Available online at https://www.asjp.cerist.dz/en/PresentationRevue/85

Economic Researcher Review

ISSN: 2335-1748, EISSN: 2588-235X VOL 09,N^{O} 01. (2021), PP 119-131

The Knowledge collaboration and success firm's innovation: study of French Innovation and R&D's surveys

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Received: *07 /29/2020 ;* ***Accepted:*** *01 / 11 /2021 ;* ***Published:*** *06 / 30 /2021*

Abstract :

This study links knowledge collaboration with innovation, and ways of obtaining the necessary knowledge that affect the innovation. Considering the process innovation as the result of R&D, we aim to highlight the determinants of knowledge structures that affect innovative and cognitive capabilities.

The evolution of cooperative activities shows the desired goal and the capabilities that can be result from this cooperation, especially the result of interaction of the internal and external firms' knowledge. This result may be embodied through research efforts to innovations and patents that represents an aspect of institutional protection. The development of innovative is mainly based on the ability of firms to value its knowledge capabilities linked with the development of the innovative capabilities.

Keywords: *Innovation, R&D, innovative capabilities, knowledge collaboration.*

Jel Classification Codes : *O32, O33, M13, L25*

الملخص :

تهتم هذه الدراسة بربط التعاون المعرفي بالابتكار في المؤسسات، وطرق الحصول على المعارف اللازمة والضرورية في التأثير بشكل أو بآخر على الابتكار. وباعتبار العملية الابتكار ثمرة البحث والتطوير، نهدف إلى تسليط الضوء على محددات بنى معرفية التي تؤثر على القدرات الابتكارية والمعرفية.

فمعرفة التطور الحاصل في كثافة الأنشطة التعاونية بأنواعها يبين الهدف المرجو والقدرات التي يمكن أن تنجم عن هذا التعاون، لا سيما التفاعل بين حصيلة معارف المؤسسة الداخلية والخارجية والتي تم تجسيدها من خلال الجهود البحثية إلى ابتكارات. أين يمثل تجسيد أنشطة البحث والتطوير إلى براءات اختراع، وجها من أوجه حماية المؤسسات لجهودها. كما أن تطور المؤسسات المبتكرة يرتكز أساسا على قدرتها على تثمين قدراتها المعرفية وربطها بتطوير قدراتها الابتكارية.

الكلمات المفتاح: *الابتكار، البحث والتطوير، القدرات الابتكارية، التعاون المعرفي.*

تصنيف JEL: L25, M13, O33, O32

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1. Introduction.

There is clearly a consensus on the importance of knowledge in competitive dynamics and in the economy. Although a knowledge-based view is not a new theory for the firms, a knowledge-based view is a model basis that reflects the impact of knowledge accumulation on the firm. However, with existing foundations, Kaplan et al. proposed an integrated knowledge-based presentation as well as a set of indicators to assess the contribution of knowledge to improving performance. Therefore, with realizing the importance of "knowledge" resources in the activities of firms, it is necessary to take into consideration the dimension of the creation of resources and also that of the allocation of resources (Kaplan, S. al., 2001).

The knowledge base-view presents the foundation for maximizing the value of knowledge that the firms have built over time. For that, the firms aim to develop and enhance their performance capabilities, and direct knowledge creation activities, by managing the interactions through which knowledge is developed within the organization.

1. 1. Problematic

The most important ways that can be adopted to reach this goal lies in developing firms' capabilities to innovate and cooperate with the environment. In this fact, the firms make efforts to acquire knowledge and skills that are necessary to improve their performance. In addition, the firms are working to materialize this combination into innovative activities.

Through the above, we can ask the problematic of study as follow

How can the firms develop the knowledge collaboration to make a success in its innovative process?

In order to define the parameters of the previous problem, it is important to guide this reflection on the following questions:

- What is the role of research and development activities in knowledge cooperation?
- How knowledge cooperation between industries can affect cognitive exploitation?
- What is the links of cognitive agglomerations with the difference in the firms' performance?

1. 2. Hypothesis

In our research, we put the hypothesis of the work as follow:

- The internal research and development activities are a tool to build and value the firms' knowledge and innovative capabilities.
- The intensity of collaborative activities related to research and development activities can show the relationship it has with the knowledge contributing to the development of innovative capabilities.
- Embodies research and development activities into patents, which are an aspect of protecting enterprise efforts.

1. 3. Importance of the study

The importance of the study appears in showing how to enhance the capabilities of firms to transform their knowledge into realisations that enable to differentiate its from the rivals. Also, the study try to know the harmonic relationship between the ability to innovate and cooperate with the environment to gain knowledge and skills in order to improve its performance.

In general, the firms embody its research and development activities into patents. For that, it is important to study the evolution of the number of patents in order to know the direction taken by firms with regard to research and development activities, and to know the extent of success in their innovative activities

2. From knowledge to the innovation

The development of professional societies has often a strategic nature, as the firm helps to promote, create and transfer knowledge. The process of incorporating this knowledge into basic

activities is often neglected. The knowledge's created value will decrease relatively when it is not used to improve the efficiency of professional operations. The image of the firm as a knowledge healer is based on its importance. For that, the firm should not lead to neglect the creation of knowledge, but it should also make efforts to avoid the failure to convert this knowledge into real activities, and avoid making its value merely hypothetical.

2. 1. The importance of innovation for the firm

Innovation in firms has an important role, especially in the strategic orientation. The process innovation must give equal attention to the types of technological innovations because of its significant contribution to improving productivity (Heygate, 1996).

Through the study of Linder et al., which relates the behaviour of forty managers, the result was that most of them believed that the concept of innovation was linked with the introduction of new products in the market, ignoring the contribution of process innovation to improving the firm's competitive position or its contribution of product's innovation. (Linder, J. C. Jarvenpaa, S. Davenport, T. H., 2003).

Indeed, it must be noted that the relationship between product innovation and process innovation is very strong and interrelated (Martinez-Ros, 1999), despite their different determinants and the different processes of innovation for each of them (Lager, T. , Hörte, S. A., 2002; Gopalakrishnan, S. , Bierly, P. , Kessler, E. H., 1999) (Sternberg, R. , Arndt, O., 2001; Freel, 2003). In this context, it enhances the innovation of procedures and strengthens the productive capacity of the firm. On the one hand, the process innovation works to allow the realization, development and introduction of new products in the market. The product's innovation encourages and forces the firm to find new or improved procedures on the other.

In this regard, the study of Michie and Sheehan (Michie, J. Sheehan, M., 2003) recommended paying more attention to process innovation and making separation from product innovation, in order to separate the determinants of each type.

2. 2. Innovation, skills and knowledge

Firms give importance to management, production, marketing strategies, etc. Based on this principle, firms can build heterogeneous skills, according to their main strategies. On the one hand, skills can be built from the interaction between the various firm's external or internal factors. On the other hand, the environment can serve as the engine that motivates the firm to implement and enhance its skills by taking the experiences of different external parties.

In general, the acquisition of basic skills develops over time, when the firm develops its activities and goals, it helps directly or indirectly build new skills, through the interaction between various external or internal factors of the firm. The environment can also serve as the engine that motivates the firm to implement and enhance its skills, taking into account the experiences of various external parties.

Therefore, identifying skills is extremely important when developing or implementing an effective innovation strategy. Accordingly, more innovative firms tend to give excellence to their skills in various fields, such as production, finance, human resources, etc (Baldwin, 1995). However, firms that make efforts to acquire and improve their basic skills, which influence creative activity, become more creative than their equivalents.

The difference in the size of firms reflects also a profound difference in their internal competencies. If skills and knowledge are considered key factors in the field of innovation particularly, it can be estimated that their uses differ from one firm to another, and they also extend to their manufacturing processes, which are very different (Baldwin, J. R. Sabourin, D., 1995).

3. Expand external knowledge innovation sources

The knowledge production model has been criticized for considering the firm as a basic unit of analysis. When expanding the model and linking it to the spatial or space dimensions, it is impossible to measure knowledge flows to the firm, because it is not visible, and there is no

channel, which can be tracked. Therefore, basing on this ambiguity, theoretical frameworks are made in their consideration in order to know how knowledge passes between geographical units.

3. 1. Externalisation of knowledge spillovers

The externalisation of knowledge spillovers comes, in particular, from labour markets and financial externalisation that facilitate the provision of non-market inputs to various industries at very low prices, such as information, especially technological ones (Krugman, 1991).

It is necessary to know if the knowledge spillovers have a geographic specificity, given the importance of the process of knowledge externalisation that is evident through its strength in penetrating the boundaries of firms, mainly due to the inability to be unique to it, which makes it related to externalisation (Arrow, 1962). Therefore, knowledge spillovers are an inevitable phenomenon, which does not require evidence of its importance as it proves that no force can determine it in a place (Krugman, 1991).

3. 2. The role of research and development activities in knowledge cooperation

Small firms, less able to do research and development activities, can benefit from various knowledge by exploiting knowledge spillovers from specialized firms such as universities and R&D firms. This orientation is with the aim of achieving innovations with marginal investments in research and development.

Accordingly, the increase in R&D expenditures will have a positive impact on the results of these activities, which means growth in creativity and innovation (Acs, Z. J. Audretsch, D. Feldman, M. P., 1994). In the opposite, private firms and universities do not give an exception as research firms.

Also, R&D spending has a vital role in the field of logistics services. This important role is to provide firms with the knowledge necessary to refine and achieve satisfactory results for innovation. Conversely, university expenditures on the research and development are the staple source for small firms from the knowledge that connects it to innovation.

3. 3. Patents as a measure of knowledge flow in innovation

Several patent's indicators were adopted to measure the flow of knowledge used in innovation (Jaffe, A. B, Trajtenberg, M., 2002; Jaffe, A. B. , Trajtenberg, M. Henderson, R., 1993; Almeida, 1997). It is worth noting that geographical proximity is considered as one of the important factors in the process of knowledge spillovers. In general, firms make proofs for their innovation by their domestic patents.

Audretsch and Feldman have demonstrated that the tendency to pool research and development activities geographically takes a strong direction in sectors requiring new economic knowledge. However, the main factor of the geographical concentration of the production presence is the relative importance of new knowledge in this industry (Audretsch, D. B. Feldman, M. P. , 1996).

3. 4. The inter-industries cognitive cooperation

If the geographical dimension between firms has an effect on cognitive exploitation, as is the type of research and development activities carried out by the firm or those that exist in it environment, then industries require inputs in the field of research and development such as specific skills, academic and industrial research.

Accordingly, the tendency to group research and development activities geographically is very strong. Where does the qualified workforce contribute to creating a dynamic mechanism for knowledge spillovers? This contribution is made through their movement in the same industry without controlling or dropping of the accumulation of their knowledge and performance. Position and geographic proximity are at the heart of the process of exploiting the knowledge spillovers. In this sense, it is difficult to separate the correlation of knowledge spillovers with variables at the geographical level, but also, it is difficult to determine a reliable causal model (Audretsch, D. B. Feldman, M. P., 2003).

3. 5. Cognitive blocs for firm excellence

The organization and concentration of economic activities varies by geographical regions, which can be the basis for variation in performance even with the use of the same inputs of knowledge. This difference comes mainly from the variation of cultures between regions. In the same sense, the difference in relations between agents in different regions has an undeniable role in the difference in the performance of firms in the concerned regions (Saxenien, 1994).

In addition, the concentration of industry in a region encourages knowledge spillovers between firms. This aim necessitates a positive impact on the activities of research and development of firms, which means also make the knowledge resulting from these activities like advantages. These advantages are the result of their contribution to increase the concentration of specific industries in specific geographical regions (Glaeser, E. Kallal , H. Scheinkman, J. Shleifer, A., 1992).

As the creation of knowledge spillovers, in the same industry, is limited, it is more likely that the horizontal externalisation of knowledge, in the same industry, will extend to other industries (Glaeser, E. Kallal , H. Scheinkman, J. Shleifer, A., 1992, pp. 1129-1132).

In addition, the diversity of existing sources of knowledge, especially in innovative regions and cities, is a haven that provides firms with their supply of knowledge, which is usually achieved by extending their knowledge externalisation for their industry to other industries.

Accordingly, the combination of regional specialization versus regional diversity is one of the main determinants of enhancing knowledge spillovers in order to build conglomerate knowledge. For that and in the aim to make complementary exchanges of knowledge, it is required to tie knowledge relationships and contribute to the development of the activities of innovative firms.

4. Innovative and collaborative activities in the study database

The various firms in different sectors work to be more competitive in comparison with other firms' competitors. Consequently, technical and scientific economic information - as a strategic material - attaches great importance in the activities of the firms, which seeks to control it as a necessary condition for its development and security.

In fact, innovation is considered as the result of research and development activities. For that, firms seek to establish and activate an organizational system whereby they establish, rationalize and give determinants of knowledge structures. When the firms realize this system, they can obtain the necessary knowledge to influence in their future.

4. 1. Presentation of database

The study was based on studying the reality of innovative and cooperative activities of firms. The database was established from annual surveys in order to make relationships between the most important variables in them, especially innovation and R&D variables. Through the survey carried out by the National Center for Statistical and Economic Studies, this study covers all firms that have a research and development function aimed at innovation. These firms are active in the Metropolitan France, its islands as well as the active firms in the principality of Monaco.

An average of 5,061 firms was polled each year, with around average foreign spending on research and development equal to 26.5 billion euros. As all data was recorded in research files. The database is interesting to the firms that have at least one full-time researcher engaged in research activities.

4. 2. Intensity of cooperative activities related to research and development

The intensity of cooperative activities related to research and development activities can show its relationship with the knowledge. This knowledge contributes to the development of the innovative capabilities of the investigated firms. In fact, the development in the intensity of cooperative activities shows the desired goal and capabilities that can result from this cooperation. This aim should focus on the quality of cooperative activities. Indeed, it is very interesting to define the importance that each type represents on the overall orientation of research and development activities. This meaning is for clarifying the potential impact on the innovative and cognitive capabilities of the investigated firms.

The following table shows the various cooperative activities related to research and development, while showing their development:

Table 1. Evolution of collaborative activities in research and development

Year	Global cooperative intensity	Cooperative intensity assigned to the firm by a private partner,	Cooperative intensity assigned to the firm by a public partner,	Cooperative intensity assigned by the firm to the other party
2008	8 963	1 623	2 331	5 009
2009	9 509	1 692	2 657	5 160
2010	8 660	1 584	2 535	4 541
2011	10 716	1 643	3 204	5 870
2012	10 748	1 805	3 348	5 595
2013	12 116	1 760	4 230	6 126
2014	12 300	1 796	4 121	6 384
2015	10 937	1 710	3 729	5 498
2016	10 884	1 520	3 845	5 520
2017	12 731	1 779	4 734	6 218
2018	13 142	1 871	4 673	6 599

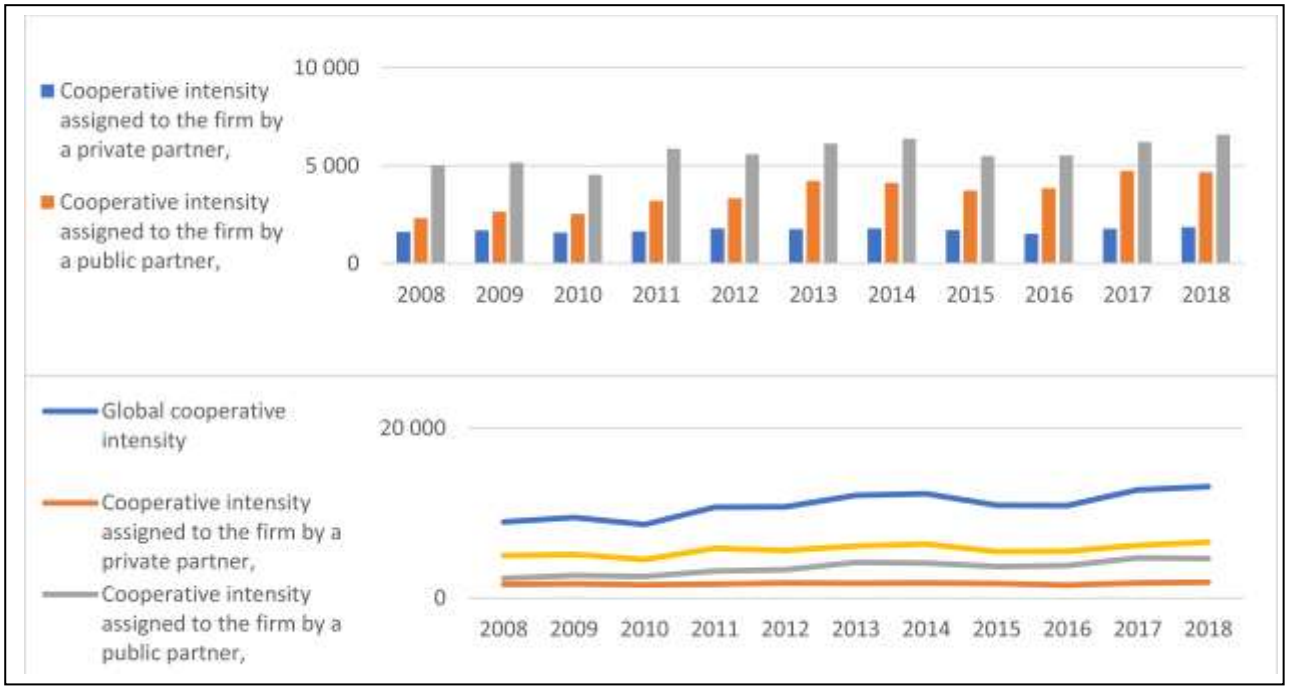
Source: Established by the researchers based on database of Innovation and R&D

The above table shows that the total cooperative intensity of research and development activities has increased from one year to another. This development results in the possibility of an increase in some or all kinds of cooperation for the investigated firms. In this sense, the cooperative intensity of the research and development activities has been divided into:

- The cooperative intensity assigned to the firm by a private partner,
- The cooperative intensity assigned to the firm by a public partner,
- The cooperative intensity assigned by the firm to the other party.

Each form of cooperative forms is affected by the impact on the total cooperative density. Then the above table data can be represented in the following figure, which justifies the evolution of collaborative activities in research and development:

Fig 1. Evolution of collaborative activities in research and development



Source: Established by the researchers based on database of Innovation and R&D

The previous figure shows the comparison between the developments in the total cooperative density, the cooperative density assigned to the firm by a private partner, and the cooperative density assigned to the firm by a public partner and the cooperative density entrusted by the firm to the other party. The first form is characterized by a relative stability, or the two remaining forms that match with the increase of the total of the cooperative density. Whereby, the collaborative intensity assigned by the firm to the other party represents the largest component of cooperative activities for research and development. In consequence, the firms do not dispense with external knowledge sources which impact their research and development activities, innovative capabilities and capabilities to influence the environment in which firms are active.

4. 3. Specializations of internal research and development activities

The internal research and development activities are extremely important in building and appraising the firm's knowledge and innovative capabilities, as well as its capabilities to track the signals in it environment. Determining the disciplines of research and development activities helps identify the disciplines and sectors characterized by technological change, technological competition, and the impact of key knowledge on excellence.

Consequently, the progress made in the activities that are specific to the internal research and development activities of the investigated firms, is presented in the following table:

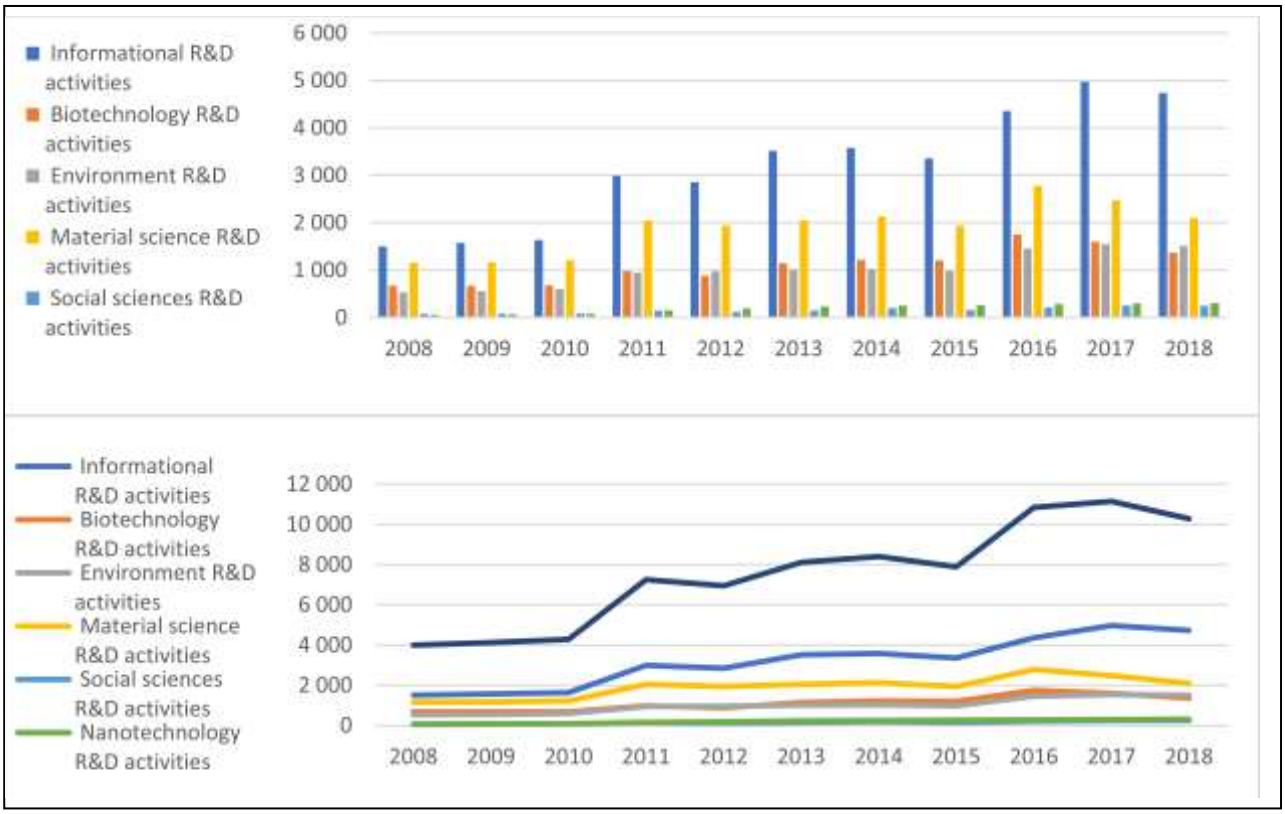
Table 2. Evolution of the disciplines of R&D activities

Year	Informational R&D activities	Bio technology R&D activities	Environment R&D activities	Material science R&D activities	Social sciences R&D activities	Nano technology R&D activities	Global of observations
2008	1 501	676	533	1 151	80	58	3 999
2009	1 572	674	557	1 171	82	69	4 125
2010	1 632	678	598	1 218	85	81	4 292
2011	2 987	981	947	2 045	147	150	7 257
2012	2 856	884	968	1 938	115	190	6 951
2013	3 516	1 146	1 015	2 047	153	234	8 111
2014	3 578	1 214	1 025	2 134	200	255	8 406
2015	3 352	1 206	978	1 941	159	262	7 898
2016	4 357	1 752	1 459	2 780	212	287	10 847
2017	4 972	1 598	1 548	2 475	253	301	11 147
2018	4 739	1 370	1 515	2 104	245	307	10 280

Source: Established by the researchers based on database of Innovation and R&D

From the above table we can note that internal research and development activities take several types of activities. All these types can be related to research activities in informatics, biotechnology's research activities, environment's research activities, material science's research activities, social sciences' research activities and the proportion of research activities related to nanotechnology. The proportions of each type of research activities is affected by the number of investigated firms, as well as the evolution of the budget allocated to internal research and development activities. The data of the previous table can be represented in the following figure to show the evolution in the proportions of the activities that constitute internal research and development:

Fig 2. Evolution of the disciplines of R&D activities



Source: Established by the researchers based on database of Innovation and R&D

From the above figure, it is possible to note the development occurring in the constituent types of internal research and development activities. It is noted that the percentage of research activities related to informatics increases from year to year, in addition to that it represents the large percentage of internal research and development activities. As for the percentage of research activities related to material science, it is in fact the second percentage after activities related to informatics, but it is gradually decreasing in the interest of other activities for internal research and development activities. Regarding the percentage of research activities related to biotechnology, it is almost the same as information activities, and it increases relatively from year to year, and it occupies the third position compared to the total research activities. Subsequent activities are followed, respectively: the proportion of research activities related to the environment, the proportion of research activities related to social sciences, the proportion of research activities related to nanotechnology as they increase relatively from year to year.

4. 4. The evolution of the number of innovative firms registered in the database

It is crucial to study the development of firms that recorded its innovations among those investigated. Where innovation can be considered as a product of research and development activities, whether internal or external. Or, it is a result of the internal and external knowledge that has been embodied through research efforts into innovations. The following table shows the developments that touched the number of innovative firms during the period of study:

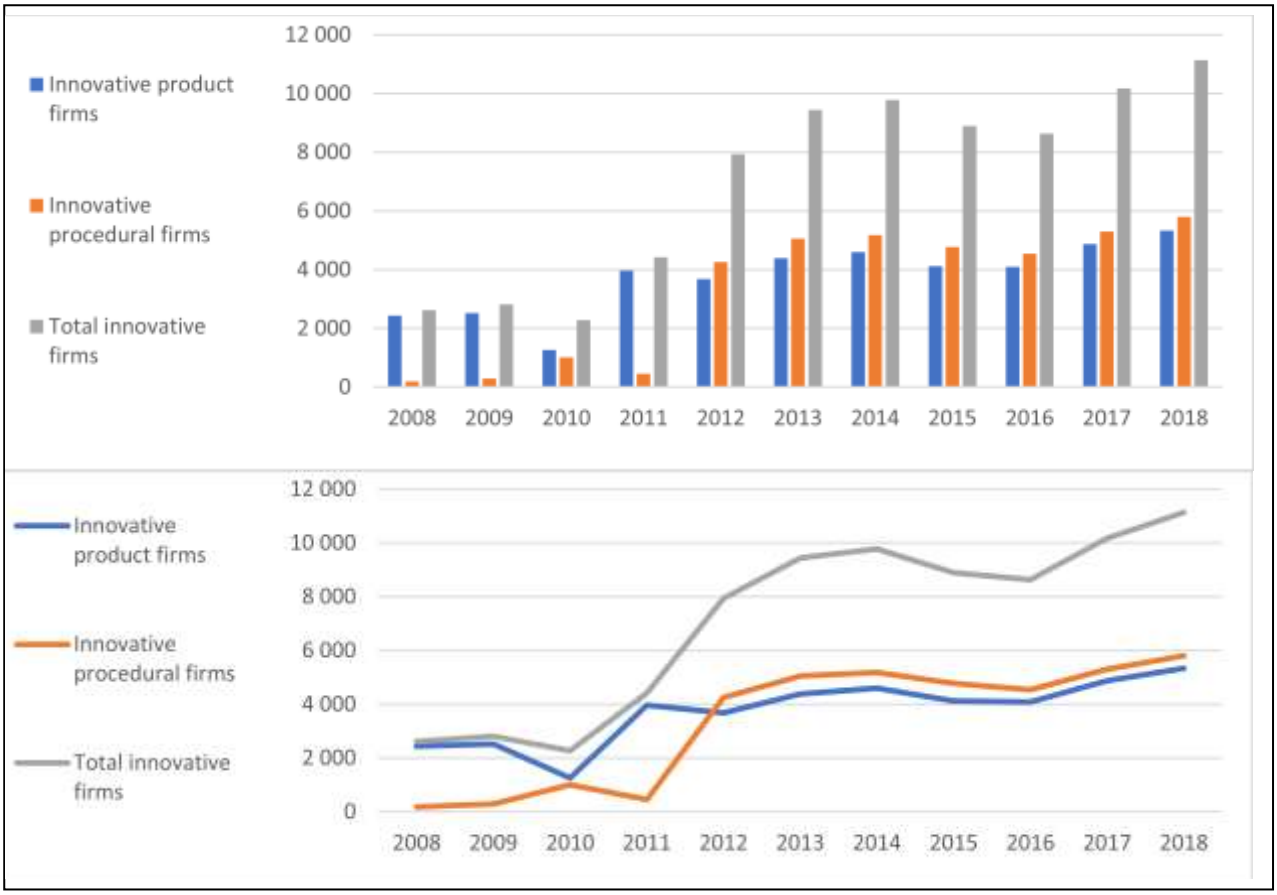
Table 3. Evolution of the number of innovative firms

Year	Innovative product firms	Innovative procedural firms	Total innovative firms
2008	2 433	185	2 618
2009	2 522	291	2 813
2010	1 262	1 011	2 273
2011	3 966	455	4 421
2012	3 681	4 253	7 934
2013	4 389	5 052	9 441
2014	4 601	5 177	9 777
2015	4 115	4 775	8 889
2016	4 091	4 538	8 628
2017	4 871	5 300	10 170
2018	5 333	5 804	11 136

Source: Established by the researchers based on database of Innovation and R&D

From the table, the increase in the number of innovative firms is observed among the total firms surveyed from one year to the next. Where innovations can be divided into product innovations or process innovations. Through studying the development of innovative firms, it is possible to extract the proportion of firms that succeed in embodying their research and development efforts, and value their knowledge capabilities and link them to the development of their innovative capabilities. The data of the previous table can be graphically represented by the following figure:

Fig 3. Evolution of the number of innovative firms



Source: Established by the researchers based on database of Innovation and R&D

The previous figure shows a positive development in the number of firms that carry out innovation, but there is a difference between the percentage of what represents product-related innovation and that related to procedures. Where procedural innovations are observed to increase after they were less than product-related innovations. Indeed, this enhancement is due to the complementary relationship between the two types of innovation. On other side, the augment in the interest to the procedural is aimed to develop and control its impact on the production process. In addition, this interesting influence positively the knowledge building capabilities that contribute to enhancing innovative capabilities, especially related to products, as well as follow the environment.

Generally, this situation ensures the development of pillars that activate research and knowledge cooperation activities. The recording of an evolution in the number of innovative firms shows the extent of the firms' ability to realize their research and development activities, which can go beyond their consideration of knowledge components to activate and succeed the research and knowledge cooperation goals of firms.

4. 5. Evolution of the number of patents for firms involved in the database

Generally, the firms work to embody their research and development activities into patents, which are an aspect of protecting their efforts. It is important to study the evolution of the number of patents for investigated firms in order to know the orientation taken by firms with regard to research and development activities, and to know the extent of success in their innovative activities. The following table highlights the evolution of the number of patents for the investigated firms:

Table 4. Evolution of the Number of Patents for Investigated firms

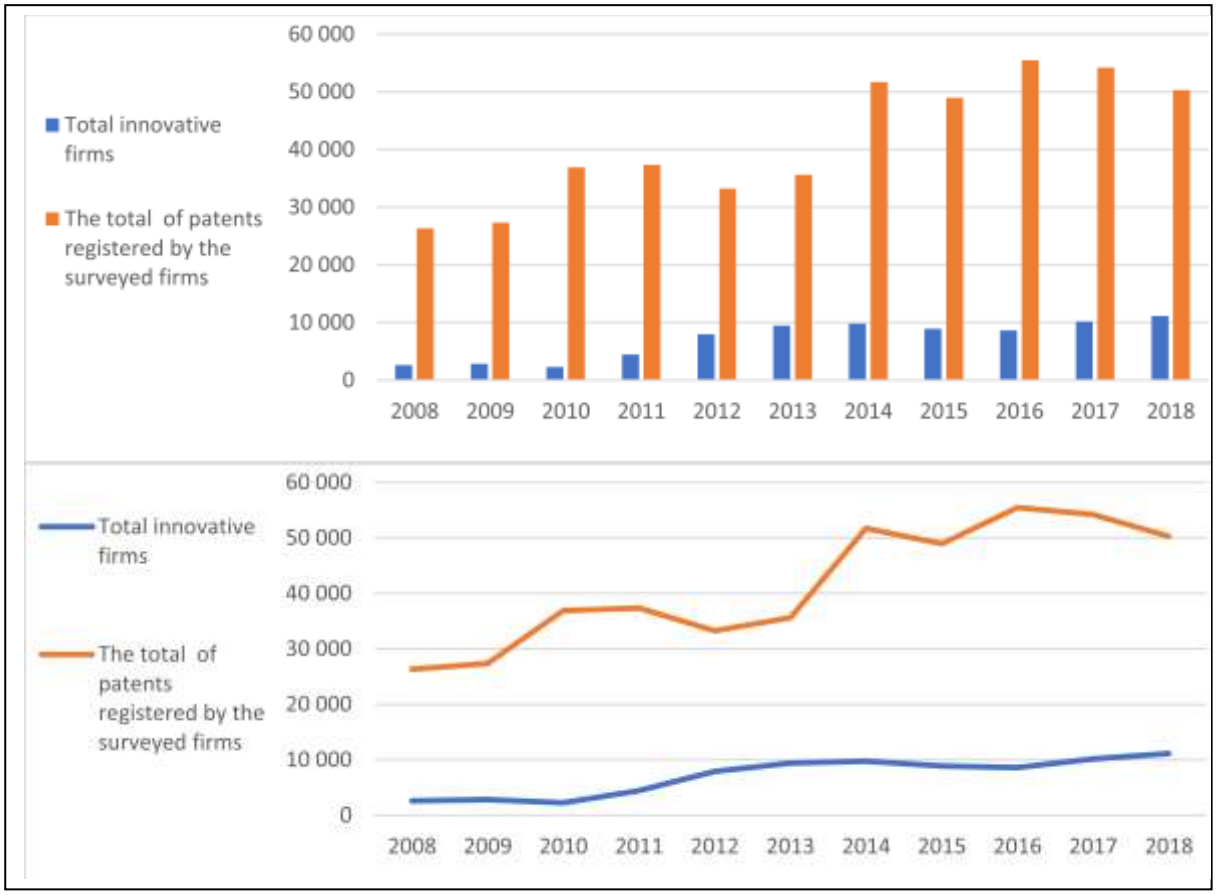
Year	Total innovative firms	of patents registered by The total the surveyed firms
2008	2 618	26 301
2009	2 813	27 342
2010	2 273	36 899
2011	4 421	37 367
2012	7 934	33 233
2013	9 441	35 592
2014	9 777	51 720
2015	8 889	48 971
2016	8 628	55 494
2017	10 170	54 204
2018	11 136	50 289

Source: Established by the researchers based on database of Innovation and R&D

From the table, we observe an increase in the number of patents registered by the investigated firms from one year to the next, which is due to the increase in the number of the investigated firms. This result indicates that there is a tendency to protect research activities, but also, there is an enhancing in the success of research activities and embodied innovations. As patents can be the result of internal and external knowledge generated by cooperative activities. The combination between the result of internal and external knowledge can make facilities for firms in order to succeed their research activities and register specific innovations.

The data of the previous table can be graphically represented by the following figure:

Fig 4. Evolution of the number of patents for investigated firms



Source: Established by the researchers based on database of Innovation and R&D

In fact, we note from the above figure that there is an increase in the number of patents registered by the surveyed firms, but it is proportional to the total number of firms that the sample studied. The tendency of firms to register patents underscores their tendency to protect their R&D activities and embody them in innovations. Generally, firms exploit internal and external knowledge derived from cooperative activities, and reconcile it to make their research activities successful and to enhance innovative capabilities.

5. Results and discussion.

We measured the level of cooperative intensity allocated to the firm with the degree of cooperative intensity allocated to the other side by the firm. The first type is distinguished by relative equilibrium, or the following two ways that follow the rise of the cooperative overall number. Whereby, the cooperative intensity allocated to the other side by the firm forms the main portion of the research and development cooperation activities. Therefore, the firms do not dispense with external channels of knowledge that affect its R&D operations, technological technologies and skills to control the world in which firms are involved.

In addition, there is a rise in the number of innovative firms among the total firms surveyed, from year to year. By observing the growth of innovative firms, the proportion of firms who excel in embodying its research and development activities may be identified, and value its knowledge capabilities, and related to the creation of its innovative ability.

Indeed, this enhancement is due to the complementary relationship between the two types of innovation. At the other hand, the rise is directed at establishing and regulating its effect on the production process in the context of the procedural. Therefore, this interesting impact positively the

knowledge-building skills that lead to the enhancement of innovative capabilities , especially related to products, as well as the environmental monitoring.

We also notice that companies' propensity to file patents underlines their desire to shield and represent their R&D investments in inventions. Companies typically leverage and combine internal and external expertise obtained from cooperative practices to improve their research efforts and creative ability.

This situation usually ensures the creation of the foundations that enable the activities of research and knowledge cooperation. The reporting of an increase in the amount of creative companies demonstrates the magnitude of the willingness of firms to carry out its research and development efforts that may go beyond its consideration of knowledge components to activate and achieve the aims of the firms' research and knowledge cooperation.

6. Conclusion.

The study has presented the reality of the innovation and cooperative activities. It is a very important to analyse the relationships that link the most important variables related to R&D and innovation. However, the innovation and cooperative activities attest an impact on building the cognitive capabilities of firms. Also, it contributes to distinguishing the firm's performance.

This work has made a relationship between the innovation and cooperation activities through a study of the intensity of cooperative activities related to research and development, the evolution of the number of patents for firms concerned with the database, the specializations of internal research and development activities and the evolution the innovative firms' number.

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How to cite this article by the APA method:
Rafik ALIOUAT, Baghdad BENINE (2021), ***The Knowledge collaboration and success firm's innovation: study of French Innovation and R&D's surveys,*** *Economic Researcher Review* ,Volume09.(issue01), Algeria: University of skikda, pp119-131