Participation in Group Companies as a Source of External Knowledge in Obtaining and Making Profitable Radical Innovations

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Abstract: In the context of potential absorptive capacity, the present work analyzes sources of knowledge through the adjustment between the typology of sources and innovative results. Different external sources can condition the later phases of knowledge absorption. In relation to external sources of knowledge, we enrich their treatment by considering other companies in the same group as deeper relationships. In addition, we analyzed the results regarding the generation of radical innovations with impact on income. The results show that company groups can reduce costs in the exchange of technological knowledge, not only to develop radical innovations but also to improve their economic performance. Furthermore, membership in a group allows a company to obtain a greater economic return when combined with assimilation resources.

Keywords: sources of knowledge; participations in firms; potential absorptive capacity; radical innovation; profitability

1. Introduction

In turbulent business environments, the continuous reduction of a product’s life cycle increases the number of competitors based on technological advances and globalization and increases the development of new goods, services or processes, all of which have become key success components within organizations [1].

Innovations that allow the creation of new goods, services or processes or the modernization of existing ones require the use of valuable resources that, in many occasions, need to be acquired through the establishment of relationships with the environment or external knowledge suppliers [2]. The sustainability and superior performance of the process will depend on the ability to manage the absorptive process [3]. In fact, “absorptive capability plays a critical role in business growth and sustainability” [4].

There is an extensive array of scientific papers about the relationship between knowledge absorption and the development of new products [1,3,5]. Based on the source of knowledge approach, different external sources can condition the latest phases in knowledge absorption and, consequently, innovative result can be obtained [6]. Many papers point to knowledge management practices or knowledge domains or contexts as a source of success or failure in obtaining innovations [7–10]. Recent research has also considered the ownership of the company when studying the effect of absorption capacity [11].

However, research will be enriched if sources of knowledge are also considered. It is necessary to deepen the establishment of a framework of relations between types of knowledge and types of innovation.
To fill this gap, the main objective of this article is to support the superiority of particular sources of knowledge for obtaining a certain type of innovation. In our paper, participation in intensive companies within the enterprise group as well as obtaining radical innovations are considered. It is argued that the participation of companies is a more efficient alternative mechanism of government compared to other formulas of external acquisition of knowledge such as market or cooperation which, most of the time, entail a less deep relation. Therefore, the treatment of the absorption capacity is enriched using the approach from the external knowledge search strategies [6,12,13] as a reference. We consider acquisition, which is the first phase of the absorption process, to play an important role regarding the relationships a company has with different agents under different government systems as knowledge sources [14,15].

A subsidiary objective is to allocate resources for the improvement of the innovative result, both with respect to considering its innovative features as well as its impact on the profit and loss statement. Absorptive capacities have a strong influence on firm performance [16]. Nevertheless, the source of knowledge could condition the characteristics of this influence. This would imply a more efficient management strategy, as it would not require an extensive portfolio of knowledge sources but a portfolio adjusted to the desired results.

The present study also represents a new step in the use of a systemic approach. The ownership of a certain source of knowledge may not guarantee a certain result. This entails an advancement with respect to the traditional approach that opts for the accumulation of resources and the balanced development of all phases of the absorption capacity [17]. Therefore, we consider the facilitator role that the assimilation phase plays regarding different levels of depth of the external knowledge sources used and the type of result analyzed.

To carry out this research, we define the following research questions:

1. Do different sources of knowledge facilitate different types of innovation?
2. Does a source of knowledge have a different effect on a type of innovation than on its economic benefit?
3. Do moderate assimilation routines guide the relationship between sources of knowledge and radical innovation?

The empirical research was conducted on a sample of Spanish manufacturing companies from the Technological Innovation Panel (PITEC). The individual results show that all sources of external knowledge of the absorption capacity enable the organization to enhance the creation of radical innovations. Moreover, if the knowledge comes from companies of the same group, the innovations will have a more remarkable impact on the turnover. Doing business in a group implies closer proximity to cognitive structures, which enhance the attainment of yield from the new external knowledge. When the joint effect of the acquisition and assimilation of the knowledge on the economic impact of the innovation is analyzed, the relationship is more complex.

On one hand, we find a positive synergistic effect when the acquisition is carried out through group companies. This is vital to achieve the economic performance of innovations, which require tacit, specific and complex knowledge [18]. On the other hand, the effect is negative when the company accumulates new external knowledge through the market, as they are less complex, specific and easier to assimilate.

After this introduction, the paper presents a description of the concept of absorption capacity, in addition to the model used for empirical contrast. Subsequently, the methodology used is described and lastly, the main results, conclusions and further lines of research are presented.

2. Theoretical Approach and Hypothesis

The ability to recognize the value of new information, assimilate it and use it for commercial purposes [19] improves a company’s collective skills to manage and exploit knowledge and innovation. In this research paper, this capacity is considered as a continuous series of intensive organizational
routines in knowledge. We can define routines as stable patterns of collective behavior that develop distinctive activities through clusters of specific assets so they can respond to diverse stimuli [20].

According to [21] proposal, the capacity of absorption is defined as the sequential set of grouped routines around two factors: the capacity of prospective absorption (PACAP) and realized capacity of absorption (RACAP). This starts with the identification of valuable sources of knowledge and, through different phases, concludes with the exploitation and incorporation of that knowledge into particular business processes.

Both concepts can be considered different as they would require various types of structures, objectives and strategies [5,22].

The prospective capacity of absorption is developed through the dimensions of acquisition and assimilation of external knowledge [23] and allows the organization to reinforce and/or re-orientate their knowledge base. This allows them to identify proactive or generative learning that guarantees the survival of organizations through radical innovations.

Consequently, this paper focuses on the analysis of the prospective aspect of absorption as the set of intensive routines in knowledge that will have a major impact on the generation of radical innovations. In the phase or dimension of acquisition, the most suitable sources of knowledge must be identified so that the most valuable knowledge to obtain an innovation can be selected. Therefore, in this initial phase, the relationships the organization have with many different agents are crucial, as they are considered sources of knowledge beyond their own strict boundaries [14,15]. To achieve this, the organization must have what is called a “porous boundary” with the external environment, to allow the organization to identify and monitor changes in valuable sources of knowledge [24].

In this routine, some organizational background components play an essential role. These include dissemination capacity, reciprocity expectations, resemblance of organizational structures, cognitive, technological and/or geographical proximity or distance, frequency, duration and quality of relations and/or levels of separation in a collaboration network [22,23,25].

Therefore, one must consider both the absorption capacity of the recipient organization and the dissemination capacity of the issuing organization, as both concepts must be analyzed together if the process of knowledge transfer wants to be fully known.

For a better development of the process of assimilation, it is important that the organization creates an adequate level of flexibility, which will enable it to effectively reconfigure its cognitive and resource base. In the prospective absorption capacity, the knowledge flows from the external environment into the inside of the organization, and once there, it must be adapted to a series of actions at different levels, which would transform it to meet the needs of the recipient organization.

The prospective capacity of absorption depends on the employees’ abilities to assimilate the absorbed knowledge. These abilities will depend on the richness of cognitive structures [19], because when a new idea is assimilated, it suffers a slight modification with the purpose of integrating it into the prevailing cognitive structures that are currently present [26]. The success of this adaptation process depends on the level of matureness within the organization at the different phases involved in the absorption of external knowledge.

In this area of research, diverse research papers consider the capacity of absorption as a multi–level and interdisciplinary construct [27] that deserves further research.

Hypothesis

In the first phase of the process of absorption, known as acquisition, it is essential to highlight the importance of the relationships the organization maintains with different actors, by virtue of different government systems that act as knowledge sources [14,15], as well as the specific knowledge base previously accumulated [19].

From the source of knowledge approach, different external sources can condition the process of posterior knowledge absorption through its multiple stages and, consequently, the achieved result [6].
According to this approach, this study deems the amplitude and depth of third parties’ relations [12] as precedents of the effective assimilation and exploitation of knowledge.

Several articles consider wider access to knowledge using multiple sources, [28] although this will increase the complexity of the process [29]. Regarding the study of the depth of these relationships [3,13,24], it depends on the cognitive duration, trust and proximity between organizations. For instance, cognitive proximity is based on the similarity between knowledge bases, technological competences and the markets they supply to, which facilitates the communication and effective exchange between companies and can therefore improve their relationships [30].

In summary, it is assumed that the results would be enhanced if the object of the absorption is linked to what it is already known by the company itself [21,26] and if the features of the source of knowledge are compatible with the ones in the recipient organization [23].

Nevertheless, the need to create radical innovations will lead the organization to search for a cognitive distance with their own knowledge base, even if the process slows down [31], as long as the organization reaches or does not exceed specific levels [24]. Hence, finding the equilibrium in the cognitive factor will turn out to be fundamental to the development of this type of innovation.

Considering the cognitive proximity of the main sources of knowledge, the market would be the most afar one regarding the knowledge bases.

The positive effects of the market formula are outlined in the reduction of risks and costs derived from the development of their own knowledge in this way, overcoming what is called organizational inertia. This is because it breaks the purchasing company rigidities when enhancing their knowledge base [6]. This source is based on the resource that it is obtained from it. However, the scarce specificity of acquired knowledge through the markets makes, at first, this source of knowledge barely appropriate to achieve radical innovations [23,32].

Secondly, as sources of knowledge, those based on relations are sustained in the long-term between agents. The alliances involve a closer cognitive proximity than the market and, consequently, they have become sectors with a high technological component. Therefore, they have become cornerstones of innovation strategies [33], particularly when they take part in a worldwide plan for innovation management [33,34].

In this way, acquisition or access channels to resources and/or complementary valuable knowledge are provided in order to develop the dynamic and complex nature that radical innovations possess. In some cases, under certain circumstances, the period for obtaining these radical innovations could be reduced [6].

Nonetheless, companies cannot always acquire valuable resources or knowledge in the strategic factors market or through cooperation partnerships. They might not exist, competitors can acquire them easily as well and they might not be financially attractive with respect to the associated costs [35] such as small and medium sized enterprises (SMEs) [9,10].

Thus, other routines and sources of knowledge that have not received adequate attention in the context of capacity of absorption are proposed, particularly from an empirical perspective [21,33].

In relation to the issues raised in previous paragraphs, the focus of this paper is to differentiate between two models of alternative routines when accessing new knowledge beyond the strict boundaries of the organization, with particular focus on performance. First, we consider external relationships, if the acquisition of knowledge is made through formulas where the agents maintain a higher level of independence, either with specific market interactions between independent companies or by more stable cooperation agreements. Second, we look at the relations of a quasi-external nature, which is when the acquisition is carried out through other intensive knowledge and technology organizations. The company must have a significant participation in the capital stock of these other organizations.

The dynamic of the capacity of absorption shows the efficacy of significant participation in various intensive knowledge group companies. This option means reaching the maximum level of familiarity with a positive and beneficial effect, a feature that allows organizations to identify valuable resources in external organizational memories [36]. In certain sectors with a higher technological
component, business clusters have formed in order to look for certain diversity in the company’s technological knowledge base in that specific cluster. However, they still share cultural patterns and some organizational routines which help to reach that level of familiarity [8]. In these sectors, participation in technological base companies facilitates the access to precious technological knowledge which allows, these companies achieve greater innovative positioning on the market [37].

When a company does not possess a sufficient level of prior knowledge, it should use more internal sources of knowledge acquisition through inter−organizational relations, rather than acquisition in the market or cooperation between external companies for its accumulation [6]. In this sense, we express a positive relationship between the participation in group companies with a technological base and radical innovations, as they have a greater depth in their interaction with agents, which would ultimately improve the transfer of tacit and complex knowledge [13,18].

Based on the arguments expressed in previous paragraphs of this paper, we establish the first hypothesis of the model as follows:

**Hypothesis (H1a).** Significant participation in group companies with a technological base in the phase of acquisition has a meaningful direct effect on radical innovation.

The capacity of absorption arises as a consequence of the external and internal links which will be mutually affected [38]. Hence, once the organization has externally identified and acquired the knowledge that is considered valuable, the organization could lose the richness derived from that new knowledge if it does not establish routines and internal connections that would allow the company to assimilate it.

In accordance with the description proposed in the assimilation phase, the focus of attention lies on the understanding of external knowledge that has been previously acquired. In this way, the company is able to foster the innovative potential of the organization after its appropriate application [39].

The achievement of a radical innovation requires the employees involved to possess certain cognitive or psychological abilities to implement assimilation practices, such as risk acceptance or experimentation from past experiences [40]. The possession of these cognitive structures and their use under the best conditions requires an analysis from a theoretical framework. This is based on the ability, motivation and opportunity [41,42] that permits both the employee’s individual characteristics and the design of a formal organizational structure in which those individuals can fulfil their duties to agglutinate. In this regard, three particularities are considered when enhancing the cognitive base that allows assimilation of the knowledge from an external source.

Firstly, for a company to assimilate knowledge in the right conditions it must have a sufficient number and an adequate design of job posts for qualified specialized technicians, scientists and engineers matching the specificities and requirements of the operations [40]. The work of [14,43] contributes by providing empirical evidence that supports this argument, which shows a positive effect on the innovative potential of the organization.

The proper design of these job posts will offer the opportunity to develop the tasks of assimilation of external knowledge in optimal conditions [44]. Additionally, over time the human capital behind these job posts will gain experience and eventually, they will become more capable of understanding how knowledge can be used in other contexts [45,46].

Secondly, the role of proper training and qualifications should be highlighted as it has great influence on the capacity of assimilation of new knowledge by human capital. Qualifications or educational level and trainings, both internal and external to organizations, enhance the management of knowledge and improve innovation by training the cognitive resources required [25,47].

Finally, the behavior an employee shows when developing a task will be conditioned by their own cognitive capacity as well as by his/her will to complete it. The psychological and emotional traits influence the degree to which an individual is inclined to complete a task, which means dimension should be considered [48]. In relation to this will and based on the theories of motivation [49],
motivation has been considered a factor that encourages an open attitude towards work and allows individuals to being fully aware [50].

At an organizational level and with the purpose of obtaining the desired innovations, policies, routines and tools must be implemented in order to foster the will to assimilate new knowledge and make it compatible with the competitive mindset and work achievement of the people involved. Certain levels of structures and routines will enable the assimilation and interiorization of knowledge, even when the objective is to develop radical or disruptive innovations [36].

Among these policies, the design and establishment of compensation structures has a prominent role [44,51].

As a result, the compensation system, particularly financial compensation, will be analyzed as a motivation tool in the development of the assimilation process. The amount of money allocated for salaries has an impactful influence at an individual and organizational level, as it conditions both behavior when managing knowledge and organizational results [52], especially those related to innovate performance [34].

To sum up, this paper deems that the design of specific job posts, qualifications and the employee’s compensation system related to innovative activity are crucial for the effective assimilation of knowledge.

For all the components mentioned above, the following hypothesis is related to the capacity of assimilation of the workforce involved in the dimension of assimilation of external knowledge:

**Hypothesis (H2a).** Assimilation routines of the external knowledge moderate the relationship between significant participations in group companies with a technological base and radical innovation.

The innovative process has positive effects on the organization’s income and on the market value these companies will reach. This will foster their own innovative mindset and will help them to pursue routines and activities destined to enhance their innovation and renewal capabilities [53]. Nevertheless, further research is advised as a matter of linking certain resources and capacities related to research and development (R&D) activities for businesses [54].

Significant studies link either directly or through a moderator role the capacity of absorption with financial and/or economic outcome within organizations [55–57]. Nevertheless, some of those studies establish different effects on the results depending on the phase or dimension of the absorption capacity. For example, [55] presented a curvilinear relation between the capacity of absorption and the company’s financial outcomes and positively associated the prospective capacity of absorption with the financial results, stressing the need to empirically deepen the partial effects of its dimensions.

Consequently, taking into consideration the business volume that comes from radical innovations, the last two hypotheses are presented:

**Hypothesis (H1b).** Significant participation in group companies with a technological base in the acquisition phase has a direct, impactful effect on the business volume outcome derived from a radical innovation.

**Hypothesis (H2b).** Assimilation routines of external knowledge regulate the relationship between significant participation in group companies with a technological base and the business volume outcome coming from a radical innovation.

3. Research Methodology

This section describes the main methodological aspects of the empirical research carried out in this paper. First of all, the sources of information used are detailed, as well as the population and the time period in which the data were collected. Subsequently, the measures established for the variables included in the model are presented, detailing the psychometric analysis performed. Finally, the preparation and analysis of the data is addressed, prior to empirical testing of the hypotheses.
The population of study is formed by 12,838 companies from the Technological Innovation Panel (PITEC) -see Spanish National Statistics Institute. This is a free statistical instrument for monitoring the innovation activities of Spanish companies, the result of a joint effort by the Spanish Foundation for Science and Technology (FECYT), the National Institute of Statistics (INE) and the Cotec Foundation, along with the advice of a group of academic experts. This panel has been used in numerous impact studies related to innovative performance in general and to absorption capacity in particular.

The sample chosen to contrast the hypotheses is limited to the organizations that fall under the CNAE−2009 classification, which entail manufacturing companies. Furthermore, the sample was stratified based on the level of technological intensity, according to The Organization for Economic Co-operation and Development (OECD) criteria, which establishes a list of sectors in terms of the level of importance about technology and intensity in R&D. Since the year 2001, a classification from this international organization divides the activities into four levels of technological intensity: high, medium-high, medium-low and low [58]. The total number of companies matching all the variables during the time period of study with valid data amounted to 9612, which equates to 74.9% of all the companies in the PITEC panel.

The measurement of variables was elaborated in accordance with the indicators included in the already mentioned survey. From the analysis of variables included in PITEC and from previous literature reviews, the selected indicators were those that had greater theoretical or content validity [59].

As decisions in the field of knowledge management do not immediately translate into innovative results, we have incorporated a time delay [60]. In doing so, the chosen independent variables refer to the year 2010, while the dependent variables refer to the year 2012.

In the case of the phases of prospective absorption on which the factorial analysis has been conducted, each of the quantitative dimensions were normalized so that they would be homogeneous and the resulting factor(s) would be coherent.

Figure 1 represents the hypotheses of individual and joint relationships of the prospective absorption capacity with radical innovations and its impact on the business volume outcome, which form the full analysis model.

Figure 1. Analysis model.

3.1. Independent Variable Routines of Absorption

Going beyond the one-dimensional vision of the traditional measure of the capacity of absorption (which focuses on the expenditure on R&D [61]), the present paper encompasses its complexity and structures the construct around the main phases that form the prospective absorption capacity in
accordance with other research [21]. To summarize, Table 1 shows measurement indicators of the capacity of absorption and innovative performance.

Table 1. Measurement indicators of the capacity of absorption and innovative performance.

| Independent Variable: Absorption Capacity | Potential Absorption Capacity (PACAP) |
|------------------------------------------|---------------------------------------|
| Acquisition                              | Assimilation                          |
| Scanning, evaluation and incorporation of external knowledge | Analysis and interpretation of external knowledge |

Indicators (PITEC)

Relations of an external nature:
- Market
- Cooperation:
  - Suppliers
  - Clients
  - Competitors
  - Universities and technology centers

Quasi–external relationships of nature:
- Participation in group companies

| Capacitation:                           |
|-----------------------------------------|
| Specialist positions (researchers, technicians and assistants) |
| R&D personnel training (university graduates and doctors)/total staff |
| Monetary remuneration                   |

| Cronbach Alpha Reliability | N.A. |
|---------------------------|------|
| KMO                       | 0.675|
| Bartlett                  | Sig: 0.000 |
| % Accumulated             | 68.81 |

| Cronbach Alpha Reliability | Remuneration | 0.862 |
|---------------------------|--------------|
| Training                  | 0.741 |
| Specialist                | 0.879 |

In relation to the knowledge acquisition phase and in accordance with the three alternative processes explained in the suggested model, the measurement was formulated into three dichotomy variables: (1) acquisition of knowledge, (2) cooperation with independent partners and (3) participation in group companies.

Regarding the phase of knowledge assimilation, it has been included, concerning the total workforce, relative indicators to the experience gained in specialized job posts (researchers, technicians and auxiliary staff), personnel training what is responsible for Research and Development (R&D) tasks (university graduates and PhD), and finally, to the financial compensation that they receive as a motivational factor.

This proposal references previous research which is considered through different indicators. For example, human capital reaches greater empowerment, which will turn into better recipients and platforms of external knowledge, allowing people to become experts when processing it which is necessary for innovation within organizations [14,38,43,45,52].
3.2. Dependent Variable

3.2.1. Radical Innovations in New Products

Innovative performance is also identified with the adoption and exploitation of new ideas and behaviors. Innovation encompasses the creation of new products, services or processes [62]. According to Oslo’s Manual [63], technological innovation happens when a company launches new technology or enhanced products into the market.

For a product to be considered innovative by clients, they must perceive it to provide new practical benefits and must be considered reliable. In this regard, the Survey on Innovation in Companies (PITEC Panel) defines radical innovation as the introduction of new or significantly enhanced products into the market.

3.2.2. Impact of Innovation on Company’s Turnover

One of the most controversial topics found in empirical studies is related to the contribution of innovation to the economic and/or financial outcomes of a company. The issue relies on the difficulty of establishing a direct link between innovation generated and the financial benefits of an organization.

Consequently, along with the study of the influence of the capacity of absorption on the prospective new innovation, we will also include the impact of efforts performed on the routines that form it and on the operating earnings, as it is a field that requires new research [57] due to the existence of contradictory results [55].

With the present study and taking into consideration two types of analysis (individual effects and moderating effects), new empirical data will be obtained in order to improve our insight into the role of the capacity of absorption in the enhancement of the economic and financial results of a company through the impact radical innovation has on them. In this case, the dependent variable will be the impact radical innovations have on the company’s result, as this indicator is available on the PITEC database.

3.2.3. Control Variables

To avoid unnecessary misinterpretations concerning the analysis of the results, three control variables have been included: the size of the company (number of employees), age of the organization (how many years they have been active in the industry) and the sector it belongs to (according to the level of technological intensity).

The size of the organization can affect the innovative process [25], as it is related to its capacity to devote resources when developing new products facing uncertainty [64].

The age of the company alters the context in which the innovation is produced (p. 287, [64]) both in terms of certain competencies and capacities that are improved, as well as obstacles due to the organizational inertias that it causes [33, 64].

The existence of a variety of industries in the sample requires the inclusion of the variable “industry” to control the effects its characteristics might have on innovation [25, 33].

4. Results

4.1. Absorption Routines and Radical Innovations

To contrast the hypotheses related to radical product innovation, which is measured in a dichotomous way, we used the multiple binary logistic regression method. This technique is appropriate because it allows for an explanation of the behavior of a dichotomous categorical or binomial dependent variable (Y) from a set of predictor or independent variables (X), both categorical and quantitative.

First, we jointly analyzed the individual relationships that maintain the different phases of potential absorption capacity.
In terms of the predictor variables, the significant and positive character of both acquisition and assimilation were observed. In this way, we could support the non-denial of hypothesis (H1a), because we observed that the alternative process of access to technological knowledge through companies in the technology-based group increased the probability of obtaining radical innovation by 55% (Exp (B) = 1.57; Table 2).

**Table 2. Potential knowledge absorption routines and the introduction of radical innovations.**

| Outcome variable | Omnibus test coefficients | Nagelkerke square R | % success rate |
|------------------|---------------------------|---------------------|----------------|
|                  | Chi square | gl | Sig. (bilateral) | −2 log of plausibility (deviation) | |
| Radical innovations | 981.371 | 30 | 0.000 | 6.344629 | 20.7% | 74.5% |
| Age (0) | | | | | |
| Age (1) | 0.213 | 0.239 | 0.795 | 1 | 0.373 | 1.238 | 0.774 | 1.978 |
| Age (2) | 0.041 | 0.230 | 0.032 | 1 | 0.859 | 1.042 | 0.664 | 1.635 |
| Sector In Tec (0) | 4.248 | 3 | 0.236 | |
| Sector In Tec (1) | 0.649 | 0.373 | 3.031 | 1 | 0.082 | 1.914 | 0.922 | 3.974 |
| Sector In Tec (2) | −0.190 | 0.580 | 0.107 | 1 | 0.744 | 0.827 | 0.265 | 2.580 |
| Sector In Tec (3) | 0.407 | 0.310 | 1.717 | 1 | 0.190 | 1.502 | 0.817 | 2.760 |
| Size (0) | | | | | |
| Size (1) | 0.294 | 0.181 | 2.644 | 1 | 0.104 | 1.342 | 0.941 | 1.912 |
| Size (2) | 0.392 | 0.185 | 4.485 | 1 | 0.034 | 1.479 | 1.030 | 2.126 |
| Size (3) | 0.208 | 0.214 | 0.949 | 1 | 0.330 | 1.231 | 0.810 | 1.871 |
| Sector In Tec (0) * Age (0) | 10.158 | 6 | 0.118 | |
| Sector In Tec (1) * Age (1) | −0.450 | 0.360 | 1.564 | 1 | 0.211 | 0.638 | 0.315 | 1.291 |
| Sector In Tec (1) * Age (2) | −0.587 | 0.368 | 2.536 | 1 | 0.111 | 0.556 | 0.270 | 1.145 |
| Sector In Tec (2) * Age (1) | −0.818 | 0.506 | 2.616 | 1 | 0.106 | 0.441 | 0.164 | 1.189 |
| Sector In Tec (2) * Age (2) | −0.681 | 0.489 | 1.937 | 1 | 0.164 | 0.506 | 0.194 | 1.320 |
| Sector In Tec (3) * Age (1) | −0.817 | 0.289 | 8.006 | 1 | 0.005 | 0.442 | 0.251 | 0.778 |
| Sector In Tec (3) * Age (2) | −0.614 | 0.279 | 4.834 | 1 | 0.028 | 0.541 | 0.313 | 0.936 |
| Sector In Tec (0) * Size (0) | 6.545 | 9 | 0.684 | |
| Sector In Tec (1) * Size (1) | 0.237 | 0.290 | 0.666 | 1 | 0.415 | 1.267 | 0.717 | 2.240 |
| Sector In Tec (1) * Size (2) | 0.222 | 0.315 | 0.497 | 1 | 0.481 | 1.249 | 0.673 | 2.316 |
| Sector In Tec (1) * Size (3) | −0.234 | 0.402 | 0.338 | 1 | 0.561 | 0.792 | 0.360 | 1.739 |
| Sector In Tec (2) * Size (1) | 0.529 | 0.448 | 1.392 | 1 | 0.238 | 1.696 | 0.705 | 4.082 |
| Sector In Tec (2) * Size (2) | 0.620 | 0.454 | 1.863 | 1 | 0.172 | 1.859 | 0.763 | 4.528 |
| Sector In Tec (2) * Size (3) | 0.531 | 0.465 | 1.304 | 1 | 0.253 | 1.701 | 0.683 | 4.235 |
| Sector In Tec (3) * Size (1) | −0.063 | 0.236 | 0.071 | 1 | 0.790 | 0.939 | 0.592 | 1.490 |
| Sector In Tec (3) * Size (2) | −0.118 | 0.241 | 0.241 | 1 | 0.623 | 0.889 | 0.555 | 1.424 |
| Sector In Tec (3) * Size (3) | 0.014 | 0.266 | 0.003 | 1 | 0.959 | 1.014 | 0.602 | 1.707 |
| Cooperation | 0.610 | 0.064 | 91.193 | 1 | 0.000 | 1.841 | 1.624 | 2.086 |
| Group companies | 0.443 | 0.088 | 25.151 | 1 | 0.000 | 1.557 | 1.310 | 1.851 |
| Purchase | 0.496 | 0.064 | 59.678 | 1 | 0.000 | 1.641 | 1.448 | 1.861 |
| Assimilation | 0.084 | 0.033 | 6.375 | 1 | 0.012 | 1.088 | 1.019 | 1.161 |

* Joint effect of the variables.

Once the joint effects have been incorporated (Table 3), it can be seen that the control variables generally maintain their influence.
### Table 3. Moderating effect of assimilation routines and obtaining radical innovations.

| Outcome variable | Omnibus test coefficients | Model Summary | "-2 log of plausibility" | Nagelkerke square | % success rate |
|------------------|---------------------------|---------------|---------------------------|-------------------|----------------|
| Radical innovations | 992.037 | 41 | 0.000 | 7.333.863 | 22.4% | 74.5% |

| B | Standard error | Wald | gl | Sig. | Exp(B) | 95% CI to EXP(B) |
|---|----------------|------|----|------|--------|------------------|
| Age (0) | 2.645 | 2 | 0.266 | [0.932, 7.847] |
| Age (1) | 0.210 | 0.239 | 0.774 | 1 | 0.379 | [0.572, 2.072] |
| Age (2) | 0.041 | 0.230 | 0.031 | 1 | 0.860 | [0.972, 2.000] |
| Sector In Tec (0) | 4.290 | 3 | 0.232 | [1.292, 14.349] |
| Sector In Tec (1) | 0.652 | 0.573 | 3.061 | 1 | 0.080 | [0.925, 3.985] |
| Sector In Tec (2) | -0.193 | 0.581 | 0.110 | 1 | 0.740 | [0.264, 2.575] |
| Sector In Tec (3) | 0.408 | 0.310 | 1.723 | 1 | 0.189 | [0.818, 2.762] |
| Size (0) | 5.364 | 3 | 0.147 | [1.867, 15.431] |
| Size (1) | 0.296 | 0.181 | 2.683 | 1 | 0.101 | [0.943, 1.915] |
| Size (2) | 0.395 | 0.185 | 4.554 | 1 | 0.033 | [1.033, 2.132] |
| Size (3) | 0.204 | 0.214 | 0.910 | 1 | 0.340 | [0.806, 1.867] |

However, it can be seen that certain predictor variables change their role. Thus, the positive effect of assimilation disappears, maintaining the potential value of the acquisition routines, otherwise known as what the organization maintains with the external world. However, it is not observed in this model **
that the joint analysis of the phases that form the potential absorption capacity significantly influence the introduction of radical innovations. Therefore, the H2a hypothesis has to be denied.

4.2. Absorption Routines and the Economic Impact of Radical Innovations

Along with the effect of potential takeover routines on obtaining radical innovations, it also addresses whether the innovations generated have a significant impact on the company’s turnover. In other words, if they are innovations that really meet the needs of the market. For this purpose, the impact that radical innovations have on the company’s turnover is taken as a dependent variable. Given the quantitative nature of the dependent variable, in this case multiple linear regression models are used. Before conducting the tests, we submit the data to the necessary tests to apply this statistical technique. The models finally incorporated met the criteria regarding performance of the waste and the relationships between the independent variables, as well as between these and the dependent variable. The analysis of the residues includes the tests of independence, normality and homoscedasticity. The relationships between the independent variables are analyzed through tests that evaluate the possible multicollinearity among them, and for the relationships between independent variables and the dependent variable it is controlled through the linearity tests (Correlation matrix in Table A1).

The individual effect of each of the absorption routines is included below, once the effects of the control variables are included.

As shown in Table 4, the economic impact of radical innovations depends significantly of the acquisition of specific knowledge, accumulated through relationships with other technology-based companies belonging to the same business group. In such a way that, unlike what occurred in the case of the mere creation of radical innovations, it happens to be the only source of external knowledge that allows the innovation obtained to be reflected on the profit and loss statement of the organization. This result is of great interest when it comes to making an efficient investment of resources if the company wishes to obtain an economic return on its innovation. In this way, we could support the non-denial of the H1b hypothesis and, in this case, in a particular way for this source of knowledge compared to the rest of the alternatives studied: markets and cooperation agreements.

| Table 4. Potential knowledge absorption routines and the impact of radical innovations. |
|-----------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| **MODEL SUMMARY**                      |                 |                 |                 |                 |                 |                 |
| Outcome variable                       | F               | gl              | Sig. (bilateral)| Durbin–Watson   | R square        | Adjusted R—square |
| Impact radical innovations             | 71.556          | 12              | 0.000           | 1.925           | 16.8%           | 16.7%           |
|                                        |                 |                 |                 |                 |                 |                 |
| Beta (standard)                        |                 |                 |                 |                 | Statistics of co-linearity |
| Constant                               | 1.262           |                 | 0.207           |                 |                 |
| Age                                    | –0.026          | –1.363          | 0.173           | 0.348           | 2.874           |
| Sector                                 | –0.074          | –2.219          | 0.027           | 0.113           | 8.819           |
| Size                                   | 0.017           | 0.850           | 0.395           | 0.302           | 3.307           |
| Age * Sector                           | 0.071           | 2.063           | 0.039           | 0.108           | 9.280           |
| Size * Sector                          | 0.059           | 2.084           | 0.037           | 0.159           | 6.306           |
| Cooperation                            | –0.019          | –1.602          | 0.109           | 0.874           | 1.144           |
| Group companies                        | 0.070           | 5.646           | 0.000           | 0.832           | 1.201           |
| Purchase                               | 0.018           | 1.433           | 0.152           | 0.834           | 1.198           |
| Assimilation                           | 0.117           | 9.675           | 0.000           | 0.867           | 1.153           |

* Joint effect of the variables.

It is observed that the economic impact of radical innovations depends significantly on the synergetic effects caused by the assimilation of knowledge when it is developed through relations with
group companies and the purchase of knowledge, although in this second case the effect is negative (Table 5). This is possibly because the company assumes significant opportunity costs by striving for assimilation routines that are not necessary when the accumulation process of knowledge has been achieved through markets and the technology is therefore more transparent and easily assimilated.

**Table 5.** Moderating effect of assimilation routines and the impact of radical innovations.

| Outcome variable                  | Model Summary                                                                 |  |
|-----------------------------------|-------------------------------------------------------------------------------|---|
|                                   | F | gl | Sig. (bilateral) | Durbin–Watson | R square | Adjusted R-square |  |
| Impact radical innovations        | 71.556 | 23 | 0.000 | 1.931 | 25.4% | 25.2% |  |
| **Beta (standard)**               | **T** | **Sig.** | **Statistics of co-linearity** |  |
| Constant                          | 0.391 | 0.695 |  |  |  |  |  |
| Age                               | −0.026 | −1.474 | 0.141 | 0.348 | 2.875 |  |  |
| Sector                            | −0.065 | −2.104 | 0.035 | 0.113 | 8.834 |  |  |
| Size                              | 0.044 | 2.277 | 0.023 | 0.298 | 3.356 |  |  |
| Age * Sector                      | 0.066 | 2.083 | 0.037 | 0.108 | 9.287 |  |  |
| Size * Sector                     | 0.047 | 1.795 | 0.073 | 0.158 | 6.330 |  |  |
| Cooperation                       | 0.004 | 0.341 | 0.733 | 0.863 | 1.159 |  |  |
| Group companies                   | 0.035 | 2.982 | 0.003 | 0.786 | 1.272 |  |  |
| Purchase                          | 0.059 | 4.316 | 0.000 | 0.588 | 1.700 |  |  |
| Assimilation                      | 0.078 | 3.619 | 0.000 | 0.236 | 4.230 |  |  |
| PACAP1 (coop * assimilation)      | −0.022 | −0.874 | 0.382 |  |  |  |  |
| PACAP2 (group * assimilation)     | 0.224 | 14.430 | 0.000 |  |  |  |  |
| PACAP3 (purchase * assimilation)  | −0.128 | −6.990 | 0.000 |  |  |  |  |

* Joint effect of the variables.

Finally, we include Figure 2, which represents the direct results of the different sources of knowledge about radical innovation, as well as the joint effect of the assimilation routines with the sources of knowledge when it comes to obtaining profitability from radical innovation.

![Figure 2. Direct results and joint effects of acquisition and assimilation variables.](image-url)
5. Discussion and Conclusions

In this paper we focused our attention on knowledge that comes from outside the organizational boundaries, since turning to external sources of knowledge has become a necessity as a consequence of the high level of dynamism and complexity of most industries. In this context, it makes sense to analyze the routines that form the potential absorption capacity and its effect on the innovative strength of the company. In this way, the present study proposes to take a step forward in understanding the knowledge management processes. Considering the limited resources available to a company, it is essential to optimize them when looking for external sources of knowledge. The greatest emphasis has been placed on the source of knowledge that has received the least attention theoretically and empirically in the context of absorption capacity, which is participation in technology-based companies and the systemic effect this has on other absorption phases.

5.1. Theoretical Contribution

This starting point has guided the design of our analysis model, so that we have presented a proposal for the multidimensional measurement of the potential absorption capacity construct (PACAP), as well as a detailed analysis of each of its routines or phases. Therefore, we have dealt with the individual and joint effects that they have on obtaining radical innovations and their impact on the business turnover of companies in the Spanish manufacturing sector. The intention was not only to understand the potential of the company to generate innovations, but to also understand its ability to develop those that the market needs.

In this way, the different alternatives for accessing external knowledge have a significant influence on the design of efficient routines in the remaining absorption phases. Therefore, the finalist perspective of the traditional model is abandoned, and a systemic perspective is adopted where the absorption processes are interrelated.

According to the results of this research, traditional theoretical models are insufficient to achieve a complete development framework. This would not be a complete break with these reference models [19,21,26], which have allowed the conceptual and practical development of the absorption construct in initial stages.

5.2. Practical Contribution

The sources of external knowledge are varied, as the type of partners with which the organization interacts with to develop innovative activities increases. These partners include suppliers, distributors, consultants, clients, governments, group companies, competitors, research institutions, universities and more. However, some studies have obtained evidence that conditions the result of these relationships to the type of agreement, partner and innovations sought [33].

Based on the results of this paper, general guidelines for action can be established on a practical level. Companies should establish more efficient sources and routines within the absorption capacity considering the innovative result. Even if a source of knowledge generates a certain innovation (in our study all sources generated radical innovation), it does not have to translate into a positive economic impact. Group companies can reduce transaction costs in the exchange of technological knowledge compared to other market options or traditional cooperation, to develop radical innovations and improve their economic performance from technological developments. This result is consistent with previous studies that have concluded that the acquisition of technology-intensive firms leads to more efficient knowledge acquisition for improved innovative performance [64].

In addition, having significant participations in technology-intensive firms allow the firm to obtain a higher economic return from radical innovations when combined with complementary resources dedicated to the assimilation of knowledge. The development of these routines probably has an important weight in the improvements of products with a high level of novelty, since the external knowledge required is less known for the organization and consequently the assimilation effort will
be greater. However, it is necessary to have a corporate culture shared among the group companies. The cultural distance between organizations can obstruct innovation strategies.

Our work has provided new empirical evidence, not only on what type of knowledge source is more interesting, but also on how to complement it with other assimilation routines in order to develop and obtain radical innovations that are widely accepted by the market.

We are talking about an evolution in its practical application, with a new perspective that shifts the attention from the establishment of a balance into the development of all the dimensions, to the result to be achieved when deciding which design should be applied. From this starting point, it will be decided which dimensions should be developed, and the routines and activities that will be carried out in each of them according to the resources available to the organization and the characteristics of its competitive environment.

5.3. Limitations and Directions of Future Research

As with any research study, this paper presents certain limitations that we proceed to develop. The limitations relate mainly to some aspects of its methodological design, in particular the use of secondary information sources to measure a very complex organizational phenomenon, as well as the limited time horizon of the analysis. Although it is a database widely used by researchers in their studies about innovation, the lack of some variables more focused on aspects of the internal functioning of the different phases or dimensions of the absorption capacity has not made it possible to refute certain theoretical aspects.

For the future, it is also worth noting the incorporation of measures on certain qualitative aspects of the routines of the successive dimensions. For example, in the acquisition phase, this would include incorporating variables related to the purchase process, the characteristics of cooperation agreements or the companies that have invested capital in other companies, as well as the cognitive distance between the issuer and the recipient.

We also consider it interesting to include in the assimilation capacity the need to fit the reward systems, either with the economic situation at a macro level or with the companies’ perspectives to remain competitive. In this line, we also consider including assimilation processes at a group level such as working groups or communication systems.

Further study of other routines or procedures related to production is also required, such as digitization of processes, smart manufacturing and inter-company connectivity [9]. In this way, it will be possible to complete the study of the relationship between the sources of knowledge and their impact on the economic result.

Furthermore, replicating the study with primary information that allows for exploring into the behavior of the company and with companies from other contexts (geographical and industrial) are proposed as priority lines of research.

Regarding the dependent variables, in future studies it would be interesting to complement the formal methods used (product innovations and economic performance) with informal methods such as obtaining advantages from being the first mover, by controlling a technology or a product in the market or by reducing production times [65].

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**Appendix A**

**Table A1.** Correlation matrix.

|     | Correlation |     |     |     |     |     |     |     |     |
|-----|-------------|-----|-----|-----|-----|-----|-----|-----|-----|
|     | 1           |     |     |     |     |     |     |     |     |
|     | Sig. (bilateral) |     |     |     |     |     |     |     |     |
| Size | Correlation | 1   |     |     |     |     |     |     |     |
|     | Sig. (bilateral) | 0.000 |     |     |     |     |     |     |     |
|     | N | 9612 |     |     |     |     |     |     |     |
| Age | Correlation | 0.237 ** |     |     |     |     |     |     |     |
|     | Sig. (bilateral) | 0.000 |     |     |     |     |     |     |     |
|     | N | 9612 | 9612 |     |     |     |     |     |     |
| Sector | Correlation | 0.063 ** | −0.080 ** |     |     |     |     |     |     |
|     | Sig. (bilateral) | 0.000 | 0.000 |     |     |     |     |     |     |
|     | N | 9612 | 9612 | 9612 |     |     |     |     |     |
| Purchase | Correlation | 0.122 ** | −0.010 | −0.050 ** |     |     |     |     |     |
|     | Sig. (bilateral) | 0.000 | 0.317 | 0.000 |     |     |     |     |     |
|     | N | 9612 | 9612 | 9612 | 9612 |     |     |     |     |
| Cooper | Correlation | 0.104 ** | −0.080 ** | 0.060 ** | 0.357 ** |     |     |     |     |
|     | Sig. (bilateral) | 0.000 | 0.000 | 0.000 | 0.000 |     |     |     |     |
|     | N | 9612 | 9612 | 9612 | 9612 | 9612 |     |     |     |
| Group | Correlation | 0.221 | 0.014 | −0.031 ** | 0.252 ** | 0.294 |     |     |     |
|     | Sig. (bilateral) | 0.000 | 0.166 | 0.002 | 0.000 | 0.000 |     |     |     |
|     | N | 9612 | 9612 | 9612 | 9612 | 9612 | 9612 |     |     |
| Assimilation | Correlation | 0.144 | −0.0312 | 0.020 | 0.151 ** | 0.153 ** | 0.148 ** |     |     |
|     | Sig. (bilateral) | 0.000 | 0.244 | 0.056 | 0.000 | 0.000 | 0.000 |     |     |
|     | N | 9612 | 9612 | 9612 | 9612 | 9612 | 9612 | 9612 |     |
| In, Radical | Correlation | 0.099 | −0.027 | −0.084 | 0.277 | 0.222 | 0.257 | 0.152 |     |
|     | Sig. (bilateral) | 0.000 | 0.007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|     | N | 9612 | 9612 | 9612 | 9612 | 9612 | 9612 | 9612 | 9612 |
| Impact In, Radical | Correlation | 0.142 | 0.034 | −0.145 | 0.262 | 0.153 | 0.256 | 0.106 | 0.054 ** |
|     | Sig. (bilateral) | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|     | N | 9612 | 9612 | 9612 | 9612 | 9612 | 9612 | 9612 | 9612 |

**References**

1. Chen, J.; Reilly, R.R.; Lynn, G.S. New Product Development Speed: Too Much of a Good Thing? *J. Prod. Innov. Manag.* 2012, 29, 288–303. [CrossRef]
2. Chen, H.H.; Qiao, S.; Lee, A.H. The impacts of different R&D organizational structures on performance of firms: Perspective of absorptive capacity. *J. High Technol. Manag. Res.* 2014, 25, 83–95. [CrossRef]
3. Kim, C.Y.; Lim, M.S.; Yoo, J.W. Ambidexterity in External Knowledge Search Strategies and Innovation Performance: Mediating Role of Balanced Innovation and Moderating Role of Absorptive Capacity. *Sustainability* 2019, 11, 5111. [CrossRef]
4. Xue, M.; Boadu, F.; Xie, Y. The Penetration of Green Innovation on Firm Performance: Effects of Absorptive Capacity and Managerial Environmental Concern. *Sustainability* 2019, 11, 2455. [CrossRef]
5. Cepeda-Carrion, G.; Cegarra-Navarro, J.G.; Jimenez-Jimenez, D. The Effect of Absorptive Capacity on Innovativeness: Context and Information Systems Capability as Catalysts. *Br. J. Manag.* 2012, 23, 110–129. [CrossRef]
6. Lin, B.W.; Wu, C.H. How does knowledge depth moderate the performance of internal and external knowledge sourcing strategies? *Technovation* 2010, 30, 582–589. [CrossRef]
7. Mardani, A.; Nikoosokhan, S.; Moradi, M.; Doustar, M. The Relationship between Knowledge Management and Innovation Performance. *J. High Technol. Manag. Res.* 2018, 29, 12–26. [CrossRef]
8. Limaj, E.; Bernroider, E.W. The roles of absorptive capacity and cultural balance for exploratory and exploitative innovation in SMEs. *J. Bus. Res.* 2019, 94, 137–153. [CrossRef]
9. Müller, J.M.; Buliga, O.; Voigt, K.I. Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. *Technol. Forecast. Soc. Chang.* 2018, 132, 2–17. [CrossRef]
10. Müller, J.M.; Buliga, O.; Voigt, K.I. The role of absorptive capacity and innovation strategy in the design of industry 4.0 business Models-A comparison between SMEs and large enterprises. *Eur. Manag. J.* 2020. [CrossRef]
11. Kotlar, J.; De Massis, A.; Frattini, F.; Kammerlander, N. Motivation Gaps and Implementation Traps: The Paradoxical and Time-Varying Effects of Family Ownership on Firm Absorptive Capacity. *J. Prod. Innov. Manag.* 2020, 37, 2–25. [CrossRef]
12. Laursen, K.; Salter, A. Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strateg. Manag. J.* 2006, 27, 131–150. [CrossRef]
13. Ferreras-Méndez, J.L.; Fernández-Mesa, A.; Alegre, J. The relationship between knowledge searchstrategies and absorptive capacity: A deeper look. *Technovation* 2016, 54, 48–61. [CrossRef]
14. Caloghirou, Y.; Kastelli, I.; Tsakanikas, A. Internal capabilities and external knowledge sources: Complements or substitutes for innovative performance? *Technovation* 2004, 24, 29–39. [CrossRef]
15. Hohberger, J.; Almeida, P.; Parada, P. The direction of firm innovation: The contrasting roles of strategic alliances and individual scientific collaborations. *Res. Policy* 2015, 44, 1473–1487. [CrossRef]
16. Jiménez-Barrionuevo, M.M.; Molina, L.M.; García-Morales, V.J. Combined Influence of Absorptive Capacity and Corporate Entrepreneurship on Performance. *Sustainability* 2019, 11, 3034. [CrossRef]
17. Chu, C.P.; Li, C.; Lin, C.J. The joint effect of project-level exploratory and exploitative learning in new product development. *Eur. J. Mark.* 2011, 45, 531–550. [CrossRef]
18. Chen, J.; Chen, Y.; Vanhaverbeke, W. The Influence of Scope, Depth, and Orientation of External Technology Sources on the Innovative Performance of Chinese Firms. *Technovation* 2011, 31, 362–373. [CrossRef]
19. Cohen, W.M.; Levinthal, D.A. Absorptive Capacity: A New Perspective on Learning and Innovation. *Adm. Sci. Q.* 1990, 35, 128–152. [CrossRef]
20. Nelson, R.R.; Winter, S.G. *An Evolutionary Theory of Economic Change*; Belknap Press/Harvard University Press: Cambridge, UK, 1982.
21. Zahra, S.A.; George, G. Absorptive capacity: A review, reconceptualization, and extension. *Acad. Manag. Rev.* 2002, 27, 185–203. [CrossRef]
22. Schildt, H.; Keil, T.; Maula, M. The temporal effects of relative and firm-level absorptive capacity on interorganizational learning. *Strateg. Manag. J.* 2012, 33, 1154–1173. [CrossRef]
23. Lane, P.J.; Lubatkin, M. Relative absorptive capacity and interorganizational learning. *Strateg. Manag. J.* 1998, 19, 461–477. [CrossRef]
24. Enkel, E.; Heil, S. Preparing for distant collaboration: Antecedents to potential absorptive capacity in cross-industry innovation. *Technovation* 2014, 34, 242–260. [CrossRef]
25. Becheikh, N.; Landry, R.; Amara, N. Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993–2003. *Technovation* 2006, 26, 644–664. [CrossRef]
26. Todorova, G.; Durisin, B. Absorptive capacity: Valuing a reconceptualization. *Acad. Manag. Rev.* 2007, 32, 774–786. [CrossRef]
27. Van den Bosch, F.A.J.; Van Wijk, R.; Volberda, H. Absorptive Capacity: Antecedents, Models and Outcomes. In *Blackwell Handbook of Organizational Learning and Knowledge Management*; Easterby-Smith, M., Lyles, M.A., Eds.; Malden-Blackwell Publishing: Oxford, UK, 2003; pp. 278–301.
28. Laursen, K.; Salter, A. The paradox of openness: Appropriability, external search and collaboration. *Res. Policy* 2014, 43, 867–878. [CrossRef]
29. Martínez, M.G.; Zouaghi, F.; García-Marco, T. Diversity is strategy: The effect of R&D team diversity on innovative performance. *R&D Manag.* 2017, 47, 311–329. [CrossRef]
30. De Jong, J.P.; Freel, M.S. Absorptive capacity and the reach of collaboration in high technology small firms. *Res. Policy* 2010, 39, 47–54. [CrossRef]
31. Hautala, J.; Jauhiainen, J.S. Spatio-temporal processes of knowledge creation. *Res. Policy* 2014, 43, 655–668. [CrossRef]
32. Zobel, A.K.; Lokshin, B.; Hagedoorn, J. Formal and informal appropriation mechanisms: The role of openness and innovativeness. *Technovation* 2017, 59, 44–54. [CrossRef]
33. George, G.; Zahra, S.; Wheatley, K.K.; Khan, R. The effects of alliance portfolio characteristics and absorptive capacity on performance: A study of biotechnology firms. *J. High Technol. Manag. Res.* 2001, 12, 205–226. [CrossRef]
34. Stringer, R. How to Manage Radical Innovation. *Calif. Manag. Rev.* 2000, 42, 70–88. [CrossRef]
35. Ritala, P.; Olander, H.; Michailova, S.; Husted, K. Knowledge sharing, knowledge leaking and relative innovation performance: An empirical study. *Technovation* **2015**, *35*, 22–31. [CrossRef]

36. Zheng, Y.; Yang, H. Does Familiarity Foster Innovation? The Impact of Alliance Partner Repeatedness on Breakthrough Innovations. *J. Manag. Stud.* **2015**, *52*, 213–230. [CrossRef]

37. Camión-Haba, S.; Clemente-Almendros, J.A.; González-Cruz, T. How technology-based firms become also highly innovative firms? The role of knowledge, technological and managerial capabilities, and entrepreneurs’ background. *J. Innov. Knowl.* **2019**, *4*, 162–170. [CrossRef]

38. Ebers, M.; Maurer, I. Connections count: How relational embeddedness and relational empowerment foster absorptive capacity. *Res. Policy* **2014**, *43*, 318–332. [CrossRef]

39. Lewin, A.Y.; Massini, S.; Peeters, C. Microfoundations of Internal and External Absorptive Capacity Routines. *Organ. Sci.* **2011**, *22*, 81–98. [CrossRef]

40. Agarwal, R.; Shah, S.K. Knowledge sources of entrepreneurship: Firm formation by academic, user and employee innovators. *Res. Policy* **2014**, *43*, 1109–1133. [CrossRef]

41. Blumberg, M.; Pringle, G. The missing opportunity in organizational research: Some implications for a theory of work performance. *Acad. Manag. Rev.* **1982**, *7*, 560–569. [CrossRef]

42. Chang, Y.Y.; Gong, Y.; Peng, M.W. Expatriate Knowledge Transfer, Subsidiary Absorptive Capacity, and Subsidiary Performance. *Acad. Manag. J.* **2012**, *55*, 927–948. [CrossRef]

43. Arbussà, A.; Coenders, G. Innovation activities, use of appropriation instruments and absorptive capacity: Evidence from Spanish firms. *Res. Policy* **2007**, *36*, 1545–1558. [CrossRef]

44. Cabrera, E.F.; Cabrera, A. Fostering knowledge sharing through people management practices. *Int. J. Hum. Resour. Manag.* **2005**, *16*, 720–735. [CrossRef]

45. Foss, N.J.; Minbaeva, D.B.; Pedersen, T.; Reinholt, M. Encouraging knowledge sharing among employees: How job design matters. *Hum. Resour. Manag.* **2009**, *48*, 871–893. [CrossRef]

46. Herstad, S.J.; Sandven, T.; Ebersberger, B. Recruitment, knowledge integration and modes of innovation. *Res. Policy* **2015**, *44*, 138–153. [CrossRef]

47. Aragón, M.I.B.; Jimenez-Jimenez, D.; Valle, R.S. Training and performance: The mediating role of organizational learning. *BRQ Bus. Res. Q.* **2014**, *17*, 161–173. [CrossRef]

48. Robbins, S.P.; DeCenzo, D.A. *Fundamentals of Management: Essential Concepts and Applications* 7th ed.; Pearson Prentice Hall: Upper Saddle River, NJ, USA, 2008.

49. Steward, G.; Osei-Beyson, K.M. Exploration of factors that impact voluntary contribution to electronic knowledge repositories in organizational settings. *Knowl. Manag. Res. Pract.* **2013**, *11*, 288–312. [CrossRef]

50. Seward, G.; Osei-Beyson, K.M. Exploration of factors that impact voluntary contribution to electronic knowledge repositories in organizational settings. *Knowl. Manag. Res. Pract.* **2013**, *11*, 288–312. [CrossRef]

51. Lauring, J.; Selmer, J. Diversity attitudes and group knowledge processing in multicultural organizations. *Eur. Manag. J.* **2013**, *31*, 124–136. [CrossRef]

52. Barnes, C.M.; Reb, J.; Ang, D. More than just the mean: Moving to a dynamic view of performance-based compensation. *J. Appl. Psychol.* **2014**, *97*, 711–718. [CrossRef]

53. Blazsek, S.; Escribano, A. Patent propensity, R&D and market competition: Dynamic spillovers of innovation leaders and followers. *J. Econ. Policy* **2014**, *191*, 145–163. [CrossRef]

54. Damanpour, F.; Aravind, D. Managerial Innovation: Conceptions, Processes and Antecedents. *Manag. Organ. Rev.* **2011**, *8*, 423–454. [CrossRef]

55. Brettel, M.; Greve, G.I.; Flatten, T.C. Giving up linearity: Absorptive capacity and performance. *J. Manag. Issues* **2011**, *23*, 164–189.

56. Flatten, T.; Engelen, A.; Zahra, S.A.; Brettel, M. A measure of absorptive capacity: Scale development and validation. *Eur. Manag. J.* **2011**, *29*, 98–116. [CrossRef]

57. Herath, H.M.; Mahmood, R. Strategic Orientations and SME Performance: Moderating Effect of Absorptive Capacity of the Firm. *Asian Soc. Sci.* **2014**, *10*, 95–107. [CrossRef]

58. Martínez Álvarez, J.A.; García Martos, D.; Manjón Vilela, S. *La Política Industrial Encaminada Hacia un Mercado Más Moderno y Competitivo*. Papeles de Trabajo, 6/214, 31–36; Ministerio de Hacienda y Administraciones Públicas, Instituto de Estudios Fiscales: Madrid, Spain, 2014.

59. Cronbach, L.J.; Meehl, P.E. Construct validity in psychological tests. *Psychol. Bull.* **1955**, *52*, 218–302. [CrossRef]

60. Archibugi, D.; Filippetti, A.; Frenz, M. Economic crisis and innovation: Is destruction prevailing over accumulation? *Res. Policy* **2013**, *42*, 303–314. [CrossRef]
61. Weigelt, C.; Sarkar, M. Performance implications of outsourcing for technological innovations: Managing the efficiency and adaptability trade-off. *Strateg. Manag. J.* **2012**, *33*, 189–216. [CrossRef]

62. Chiang, Y.H.; Shih, H.A.; Hsu, C.C. High commitment work system, transactive memory system, and new product performance. *J. Bus. Res.* **2014**, *67*, 631–640. [CrossRef]

63. OECD. *Manual de Oslo. Directrices para la Recogida e Interpretación de Información Relativa a Innovación*, 3rd ed.; Dirección General de Universidades e Investigación: Madrid, Spain, 2005.

64. Lin, C.; Wu, Y.J.; Chang, C.; Wang, W.; Lee, C.Y. The alliance innovation performance of R&D alliances—the absorptive capacity perspective. *Technovation* **2012**, *32*, 282–292. [CrossRef]

65. Huizingh, E. Open innovation: State of the art and future perspectives. *Technovation* **2011**, *31*, 2–9. [CrossRef]

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