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The role of Management support for the implementation of open innovation practices in firms

Abstract – Open innovation (OI) has gained a lot of popularity in the last decade, as sharing research and innovation efforts offer several benefits for firms and industries. However, implementing a successful OI environment within firms has several internal and external challenges. Therefore, researchers are investigating the factors that might contribute to achieving a successful OI adoption. This paper investigates the effect of management support on the successful adoption of OI. The paper uses regression techniques with data from an OI survey that was conducted in Europe in 2014. Respondents, from several countries and industries, were asked to evaluate their firm's current OI adoption level, as well as, several internal competencies. The dataset analysis results showed that there is a positive correlation between management support of OI and the possibility of successful adoption of OI. Moreover, the results offered insight on some of the dynamics of how management support affect OI adoption.

Keywords: Open Innovation, Management Support, Internal Competencies, Adoption

Introduction

It is not uncommon for firms to share research efforts and findings with other firms, within the same line of business or across sectors, for various reasons. This practice became a disciplined approach in 2003, when Chesbrough wrote the book *Open Innovation: The New Imperative for Creating and Profiting from Technology*, giving this discipline the name Open Innovation (OI), as well as identifying key characteristics of this newly established discipline (Chesbrough 2003; Huizingh 2011). Since then, thousands of publications have addressed open innovation, its practices, benefits, and challenges (Mention and Torkkeli 2016). More firms became interested

in adopting open innovation with the hope of reducing research cost, risks, and time to market (West et al. 2015; Huizingh 2011). Open innovation adoption spans many sectors like information technology, healthcare, and energy (Chachoua 2015; Hillegas-Elting et al. 2015).

Researchers are particularly interested in the type of internal enablers/competencies firms need to have in order to successfully adopt open innovation and realize its benefits (West and Bogers 2017; Haefliger and Poetz 2016; Dabrowska 2015; Mention et al. 2015; Schneckenberg 2014). One internal competency that several research publications highlighted is the importance of management support for successful adoption of open innovation (Lauritzen 2017; Haefliger and Poetz 2016; Schneckenberg 2014; Huizingh 2011; Gassmann 2010; Simard and West 2006). However, there is little empirical work to support this assumption. This paper is a contribution to this effort. In this paper, regression techniques were applied to data collected from the 'First European Survey on Identification of Industrial Needs for Open Innovation Education.' This survey received responses from hundreds of firms within 36 countries. The responding firms have various levels of open innovation adoption and different internal competency levels, as perceived by the respondents (Dabrowska 2015). This paper, attempts to offer insights on how management support for open innovation, as an internal competency, affect Open innovation adoption, and what are some dynamics of this effect.

Research Question

What is the effect of the level of management support for open innovation, an internal firm's competency, on the likelihood that a firm adopts open innovation? And could training and

education offered to employees and the internal environment attitude be the factors in explaining the dynamics of how management support relates to firm's adoption of open innovation?

Literature Review

Open Innovation Definition, Benefits, and Current State

According to Chesbrough, 'Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the market for external use of innovation' (2006:1).

In other words, open innovation (OI) offers mechanisms for firms to exploit inflows and outflows of knowledge to be more innovative (Bogers et al. 2018). It can be used by firms to utilize external resources to improve internal innovation processes in combination with , as a supplement to, or even as a replacement to its internal research and development (R&D) capabilities. Furthermore, Firms can use open innovation to commercialize innovation spillovers to external entities. Spillovers are technologies developed by internal R&D, and are not used by firm, as it turned out after developing it that it is not adding value to firm's current markets or needs (Huizingh 2011; Laursen and Salter 2006).

Open innovation has three dimensions; inbound (technology exploration), outbound (technology exploitation), and coupled (inbound and outbound in the same time). Following is a review of those dimensions (Von Krogh et al. 2018; Greco et al. 2017; Cassiman and Valentini 2016; West et al. 2015; Dabić et al. 2016; Fiegenbaum et al. 2014; Gawer and Cusumano 2014; Reed 2012; Tranekjer and Knudsen 2012; Chiaroni et al., 2011; Dahlander and Gann 2010;

Spithoven et al. 2010; Enkel 2009; Vrande et al. 2009):

Inbound open innovation: Allows firms to bring-in external ideas and research efforts that might take too much time, money, and resources to do internally. This leads to cost reduction and faster time-to-market for new innovative products being developed by the firm. Open innovation also reduces the risk associated with developing new products, since several parties are engaged in the research and hence share that risk. Inbound open innovation can occur through acquiring, in which a firm acquires the innovation process input from the market. It can also occur through sourcing, where a firm scans the external environment to find and use available ideas and technologies instead of building them internally. Moreover, firms vary in their ability to evaluate, acquire, and use external innovations, based on their absorptive capacity.

Outbound open innovation: Where internal research flowing outside the firm. Internal research in firms often results in spillovers that do not add value to the core business of the firm . Open innovation allows firms to sell those ideas to other firms that have needs for them, and thus make profit from those spillovers. So, open innovation could occur in the form of selling, by commercializing internal research to achieve direct financial benefits. But it can also be non-monetized, in the form of revealing, where firms share innovation ideas with the industry to stimulate external related innovations that will help the firm and the industry as a whole.

Open innovation as a coupled process: Taking advantage of both inbound and outbound processes, through alliances, cooperations, and joint ventures. This approach results in extra gains for R&D departments. For instance, cognitive gains, as selling unexploited innovations, not only generate financial gains, but also motivates researchers, as they can see that their work is

not shelved away but rather used, as well as, making them more susceptible to using external ideas as they see their own ideas used by others. Another gain is reducing the transactional costs, as firms that sell innovations tends to have better understanding of the process of marketing those innovations, so they will have better ability of assessing and acquiring innovations offered by other firms, and vice versa. Therefore, the transactional cost of acquiring and selling innovations become lower for firms engagement in both activities. Furthermore, there are also organization cost reduction benefits to being engaged in both selling and buying innovations, as there is a need, more in larger firms, to have a dedicated unit to oversee open innovation. This entails fixed costs. When the firm is pursuing inbound and outbound open innovation in the same time, it split this fixed cost, hence; reducing open innovation cost for each operation.

Open innovation benefits can be clearly seen from the discussion above; it allows firms to maximize the value of their own technology resources by combining it or sharing it with external entities (Bianchi 2014). Open innovation reduces cost, by sharing it among collaborators, and by taking advantage of other parties' work instead of redoing it again. Open innovation also reduces time to market and the risk that each firm has to carry when innovating new products (Enkel et al. 2009; Chesbrough 2003).

Open innovation is not necessarily a binary classification, i.e., a firm does not either have an open or a closed innovation environment. Rather, in most cases, firms have a mix of open and closed innovation; the real difference is in the firm's location on the open innovation spectrum, which ranges from completely closed to completely open (Dahlander and Gann 2010). One way

of measuring the degree of openness, suggested in literature, is by looking at the breadth and depth of how a firm is using external sources of innovation. Breadth refers to the number of external knowledge sources, like research institutions or other firms, a firm is collaborating with in regards of open innovation. Depth refers to the intensity of collaboration with each source. Keupp and Gassman (2009) classified firms under those two measurement into four modes (identifying them as "Archetypes"): Isolationists: low breadth and depth. Scouters: high breadth and low depth. Explorers: medium to high breadth with medium depth. Professionals: high breadth and depth. Another approach suggested by Lazzarotti and Manzini (2009) is to measure partner variety and innovation funnel openness. Partner variety is closely related to Breadth as it refers to the number/type of partners the firm collaborate with. While, innovation funnel openness, closely related to depth, as it refers to to the number/type of phases of the innovation process that the firm opens to external contributions. Under this model, four modes of openness are identified: closed innovators, open innovators, specialized collaborators, and integrated collaborators. Lichtenthaler (2009) along the same line of other models, build a model based on the extent of external technology acquisition and the extent of external technology exploitation. Under this model, six modes of openness were identified (identified as "Clusters"): Closed Innovators 1 and 2, absorbing innovators, desorbing innovators, balanced innovators, and open innovators.

The degree of openness can be greatly influenced by the firm's ability to absorb external innovations, as well as, the firm's strategy and its organizational and managerial processes. In

fact, many literature argued that in some cases, full open innovation is less beneficial than a certain degree of openness based on strategy and business needs (Idrissia et al. 2012; Keupp and Gassmann 2009; Lazzarotti and Manzini 2009; Lichtenthaler 2009; Laursen and Salter 2006).

Open innovation is achieving high adoption rate in several industries and sectors, both high-tech and low-tech, as well as, not-for-profit and public policy organizations. Various reasons related to the nature of research and needs in each industry\sector spurs open innovation (Chachoua 2015; Spithoven et al. 2010; Idrissia et al. 2012; Chesbrough and Crowther 2006). For example, the pharmaceutical industry has high R&D capital cost, long time to market, and high risk of failure for new medicines. So, this industry has seen a high rate of open innovation adoption as one strategy to face those challenges (Ozkan 2015; Schuhmacher et al. 2013). The information technology industry is based on vertical and horizontal integration, where each firm's products must integrate and interact with other types of products. In a simplified example, when a firm develops a hard disk drive, another develops a PC that uses this drive and a third firm develops a software (part of Operating System) to save and retrieve files from that hard disk. In such an environment, sharing research efforts and results is crucial for the success of any products, and thus this industry is seeing high levels of open innovation adoption as well (Huizingh 2015; Exnovate.org 2014). A study by Chesbrough and Crowther (2006), showed that firms in industries like consumer packaged goods, home improvement hardware, lubricants, and chemical, among other industries, have used various forms of open innovation for reasons related to maintain profitable growth, improve product margin, keeping an eye on distributive

technologies, and to increase time to market.

Internal Competencies Affecting the Adoption of Open Innovation

There are many factors affecting a firm's success in adopting open innovation. Some of those factors are internal within the firm and some are external (Randhawa et al. 2016; Stucki 2009; Muala 2006). Huizingh (2011) discussed the context of open innovation and pointed out that firm's internal characteristics have an important impact on whether it can adopt open innovation successfully. Moreover, Schneckenberg (2014) highlighted the importance of internal incentives and management role in creating an internal culture that will lead to the successful fostering of open innovation practices. His research indicated that monetary incentives are not necessarily the best way to achieve open innovation adoption—rather, immaterial and task content incentives, driven by management, can have more optimal results. Furthermore, Vanhaverbeke et al. (2017), described the importance of integrating open innovation to firm's strategy, and the importance of management role in doing so.

A firm's internal culture is an important factor affecting open innovation adoption and the transition to an open innovation environment. Internal culture includes employees' mindset toward open innovation and whether they are comfortable with and supportive of ideas 'not invented here' being injected into their work, as well as employees' willing to share their own ideas with the outside (Burcharth et al. 2014; Katz and Allen 1982). Gassmann (2010) argued that creating a culture that values outside competence and know-how is crucial for open innovation practice. One way to achieve this can be through management support and

commitment for open innovation. Management support is an important driving factor for achieving successful organizational changes, regardless of the change type, within firms (Von Krogh et al. 2018; Young and Jordan 2008; Schneider et al. 1996). The transition to an environment where open innovation can thrive is no exception to that. It requires major cultural changes and new thinking approach by employees, as such; management support becomes a key enabler for successful adoption of open innovation. Since, they can override resistance to change and direct open innovation toward areas within the organization where it would add the most benefit (Richter et al. 2018; Von Krogh et al. 2018; Lauritzen 2017; Haefliger and Poetz 2016; Simard and West 2006).

Management support to open innovation can be reflected in strategies like offering employees' education and training, creating awareness among employees about how open innovation can further advance their creativity and innovativeness (Salter et al. 2015), and by offering incentives, monetary and non-monetary to employees to encourage them to embrace open innovation (Gassmann 2010; West 2006). Furthermore, having open borders with suppliers, clients, and even competitors is very important to achieve successful adoption of open innovation. Management support of open innovation can also be reflected in firm leaders advocating for consideration of open innovation when making strategic and operational decisions, acquiring information systems that enable open innovation, having communication protocols that incorporate OI open borders, and so on (Enkel 2009). In conclusion, literature suggests that management support and belief in open innovation is an important internal factor to

achieve successful adoption of open innovation within a firm. Management support has a cascading effect on employees' acceptance of the change, that open innovation imposes, by formal and informal incentives, as well as, to break any bureaucracy or silos that can hinder the move to adopt open innovation.

Firm size is another internal factor that was considered by literature. Several studies have discussed the effect of a firm's size on its adoption of open innovation. It is often found that firms of all sizes can benefit from open innovation. However, firms of different sizes have different focus and abilities regarding open innovation, and so have different adoption challenges and levels. For example, large firms have the resources and processes to absorb external innovations, while smaller firms have innovations but limited resources and market reach. So open innovation gives large firms the ability to continue to be innovative and relevant by leveraging other firms' work, while open innovation gives small firms the ability to turn their innovations into profitable products by leveraging on other firms' resources and market reach (Dabrowska 2015; Vrande et al. 2009; Christensen 2006).

Because firm size relates both to internal competencies and a firm's likelihood of engaging in open innovation, it might have a spurious influence. This measure is included as a control in this study's analyses to achieve a less biased estimate of the relationship between management support and a firm's likelihood of engaging in open innovation.

Hypotheses

Based on literature review findings, we propose the following hypotheses:

- H1: Employees' perceptions of management support for open innovation will correlate positively with firm adoption of open innovation.
- H2: Employees' perceptions of training and education offered to employees and the level of OI open borders within the firm contribute to explaining how management support increases the likelihood the firm adopts open innovation.

Data and Methods

[Insert Figure 1 Here]

Dataset

The dataset to be used in this research is 'Survey: Identification of Industrial Needs for Open Innovation Education in Europe.' This dataset is the result of a survey that was conducted by the European Academic Network for Open Innovation in 2014, a project sponsored by the European Commission under the Lifelong Learning Program. The European Academic Network for Open Innovation is a EU co-financed project designed to promote cooperation on open innovation topics in European Higher Education curricula and institutes for the benefit of EU competitiveness, more details about the survey can be found in this reference (OI-Net 2014). The aim is to facilitate European cooperation by outlining and exchanging up-to-date concepts and good practices in open innovation and open innovation education. The survey's overall

objective was to help identify industrial needs related to open innovation education (Teplov et al. 2018; EFMD 2017; Dabrowska 2015). Furthermore, the survey explored human characteristics required to manage open innovation, and how they are related to open innovation activities (Albats 2016).

The survey covers four main topic areas: employees' perceptions of 1) the current state of open innovation adoption in the industry, 2) the importance of open innovation for the industry, currently and in the near future, 3) their firm's current level of open innovation knowledge and skills with industry employees, and 4) the skills fresh graduates need in an open innovation context (Dabrowska 2015). Furthermore, the survey sample was structured to support multilevel analysis. The first level is country level. The survey authors' objective was to get data from at least 35 countries. The second level is industry level. The survey administrators' objective was to choose firms from at least 10 core industries, based on GDP for each country. The third level is the number of responding firms, under the country and sector levels. To achieve that, the survey included a question about the country of the company and another question about the industry sector the company operates in (Dabrowska 2015).

The survey was conducted in 2014. A total of 528 companies responded to the survey, with those companies representing 36 countries and 28 different industries. The response rate, depending on the country and industry, was between 5-7%. Therefore, the sample can be assumed to be representative of firms in those industries in those 36 Europe countries. In some cases, only the CEO responded to the survey. And in other cases, several management-level

employees responded to the survey. More information about how the survey was constructed and how the data was collected can be found in Dabrowska (2015). The survey template can be found at OI-Net (2014).

The Research Focus

Given the paper's focus on internal competencies affecting firms' open innovation adoption, the paper uses the part of the dataset related to respondents' evaluation of their firm's current level of open innovation adoption and their firm's current internal competencies.

Since open innovation adoption is the dependent variable, respondents who did not answer the open innovation adoption question (n=8 firms) were excluded from the analytical sample, resulting in an analytical sample of 520. Missing values on independent variables were addressed with mean/mode imputation.

The Variables

Dependent Variable (DV): Since the focus is on open innovation adoption, a dichotomous variable was created that represents whether the respondent's firm is currently adopting open innovation. This variable was created by recoding the answers to a survey question regarding the current firm's open innovation adoption status. Respondents who indicated that their firm does not have open innovation, is in early stages of open innovation adoption, or is not using open innovation anymore were coded as 'did not implement OI.' While, firms that indicated they already have open innovation as part of their processes were coded as

'Implemented OI.'

Predictor of Interest: Management support for open innovation was studied as an internal competency that has a possible effect on whether the firm adopted open innovation or not. Respondents evaluated their management support for open innovation using a Likert scale, with an evaluation range from 1 to 7, with 1 meaning 'strongly disagree' and 7 meaning 'strongly agree.'

Mediators: Two variables were used as mediators to explain how the predictor of interest may influence the dependent variable: 1) level of open innovation education and training offered in the firm and 2) the level of OI open borders in the firm. Both are direct results of management support for open innovation, and hence, they are expected to explain, in part, the relationship between management support of open innovation and open innovation adoption within the firm. Both variables represent survey questions, where respondents responded using a Likert scale ranging from 1 to 7, with 1 meaning 'strongly disagree' and 7 means 'strongly agree.'

Control: The firm's size, in term of number of employees, was used as a control variable to reduce bias in estimates of the relationship between the predictor of interest and dependent variable. Each respondent were asked to classify their firm's size by choosing between four categories: micro, small, medium, large, based on the number of employees. This was considered as large portion of the sample are large firms, so it could be source of potential bias.

Analytical Plan

First, cross tabulation and Chi-Square tests were conducted to understand the variables, the data fitness, and whether the hypothesis have predictive power. Then, three logistic regression models were estimated to understand the relationship between management support and open innovation adoption. The first model focuses on the baseline relationship between the management support for open innovation and its adoption. In the second model, firm's size was added as a control variable, to achieve a less biased estimate of the relationship between the management support for open innovation and its adoption. And in the third model, the mediators were added to determine if they appear to explain the relationship between the predictor of interest and dependent variable, that is, by determining whether the coefficient for management-support-for-open-innovation is reduced from Model 2 to Model 3. All three models will be used to validate hypothesis H1, and the third model will be used to validate hypothesis H2.

Results

Following are the results of the descriptive analysis:

[Insert Table 1 Here]

[Insert Table 2 Here]

As illustrated in Table 1 and Table 2, the Chi-Square test indicates that the predictor of interest, management support for open innovation, as perceived by respondents, correlates to the dependent variable, firm's adoption of open innovation, and the relation is statistically significant ($p < 0.001$).

Logistic Regression Models

Table 3 shows log odds from logistic regression models predicting firm's open innovation status. The baseline logistic regression model revealed that management support for open innovation correlates positively to firm's adoption of open innovation; the odds that a firm is successful in adopting open innovation increases by 40% on average with every one-unit increase in the degree to which the respondent agrees that management supports open innovation, and the relationship is statistically significant ($p < 0.001$) (Table 3, Model 1).

Model 2 includes a control for firm size to improve the estimate of the coefficient for the predictor of interest. The odds of adopting open innovation are 35% lower on average for medium firms than the odds for large firms, but the relationship is not statistically significant ($p = 0.110$). The odds of adopting open innovation are 62% lower on average for small firms than the odds for large firms, and the relationship is statistically significant ($p = 0.001$). Finally, the odds of adopting open innovation are 48% lower on average for micro firms than the odds for large firms, and the relationship is statistically significant ($p = 0.023$). After accounting for potentially spurious factors, management support for open innovation still correlates positively to firm's adoption of open innovation. In fact, the relationship is even stronger in this model. The odds that a firm is successful in adopting open innovation increases by 46% on average (comparing with 40% in model 1) with every one-unit increase in the degree to which respondents' perceive their firm's management supports open innovation—the effect is still statistically significant ($p< 0.001$), net of controls (Table 3, Model 2).

Finally, in Model 3, which includes the mediators, open innovation training and education for employees and OI open borders levels were considered. Logistic regression shows, net of other factors, that the odds of adopting open innovation increase by 29% on average with every one-unit increase in the degree to which respondents perceived their firm offers open innovation training to employees, and the relationship is statistically significant ($p < 0.001$). Furthermore, the odds of adopting open innovation increase by 14% on average with every one-unit increase in the degree to which respondents report their firm maintains open OI borders—this estimated effect is marginally significant ($p = 0.055$). Including these mediators in the model reduced the estimated effect of perceive management support of open innovation on firm's adoption of open innovation, which suggests that open innovation training for employees and OI open borders levels are mediators in the relationship between management support of open innovation and the firm's adoption of open innovation and partially explain it (Table 3, Model3). In other words, open innovation training for employees and OI open border levels appear to explain why management support for open innovation increases the likelihood of the firm adopting open innovation.

[Insert Table 3 Here]

Discussion

The results confirm the hypotheses made earlier in this paper, as well as, what the literature review indicates. The results support the H1 hypothesis: "Employees' perceptions of management support for open innovation will correlate positively with firm adoption of open

innovation." As indicated by the 'Results' sections and Table 3, all three logistic regression models demonstrate a positive correlation between management support for open innovation and successful adoption of open innovation. What the results saying is, survey participants tend to agree that management support for open innovation is correlated with successful adoption of open innovation. Adopting open innovation requires making changes in how work is being carried out internally, and as any type of organizational change, it needs a high authority to remove change barriers, like employees' resistance to change, and any current bureaucracy processes that might hinder or slow the change (Burcharth et al. 2014; Katz and Allen 1982).

Moreover, the results also support H2 hypothesis: "Employees' perceptions of training and education offered to employees and the level of OI open borders within the firm contribute to explaining how management support increases the likelihood the firm adopts open innovation," as can be seen from the third logistic regression model in the 'Results' section and from Table3. So, the results shed light on some of the dynamics of how management support can affect open innovation adoption. The results indicated two ways in which management support can positively affect open innovation adoption: First, when management supports open innovation, they approve more open innovation training and education for employees, which can create better awareness and knowledge on open innovation and its advantages among employees. Hence, employees will have the skills and understanding needed for implementing open innovation. Furthermore, when management offers open innovation training and education to employees, this will indicate to employees that open innovation is important to management, and

hence, employees will be more motivated and more efficient in practicing open innovation, as a way to maintain and advance their career in the firm (Schneckenberg 2014). Management support for open innovation also helps to create an internal environment, where sharing ideas with external entities or asking external entities for help in innovating new ideas and products, will be an acceptable common practice. Making such practices normative is an important factor in changing the mentality of 'not invented here', and therefore achieving open borders (Burcharth 2014). Those effects, education/training and open borders, in turn will result in increased odds of successful adopting open innovation. So, it can be seen that management support for open innovation can be a cascading factor, which will result in removing hurdles preventing firms from moving to the open innovation paradigm. The results also indicate that firms of all sizes need management support to influence and increase the chances of successful adoption of open innovation. It is true that what drive smaller firms to seek out open innovation might differ than larger firms, and that smaller firms don't necessarily have the bureaucracy and silos challenges usually faced by larger firms, however; employees resistance to change and the mentality of "not invented here" would still be an issue regardless of firm's size. So, management support is crucial in driving the change needed and break any barriers to it.

Conclusions

In this paper, firm's internal competences were researched for possible correlation with firm's odds of achieving successful open innovation adoption, with particular focus on the effect of management support on the likelihood of a firm successfully adopting open innovation

and some dynamics of this effect. The research was done by analyzing a dataset representing an open innovation survey that was conducted in Europe in 2014. The survey respondents evaluated their firm's level of open innovation adoption, as well as, the level of management support, open innovation training and education, and OI open borders in their firms, as perceived by them, among other factors related to open innovation. Analyses revealed that the level of management support for open innovation positively relates with open innovation adoption, and open innovation training and OI open borders are possible partial explanations of the dynamics of how management support can positively relate to open innovation adoption.

Study Limitation

As in most quantitative based analysis research, results may be biased by unmeasured factors, factors that influence both the dependent variable and the predictor of interest. This limitation is more evident in this work as the survey's overall objective was to help identify industrial needs related to open innovation education. So open innovation adoption was not the primary goal. Moreover, the survey sample is only 520. Nevertheless, the variables we used in our paper have clear bearing on open innovation adoption and reporting on its analysis has a value, in our opinion, we do believe since there is a lack of data on this topic in general, this study still contributes to the literature despite the limitations of the data it uses. In addition, the fact that the survey only included certain countries in Europe means we cannot claim with full confidence that the results represent a general global rule. Furthermore, the analysis is based on the data representing the status of open innovation adoption and the variables, used in this

paper, in firms as perceived by the respondents, which could be subject to personal subjective judgment and hence not totally accurate. In fact, another paper analysed the same survey data and found that, in some cases, firms and academia have different perceptions of the definition of open innovation (Podmetina 2016).

There are many other variables which need to be studied. This study focus on a number of them.

We also acknowledge that respondent bias is a possibility, however absent better data, this data at least provides a foundation for understanding these processes and provides direction for future research and even future data collection. Future research could re-estimate the models with additional control variables. But it is impossible to account for all potential confounders/alternative-explanations, so this is a criticism levied at any statistical analysis.

These findings may reflect the influence of unmeasured factors. We account for several potential alternative explanations for the seeming relationship between the predictor of interest and the dependent variable by including measures for these factors as control variables in the regression models. Although the measures available in the data limit our ability to account for all potential confounders, these results provide preliminary evidence that predictor of interest relates to dependent variable, suggesting a fruitful point of study for future research once data with a wider set of variables is available.

Implications

Despite the limitations mentioned, the findings of this paper can be used as an indicator of the importance of management support for open innovation and its possible effect on increasing a firm's chances of achieving successful open innovation adoption. So, when a firm decides to adopt open innovation, the team in charge of the adoption process should work with management and make sure that management have proper awareness and buy-in for open innovation adoption, to increase the chances of achieving a successful open innovation adoption. The results also shed light on some of the dynamics of how management support can result in better chances of successful open innovation adoption.

Future Research

Following are suggested future research and follow-up work that might bolster the findings of this paper:

Conducting similar surveys that target other regions of the world, to determine whether the results are generalizable beyond these countries in Europe.

Re-conducting the survey periodically to determine if the results are consistent, and the respondents' perceptions of their firms are reliable.

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Table 1. Descriptive Statistics

	Means	SD	Range
Firm's Open Innovation (OI) Status			
Firm's that has implemented OI	0.32		(0, 1)
Firm's Competencies			
Respondent agrees their firm's (Top) management strongly supports open innovation activities (by allocating enough resources)[a]	4.28	(1.93)	(1, 7)
Respondent agrees their firm provides education and training on open innovation for the employees[a]	3.53	(1.99)	(1, 7)
Respondent agrees their firm has open borders of knowledge flow from outside-in and from inside-out[a]	4.46	(1.92)	(1, 7)
Firm's Size			
Respondent firm's size: Number of employees			
Large >250	0.44		(0, 1)
Medium-sized, 50 - 249	0.19		(0, 1)
Small, 10 - 49	0.19		(0, 1)
Micro, 1- 9	0.18		(0, 1)
Firms (n)	520		

a. Range from 1: 'Strongly disagree' to 7: 'Strongly Agree'.
Note: SD=standard deviations

Table 2. Chi-Square Tests

Predictor of Interest BY Dependent Variable: Cross tabulation				
Count				
		Please evaluate your current open innovation status. Choose one option.		Total
		0. OI is not implemented yet	1. OI is implemented	
Respondent agrees their firm's (Top) management strongly supports open innovation activities (by allocating enough resources)- imputed	1: Strongly Disagree	47	5	52
	2	60	12	72
	3	50	13	63
	4	55	22	77
	5	44	32	76
	6	59	49	108
	7: Strongly Agree	39	33	72
Total		354	166	520

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	42.733[a]	6	.000
Likelihood Ratio	45.700	6	.000
Linear-by-Linear Association	40.561	1	.000
N of Valid Cases	520		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 16.60.			

Table 3: Odds Ratios from Logistic Regression Models Predicting Firm's Open Innovation (OI) Status

	Model 1			Model 2			Model 3		
	Exp(B)		(SE)	Exp(B)		(SE)	Exp(B)		(SE)
Respondent agrees their firm's (Top) management strongly supports open innovation activities (by allocating enough resources)[a]	1.40	***	(0.06)	1.46	***	(0.06)	1.24	**	(0.07)
Respondent firm's size: number of employees									
Large >250 (ref)				-			-		
Medium-sized, 50 - 249				0.65		(0.10)	0.57	*	(0.10)
Small, 10 - 49				0.38	**	(0.30)	0.35	**	(0.30)
Micro, 1- 9				0.52	**	(0.29)	0.45	**	(0.29)
Firm's Internal Competencies									
Respondent agrees their firm provides education and training on open innovation for the employees[a]							1.29	***	(0.60)
Respondent agrees their firm has open borders of knowledge flow from outside-in and from inside-out[a]							1.14	+	(0.66)

a. Range from 1: 'Strongly disagree' to 7: 'Strongly Agree'

+p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Figure 1: Conceptual Model of Firms' Management Support Impact on OI Adoption Status