategy and the efficiency and effectiveness of the firm.

As shown by the empirical study, the advantage of integrating these three approaches in the analysis is that they address aspects that are generally not considered in open innovation. As proposed by Perrow (1967) and as suggested by Johnson *et al.* (2003) in the context of strategy, the careful design of jobs by combining formalization, centralization, and complementary human resources policies is necessary to implement any strategy, particularly open innovation strategies. The focus on this idea, supported by the presentation of the types of work in the theoretical framework of this article, is another of this study's contributions.

The main conclusion is that open innovations may be useful in relation to qualified professional and creative types of work (L4 and L3). If the employees who perform these qualified professional and creative jobs are highly motivated and the company has a culture of risk tolerance, this is positively related to open innovation. One potential interpretation of this finding is that companies use work types L3 and L4 to support relations with partner companies or external agents in open innovation. If a company's innovative work is not characterized by high motivation and the company has a culture of risk tolerance toward open innovation, there may be policies to outsource some L3 and L4 positions to cut the costs associated with qualified professional and creative work that arise because of difficult measurement and control in the company. Finally, the empirical results show that in the case of qualified professional or creative work where employees are highly motivated, some L3 and L4 jobs may be outsourced because of the company's open innovation policies, even if the company does not have a risk-tolerant culture.

Another general conclusion is that after numerous approaches whose emphasis has been on achieving internal efficiency and effectiveness (Modelo de Perrow, KM, RBV, DCV, LO), open innovation **develops** these approaches by opening them to external knowledge (Chesbrough, 2003a, 2003b), just as organizational economics has done with a different theoretical focus (Williamson, 1965, 2013).

This study has some limitations, notably the reliability of the measurement of the variables, which were collected using subjective assessments by respondents (i.e., employees). The small number of cases must also be considered, although the statistical results indicate consistency.

Finally, as mentioned earlier, the main implication for management practice is the connection between internal efficiency in managing different types of work and the open innovation strategies that enrich innovation through collaboration with external companies or agents. Thus, this study reveals two options to effectively and efficiently manage innovation. First, companies can cooperate

with other companies. Doing so can provide forms of innovation by sharing knowledge and technology. In this process of open innovation, correctly managing qualified professional work (L3) and qualified creative work (L4) is crucial because these are the types of work that add new knowledge to the company's internal processes. Second, as mentioned earlier, in this interdependence between work types L3 and L4 and open innovation, the external agents that the company collaborates with may actually be some of the company's outsourced professional and creative workers. The difficulties in measuring and evaluating these types of work, especially when they are linked to innovation, may mean that it is advisable to outsource these jobs and their subsequent cooperation to transform the low-power incentives typical of organizations into high-power incentives typical of the market.

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Appendix

A structured interview

Please indicate your degree of agreement or disagreement with the following statements in relation to your company's situation. If you completely agree, mark 7; if you completely disagree, mark 1; if you partially agree or disagree, mark an intermediate number accordingly.

Work conditions	Structured questions
Employee autonomy	You have no decision-making capacity in your work post. When unforeseen situations arise, you must consult a superior.
Employee autonomy	You receive instructions in relation to the activities that must be carried out in your work post, the way they should be done, and the order in which they should be done.
Employee promotion	In your work post, there are no possibilities of promotion.
Firm's risk tolerance	In your organization, taking risks related to innovation and open innovation are not penalized, as long as they are carefully studied and analyzed.
Employee remuneration	In your work post, there are no financial incentives for the objectives you are responsible for.
Employee training	You do not receive training for the implementation of tasks in your work post.
External work	Your work is based on the collaboration with other teams and/or persons from other organizations.
Innovative work	Your work is creative or innovative.
Employee motivation	In your opinion, your work post is a source of motivation.
Teamwork	It is necessary to work in teams (multi-disciplinary work) to achieve the objectives in your work post.
Firm's open innovation promotion	Your company or institution accepts or promotes open innovation.
Open innovation	You carry out open innovation with other companies or institutions.
Open innovation	You work in an open way with other companies/institutions to develop new ideas, products, processes, and technologies.