

Absorptive capacity development level and innovation activities in innovative enterprises in Medellin (Colombia)

Nivel de desarrollo de capacidad de absorción y de actividades de innovación en empresas innovadoras en Medellín (Colombia)

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Content

- [1. Introduction](#)
- [2. Conceptual framework](#)
- [3. Methodology](#)
- [4. Results](#)
- [5. Analysis of results](#)
- [6. Discussion and conclusions](#)
- [References](#)

ABSTRACT:

This article presents, from a conceptual framework, the characterization of what are absorptive capacities and innovation activities in a specific context, innovative enterprises in Medellin – Colombia, using a mixed methodology on a population of 363 enterprises, drawing conclusions that would suggest that enterprises with more developed acquisition and assimilation capacities, that make up what Zahra & George (2002) called "potential absorptive capacity", are enterprises that have better results in innovation activities, both R&D and innovation efforts, drawing attention to this group are also companies that make greater investment in R & D.

Keywords: Absorption capacities; Absorptive capacity; Potential absorption capacity.

RESUMEN:

Este artículo presenta, a partir de un marco conceptual, la caracterización de lo que son capacidades de absorción y actividades de innovación en un contexto específico, las empresas innovadoras en Medellín - Colombia, utilizando una metodología mixta sobre una población de 363 empresas, sacando conclusiones que sugieren que las empresas con Capacidades de adquisición y asimilación más desarrolladas, (que conforman lo que Zahra & George (2002) llaman "capacidad potencial de absorción"), son empresas que tienen mejores resultados en actividades de innovación, tanto de I + D como de innovación y Mayor inversión en I + D.

Palabras clave: Capacidad de absorción; Capacidad de absorción; Capacidad de absorción potencial.

1. Introduction

Several authors have suggested the importance of absorptive capacity to improve economic growth (Cheng & Tao, 1999) and generating competitive advantages in business, Flatten, Engelen, Zahra, & Brettel, (2011), which it is more visible in countries where the economy is focused on micro, small and medium enterprises, as in Colombia, where "the economy is supported in small-scale enterprises (SMEs), together with micro, representing at least 90% of the national business and generate 73% of employment and 53% of the gross output of the industrial, commercial and services" C.H. González-Campo, A. Hurtado Ayala (2014:278).

Moreover, it is increasingly necessary for countries in general and organizations in particular, the measurement of the activities carried out for the development of innovations, which, according to the OECD is called innovation activities. This article is part of what defined by the OECD and Eurostat (2005) by stating that: "Innovation activities include the set of scientific, technological, organizational, financial and commercial activities including investment in new knowledge that lead or are aimed at introducing innovations, some of these activities may be innovative in themselves, while others they are necessary for the introduction of innovations" OECD and Eurostat. 2005. Pag 105.

From the Oslo Manual, OECD and Eurostat (2005), difficulties in the characterization of innovation activities, their measurement and valuation in specific contexts are shown, as is the case in Colombia, where they require more efforts to make their organizations perform processes that allow the generation of innovations in products and services, which is essential acceleration of organizational learning, being fundamental to this that organizations recognize the new external knowledge, be able to assimilate, transform it into potential benefits in accordance with prior knowledge they possess internally, and finally articulate to their commercial purposes.

In this context that the concept of absorption capacities initially understood as capabilities that help identify, assimilate and apply the external and internal valuable knowledge arises (Cohen and Levinthal, 1990).

Then in 2002, Zahra and George (2002) proposed a reconceptualization of absorption capacities, from the perspective of a shaped, by two threads, dynamic capacity: the ability of potential absorption, where the processes of acquisition and assimilation develop, and realized absorptive capacity having the processes of transformation and exploitation.

After various studies conducted on absorption capacities in relation to processes and innovation activities (Lane et al., 2001; Jansen et al., 2005; Liao et al., 2007; Camisón & Forés, 2010; Jiménez-Barrionuevo et al., 2011; Flatten et al., 2011), it has made it clear that the best alternative is to use measurement scales with multiple indicators that capture the multidimensional nature (Flatten et al., 2011; Jansen, Van den Bosch & Volverda., 2005; Fosfuri & Tribó., 2008; Murovec & Prodan., 2009 y Camison & Fóres., 2009) . The research part of the need to know the level of development of the processes of acquisition, assimilation, transformation and exploitation of valuable external knowledge, i.e. knowing the level of development of absorption capacities in organizations of Colombia and Brazil.

The objective of this research is to identify the level of development of the potential absorptive capacity (acquisition and assimilation processes) and the realized absorptive capacity (processes of transformation and exploitation of knowledge) and innovation activities in organizations of Medellín - Colombia, for in the future to understand the relationship between these two constructs.

Initially it presented in summary form a conceptual framework for understanding the concepts of absorptive capacities, innovation and innovation activities. The following section methodology used for research and empirical work presented. In the last part, discussions, findings and limitations of the study are presented.

2. Conceptual framework

2.1 Absorptive Capacities

The absorptive capacity, understood as the dynamic capability that allows the creation of value for the company through the development of skills and abilities for the acquisition, assimilation, transformation and exploitation of external knowledge (Pérez & Toro, 2015, citing Camisón). That is, the absorptive capacity is the combined result of learning, internal knowledge and knowledge that comes from external sources. The development of the absorptive capacity is crucial for generating new opportunities in organizations, independently if they are of goods or services.

In studies by Andrade (2009) in Brazil, it is designed as absorption capacity: "The ability of an organization to identify the elements that contribute to increase the absorption of internal and external knowledge is essential to the development of its absorptive capacity, but also stresses". Andrade, 2009, pag 25.

The absorptive capacity is analyzed as a dynamic capability, which is permanently reconfiguration process to help the organization to adapt to constant changes by the environment. (Barney., 1991; Eisenhardt & Martin., 2000; Grant., 1996; Nelson., 1991; Peteraf., 1993; Prahalad & Hamel., 1990; Teece, Pisano, & Shuen., 1997; Wernerfelt, 1984).

Historically the concept of absorptive capacity was introduced in the literature on organizational learning by Wesley Cohen and Daniel Levinthal in an article published in 1989 in Economic Journal, which is explained as one of the processes fundamental learning of the company, in which it allows to know their ability to identify, assimilate and exploit knowledge of the environment. Which, in other words, it can be explained as "the ability to recognize the value of new external, assimilate and apply for commercial ends" (Cohen & Levinthal, 1990, pág. 128., Lane & Lubatkin, 1998, pág. 462., Van den Bosch, Volberda, & Boer., 1999, pág. 552; Lenox. M., 2004, pág. 331; Newey & Shulman., 2004, pág. 495).

During the past 25 years, absorptive capacities have been addressed from different approaches such as knowledge management (Alavi & Leidner., 2001; Lane, Koka & Pathak., 2006), management of Information Technology (Sambamurthy & Zmud., 1999), innovation (Fichman & Kemerer., 1997), business value (Bhatt & Grover., 2005), understanding the knowledge base (Szulanski., 1996; Von, Krogh & Roos., 1996; Reagans & McEvily, 2003), strategic alliances (Ahuja, 2000), R & D and cooperation (Cassiman & Veugelers, 2002), human resources, marketing and strategic management (Matusik & Heeley, 2005), and other areas (Lane et al., 2002).

Zahra and George (2002) proposed the most profound reconceptualization by stating that the absorptive capacity comprises four interrelated and interdependent sub-processes: acquisition, assimilation, transformation and exploitation of external knowledge. These authors presented some relationship between what they called the potential absorptive capacity (PACAP), which is responsible for capturing the efforts of a company used in the valuation, acquisition and assimilation of new external knowledge. The other thread is called realized absorptive capacity (RAPAC), when the processes of transformation and exploitation of external knowledge for strengthening the organizational portfolio involved. This thread represents the ability of the company to integrate and reconfigure the existing internal knowledge and newly assimilated knowledge and incorporate this knowledge transformed into systems, processes, routines and business operations not only to refine existing knowledge and skills, but also to create new operations and skills.

More recently some authors looking to expand the concept defined absorptive capacity as: "The ability of an entrepreneur to understand the new knowledge, recognize their value and then sell it by creating a company" (Qian & Acs, 2013, p. 191). Another definition close to business activity is the Schmidt (2010, p. 2), who conceived the absorptive capacity and the ability of the organization to deal with external knowledge.

On the other hand, (Easterby-Smith M., 2008, p. 484; Murovec N., 2009, p. 2, based on the definition of Cohen and Levinthal, 1990), proposed that the absorptive capacity could be understood as the ability to locate or identify new ideas and incorporate them into the processes of an organization: "There are two different types of absorptive capacities: those promoted by science (based on scientific information) and demand attracted (based on market information).

Meanwhile, Liao (2007) analyzes the absorptive capacity as the ability and motivation of employees to obtain external knowledge and willingness to use this knowledge in the innovation process of the company. The absorptive capacity emphasizes the ability to obtain knowledge and level of effort used to transform and use (Liao, 2007, p. 341).

Another currently accepted definition is proposed by Tu Q. (2006, p. 694) and Jones (2006, p. 357), who analyze these capabilities as organizational mechanisms that help identify, communicate and assimilate the relevant knowledge, both internal and external.

Finally, there is a concept of recent use and which allows us to understand the absorptive capacity based on existing resources in the organization: the knowledge we have, a set of processes and organizational routines through which companies acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capacity. (Gray., 2006, pág. 347; Zahra & George., 2002, pág. 186; Wales, Parida & Patel., 2013, pág. 622).

To summarize, it includes the absorptive capacity as a dynamic capability, which allows the organization, individuals, groups or business cluster acquire, assimilate, transform and exploit knowledge coming from abroad and become an advantage. (Zahra y George., 2002).

2.2 Innovation Activities

Although each day will reach more consensus against what is understood as innovation activities, several meanings that sometimes hinder the understanding of this construct still persist. To more clearly in the article a conceptual development of what are innovation activities from what explained the concept of innovation is presented.

Innovation is understood as "the introduction of a new or significantly improved product (good or service), a process, a new marketing method or a new organizational method, the internal practices of the company, organization workplace or external relations" Oslo Manual, OECD and Eurostat, 2005, p. 56; it is a key to economic progress of organizations and countries element, especially when it is the result of the improvement and advancement of scientific and technological knowledge.

This requires that in modern management of organizations activities aimed at generating new knowledge are prioritized, its application in

projects requested by the community, innovation processes and the creation of new enterprises capable of changing conditions life of populations, especially in less developed countries.

It is from the statements made by Schumpeter (1934), when you start to understand the leading role that innovation processes in the performance of organizations and countries in general. Schumpeter (1934) postulated that innovation is the main engine of economic development, being the entrepreneur, the innovation agent. This author is given the paternity of the concept of innovation.

From proposed by Schumpeter (1934) other approaches emerge, giving great importance to human capital in economic growth models (Abramovitz, 1956; Solow, 1957 and Schultz, 1961), differentiating between those countries that can access technological developments and high-level human capital and other countries.

Explanations proposals to bridge the gaps between countries with technological developments and human capital and the rest of the countries are supported in endogenous growth models,(Romer ,1986; Barro ,1990; Lucas,1988; Putnam,2000) indicate that the spillover of knowledge, coupled with infrastructure and public spending, education, investment in human capital and accumulated experiences, are the facilitating the performance of the companies themselves. It is in this context of endogenous growth theories highlighting the role of knowledge as a source of technological opportunities and development from the implementation of different innovation activities (Griliches, 1995; Aghion and Howitt, 1998 and Veciana, 2007). .

After the approaches of Schumpeter (1934) and Abramovitz (1956); Solow (1957) and Schultz (1961), present in the world the need to unify criteria against everyday concepts. In Table 1, the main types of innovation are presented.

Table 1: Types of Innovation

AUTORES	CLASIFICACIÓN	CRITERIOS	DESCRIPCIÓN
OCDE, 2005	4 Types	Final results	Product - Process Marketing - Organizational
Freeman, 1982	2 Types	Based on the degree of novelty	Incremental Radical
Schilling, 2008	2 Types	Perspective	Enhancing skills Destructive skills
Fernández, 2005	2 Types	Degree of novelty	Original Adapted
Brady y Soderlund, 2008 Holthausen, 1995 Martin. & Scott, 2000	3 Types	Intervention Scale	Business Unit Market Project
Chesbrough, 2003; Huizingh, 2011	2 Types	Level of participation	Open Closed
Tushman y Nadler, 1986	3 Types	Degrees	Incremental Synthetic Discontinuous
Damanpour, 1991	2 Types	Orientation	Technological Administrative

Source: Own elaboration, based on the authors

Economists and experts from other areas have reached an agreement about the importance of generating new scientific and technological knowledge for the development of innovation in organizations, and that this increasingly brand in a more decisive way progress of nations, from the boost it gives to economic growth.

The basis for the study of the leading role played by scientific and technological progress on economic improvement, are to be found in authors like Adam Smith, Karl Marx, Thomas R. Malthus and Jean-Baptiste Say, who started without making direct reference innovation activities, to mention the importance it may have for the wealth of nations called "technological progress"; being precisely Say (1820) who stressed the importance for entrepreneurs to acquire knowledge, then make products:

The industry entrepreneur, first, must purchase the most essential of art that wants to pursue knowledge; then must meet the means of implementation needed to create a product; and finally must govern execution (...). The knowledge to be acquired are: nature of things it has to act and should be used as instruments; and likewise, the natural laws that can be exploited. Say (1820:67)

But Schumpeter (1934), who from the text: Theory of Economic Development (1912), began to draw attention to the importance of the role and capacity of the employer in carrying out new combinations of production factors. In other words, the ability of the employer to "perform innovation activities" through a process of "creative destruction" favored economic development.

Here seem to emerge the origins of innovation activities, even in very early stage, but already understood as the ability of some (usually employers) to take risks against uncertainty.

From the seminal works of Schumpeter, arise to the fifties other texts have increasingly become benchmarks for innovation activities, such as *Growth of the economy*, Abramovitz (1952), *Growth of the economy and capital accumulation*, Swan (1956), and a *contribution to the theory of economic growth*, Solow (1956), where emphasis is made on that technical progress was one of the determining factors for the growth of nations.

One of the great contributions in building the foundations for the development of innovation activities was made in the 60s by Schultz (1961), who following the theoretical advances of Solow (1957) and Denison (1962), he dared in his text "Investment in Human Capital", to assign a name to the theory found: Human Capital:

I propose to treat education as an investment in people and deal with its consequences as a form of capital. As education becomes part of the person receiving it, I will refer to it as human capital (Schultz; 1985:5).

Later, based on the statements of Schultz, Jacob Mincer (1958), expressed a strong interest in the effect of training or learning at work, in increasing revenue. To demonstrate their approaches made a model based on economic rationality of the subject in the labor market, which provided an analysis of how the job training causes an increase in wages and to what extent it contributes to expanding the inequality gap in income (Mincer, 1958: 291). Being education (formal and informal), health and experience the three pillars on which the theory of human capital and its development is supported and innovation capabilities of each and every human beings favor.

Although each day innovation is recognized as a determining factor for the growth of production and productivity, however, knowledge about innovation activities and the economic impact they generate remains low. Oslo Manual, OECD, 1992

In this context, it is necessary to identify the activities that make up the different types of innovation, which have their foundation in the approaches of Schumpeter (1939), with the processes of creative destruction that result in waves of innovation, and Kaldor (1961) with its conception of the endogenous nature of technical change, which puts the emphasis on the relationship between capital accumulation and technical change. Here comes a great global interest in identifying innovation activities, which are initially treated in the Frascati Manual (1993), proposed standard practice for surveys of research and experimental development, where a survey was developed for the measurement of scientific and technological activities, which reflected what so far brought together all innovation activities.

In the Frascati Manual (1993) the central concept of innovation activities was oriented towards the development of activities that focus on the development of technology was made.

Later in the Manual of Bogotá (2000), the context of scientific and technological activities towards what innovation activities was called, defining them as it expanded: "All decisions and scientific, technological, organizational, financial and commercial development are carried out within the company, including investments in new knowledge", (Manual of Bogotá, 2000, page 34). Here the emphasis was that not all innovation activities result in effective innovations, but all real innovations should be seen as a result of all the innovative activities of the company, thus showing the importance of participation of all members of the organization in the various activities that are part of the process of organizational innovation.

It is worth mentioning that the academic discussion on innovation activities, has always been energized by the OECD, showing great interest in offering a conceptual framework to help establish common references in relation to innovation and activities of this emerge, so that all member countries to make a joint measurements traceability and thus enabling the design of public policies that help further advance innovation in each of the regions.

Thus in 2005, in a partnership between the OECD and EUROSTAT, the third edition of the guide was published for the collection and interpretation of data on innovation, which was preceded by versions one and two, published in 1992 and 1997, respectively. The Oslo Manual has been prepared jointly by Eurostat and the OECD and is part of the family of manuals, in continuous evolution, dedicated to the interpretation of data science, technology and innovation. Such family consists of manuals, guidelines and guides dedicated to R & D (Frascati Manual), indicators of globalization, the information society, human resources in science and technology (Canberra Manual) and biotechnology statistics. According to the Oslo Manual, "innovation activities include the set of scientific, technological, organizational, financial and commercial activities including investment in new knowledge that lead or are aimed at introducing innovations, some of these activities can be innovative in themselves, while others are necessary for the introduction of innovations" Oslo Manual, OECD and Eurostat 2005, p. 105.

According to this definition a good part of the activities performed on a daily basis organizations can be part of the group that OECD called innovation activities, although it is very difficult to delimitate and measurement. It clarifies that R & D is only one of the stages of innovation, because innovation involves a series of activities that are not included in R & D, such as:

- The pre-production phase, where the idea is conceived, the creative process develops in different divergent and convergent clustering stages.
- The production phase, where effectively the innovative process unfolds.
- The distribution phase where the product or service is delivered to the end user
- Development activities.
- The support activities, including training and market preparation for product innovations.
- The development and implementation of new marketing methods or organization.

In short, according to the Oslo Manual, innovation activities can be classified as "R & D activities, product and process innovation activities, marketing and organizational innovation activities and innovation efforts". Oslo Manual, OECD and Eurostat 2005, p. 106.

R & D Activities

Doing a tour of the concept of what was proposed by Freeman (1975), are all works undertaken creation systematically in order to increase the knowledge base (relative to men, culture or society) (Freeman, 1975, p 36).

Later in the Manual of Bogota mentioned in Research and Development - R & D they include: "The creative work systematically undertaken to increase the stock of knowledge and use this knowledge to devise new applications. You can include the development of prototypes and pilot plants. An R & D can be basic research, applied research or experimental development. ". Manual of Bogotá, 2000, p. 6.

Additionally, it is important to mention that the experimental research and development (R & D) comprises: "The basic research, applied research and experimental development". Frascati Manual, P. 16.

Finally, the definition proposed in the Oslo Manual, OECD and Eurostat 2005, p. 106, is assumed, which includes in the definition of innovation activities, in addition to R & D, a set of actions known as product and process innovation activities, among which are:

- The acquisition of knowledge abroad: technologies, techniques, patents, inventions unpatented license, dissemination of knowledge, brands, factory, design studios and models, computer services and other computer services and technical resources needed to carry out innovation activities.
- Acquisition of machinery, equipment and other capital goods that are not included in R & D activities.

- Other preparations for innovation of products and services: activities involved in the development and introduction of innovations of products and processes, not included in R & D; designs, tests and evaluations; configuration and engineering; market readiness for innovations (including marketing studies, test market and advertising) and training.

Finally, the different elements contained in the definition of the Oslo Manual, OECD and Eurostat 2005, p 106, and which are part R & D and innovation activities of product and process, it explains what is called the activities related to marketing and organization.

Innovation activities relating to marketing and organization

This section is the entire set of activities that facilitate that new products are put on the market and new methods and strategies for implementation in organizations, materializing in:

- Preparation intended for marketing innovations (development and commercialization of new marketing methods).
- Preparation intended for organizational innovation (development and planning of new methods for the organization and activities necessary for its implementation).

Innovation efforts

In addition to R & D and related activities to this, another aspect included in innovation activities are *innovation efforts*, which include, according to Stead, 1976; OECD, 1992; the following aspects:

- Design, acquisition of embedded technology and unincorporated capital, marketing and training.
- Design, installation of new machinery, industrial engineering and commissioning of production.
- Acquisition of buildings or machinery, tools and equipment, without improved performance in the technology, needed for the implementation of innovations.
- Acquisition of technology incorporated into the capital.
- Acquisition of disembodied technology capital.
- Organizational Modernization.
- Commercialization.
- Training.

Despite the comprehensive definition, this description of the innovation activities is not exhausted, because as raises the Oslo Manual. 2005: "Innovation is a complex process and the extent of activities to be deployed to innovate can vary considerably," which creates great difficulty to group (Oslo Manual, OECD and Eurostat 2005, p. 105). In addition, "the nature of innovation activities varies considerably from one company to another", (Oslo Manual, OECD and Eurostat 2005, p. 57), this makes it difficult to make comparisons between various organizations, although these are of the same sector.

Another aspect that hinders the characterization of innovation activities is that these "can run on any part of the company" Oslo Manual, OECD and Eurostat 2005, p. 114.

It is then clear that innovation activities, both products and processes, are key to increasing the capacity of organizations to compete in new markets element, but its quantification is very difficult, which can lend to different research results generated difficult to replicate (Beise-Zee, 2006).

3. Methodology

In order to analyze the level of development of absorptive capacities and innovation activities in innovative companies Medellin - Colombia, taking as conceptual reference works which have been undertaken on measuring absorptive capacities and innovation activities, Lane et al. (2001); Jansen et al. (2005); Liao et al. (2007); Camison & Fores (2010); Jiménez-Barrionuevo et al. (2011) and Flatten et al. (2011), an instrument to assess the level of development of the potential absorptive capacity (absorption and assimilation) and realized absorptive capacity (transformation and exploitation) in innovative organizations Medellin - Colombia was built.

The empirical research work was developed from the performance of a sample of companies in Medellin - Colombia.

For the choice of companies was considered a simple random sampling (Casal, 2003), as companies held on sampling are sorted. From this list, samples directly and orderly manner from a deterministic rule is taken. That is, the companies are chosen for relevance to explain the phenomenon under investigation, specifically, to understand the state of development of absorptive capacities and innovation activities in companies of Medellin - Colombia. Where all companies selected for research have advanced an innovative project in 2015 and this will be implemented between 2016 and 2017. Similarly, companies have made specific investments in innovation (all innovative projects have received support for its implementation).

Defining the Study Population

For the selection of companies, 4 companies in the primary sector, located in the agricultural subsector, 29 companies in the secondary sector (trade, construction, energy, industry and real estate) and 28 of the tertiary sector (services, solidarity sector, telecommunications and transport) were taken into account. Table2. As the services subsector owns more companies, other prerequisites to the companies in the sample are: have done in the last year some innovation activity, be located in the city where the study was conducted and be registered as a legal entity, have during 2015 some investment in innovation, have more than one year of existence and have more than 10 workers.

Sample

The survey, conducted using a structured questionnaire was initially applied as a pilot, to an expert to verify its validity; after being approved by the expert was applied for companies from a simple random sampling (Casal, 2003), from the list of intensive innovation companies, samples direct and orderly manner from a deterministic rule were taken. In the survey are presented aspects related to the potential absorptive capacity (acquisition and assimilation) and realized absorptive capacity (transformation and exploitation), which were taken from the literature review; in addition, the survey has some questions related to innovation activities and other control characteristics of the company.

Table.2 Characteristics of innovative enterprises of Medellin -Colombia

Characteristic	Enterprises of Medellin- Colombia		
	No.	Interviewed	%

Population – Sample	363	61	16.80%	
Has made in the last year some innovation activity		61	100%	
Located in the city where the study was conducted and be registered as a legal entity		61	100%	
Annual percentage rate of investment in innovation	61	0.9% anual	29	47.5%
		Between 1% and 2%	19	31.1%
		Between 2.1% and 3%	5	8.2%
		Between 3.1% and 4%	4	6.5%
		More than 4%	3	4.9%
Having more than one year of existence	61	1-5 years	14	23 %
		6-10 years	6	9.9 %
		11-15 years	9	14.7%
		16-20 years	10	16.4%
		21-25 years	4	6.5%
		26-30 years	4	6.5%
		More than 30 years	14	23 %
No. of employees	61	10 Employees	9	14.7%
		11 to 49 Employees	21	34.5%
		More than 50 Employees	31	50.8%
Sectors	61	Services	40	65.6%
		Goods	18	29.5%
		Goods and services (offer both)	3	4.9%
Total enterprises (363)				
Number of organizations interviewed (sample)			61	
Error range			7%	
Confidence interval			95%	

Source: Own elaboration, based on field work

The total population of innovative companies in Medellin Colombia was 363, to estimate the size of the sample was taken as a criterion of quality control over the maximum error, setting at 7% maximum error of estimate, with a confidence level of 95%, giving 61 companies for the total sample. Table2.

To collect information was verified that respondents were for companies in Medellin Colombia, innovation managers of the organization, who is usually an employee with the profile of midlevel manager involved in strategic activities, have a global vision the company know the strengths and weaknesses and also has the right skills for evaluating innovation activities and the authority to answer questions, being, key informant (Hambrick & Cannella, 2004; Gruber *et al.*, 2010).

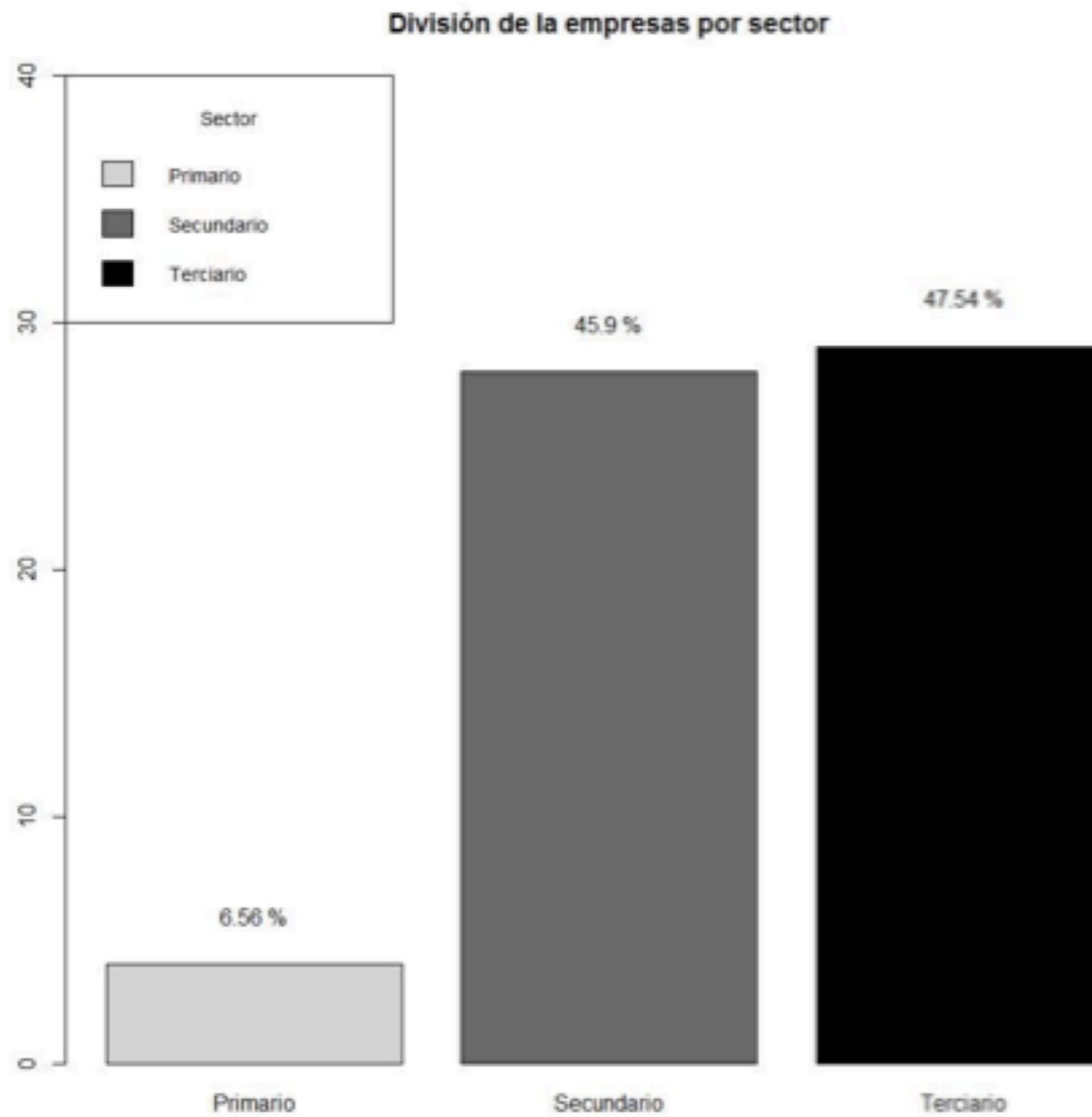
4. Results

From the research objective, namely: to characterize absorptive capacities, especially the assessment of the level of development of the processes of acquisition, assimilation, transformation and exploitation of knowledge in organizations under study, and identify development innovation activities, mainly R & D and innovation efforts, was used for the analysis of results R 3.2.3 statistical package, such as statistical computing environment, offering data analysis tools and graphics generation. This is free software that runs easily on Windows and Mac OS (Macintosh Operating System).

To measure the potential absorptive capacity (acquisition and assimilation) and realized absorptive capacity (transformation and exploitation), the items identified from the literature review were assumed. For the validity of the questionnaire used, verify the extent to which the instrument measures what it purports to measure and know the internal consistency reliability of the results obtained Cronbach's alpha was used. In addition, a cluster analysis shown through a dendrogram that allows a graphic representation or chart data in a tree structure that organizes the data into subcategories that are dividing into other until the desired level of detail, was made for which the library cluster Euclidean distance was used. Figure 5.

In the sample, 4 companies in the primary sector, located in the agricultural subsector; 29 companies in the secondary sector (trade, construction, energy, industry and real estate) and 28 of the tertiary sector (services, solidarity sector, telecommunications and transport), were taken into account; the services subsector is that more companies have. In addition, a number of innovation companies of Medellin are concentrated in the service area. Figure1.

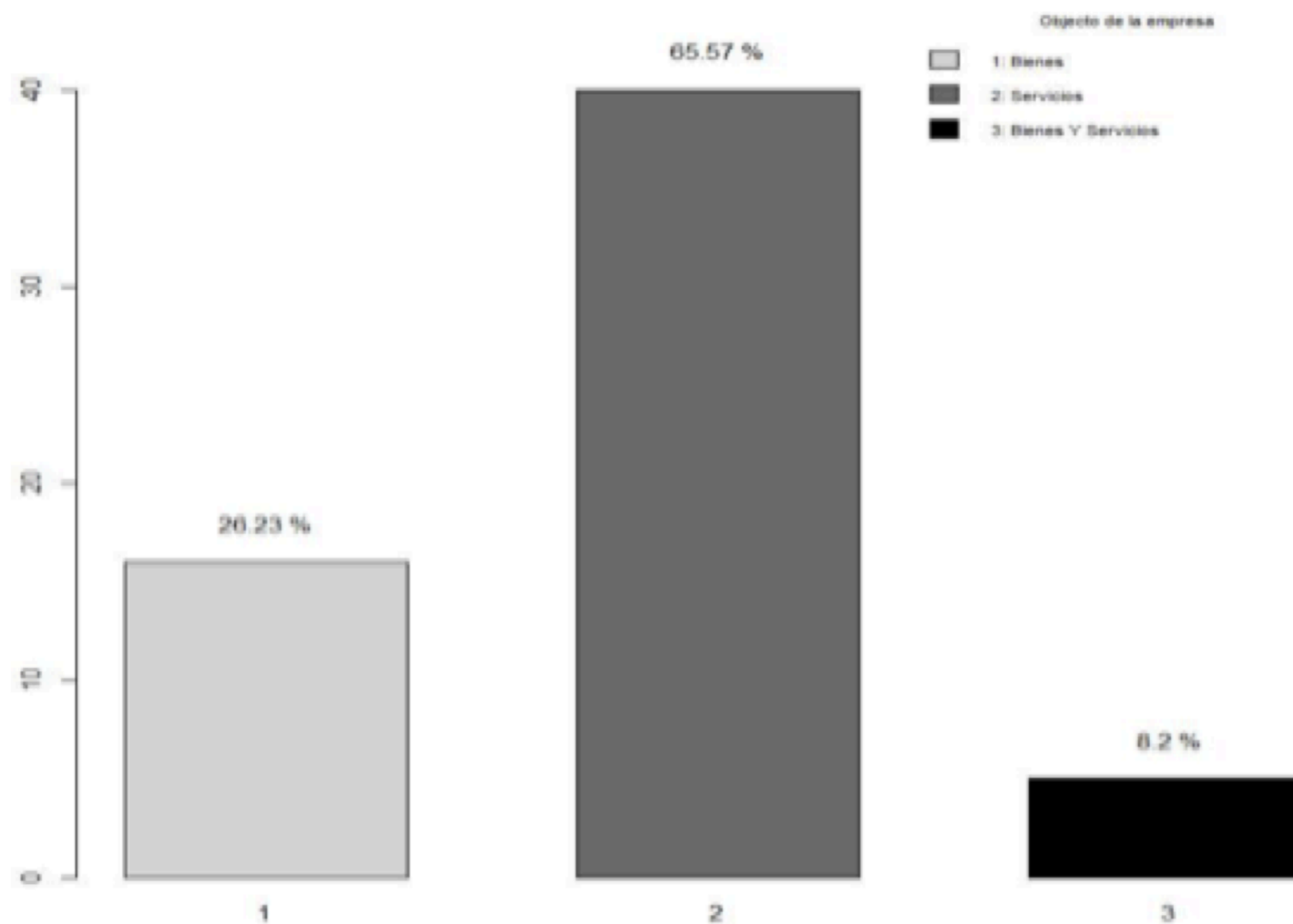
Figure 1. Division of companies by sector



Source: Own elaboration, based on field work

Figure 2. Division of companies according to social object

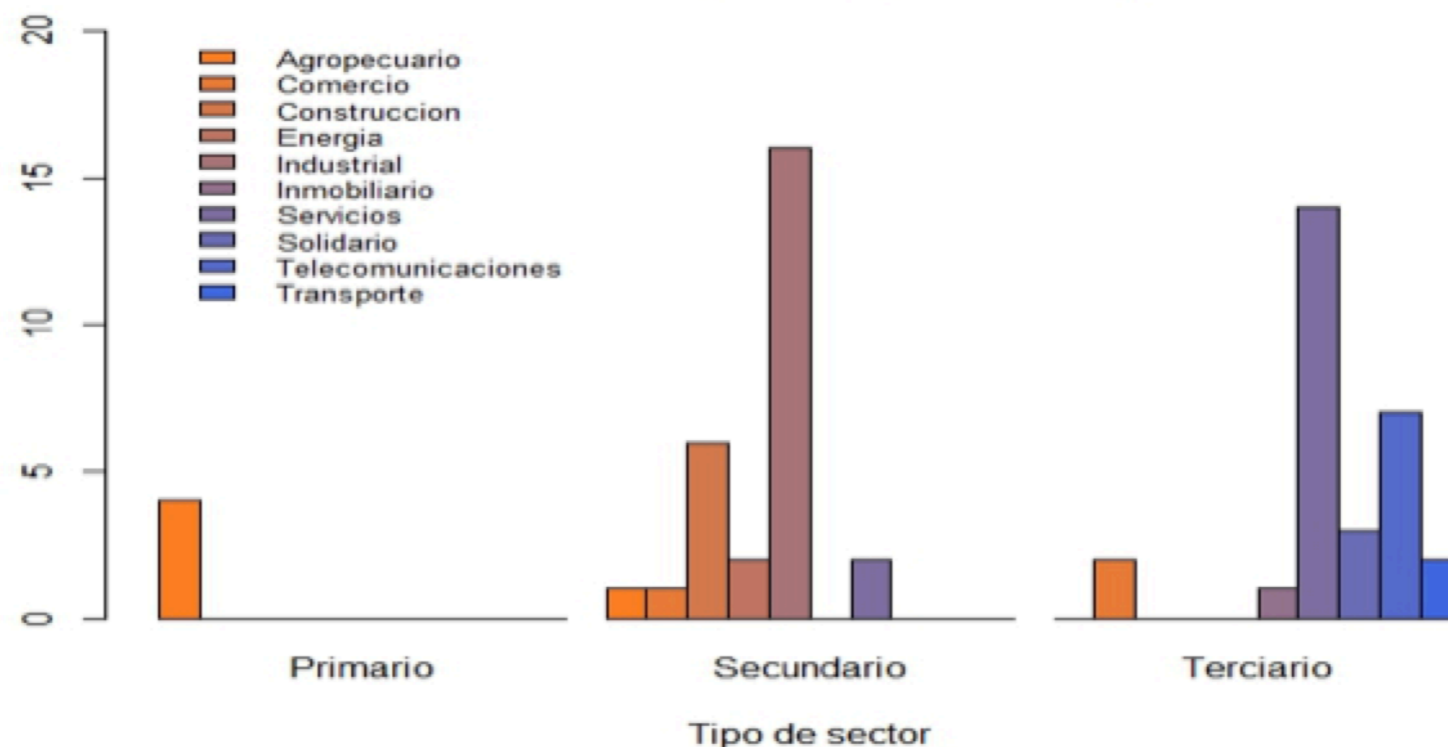
División de la empresas por el objeto de la empresa



Source: Own elaboration, based on field work

Figure 3. Sample distribution by sector and subsector

Distribución de las empresas por sector y sub sector



Source: Own elaboration, based on field work

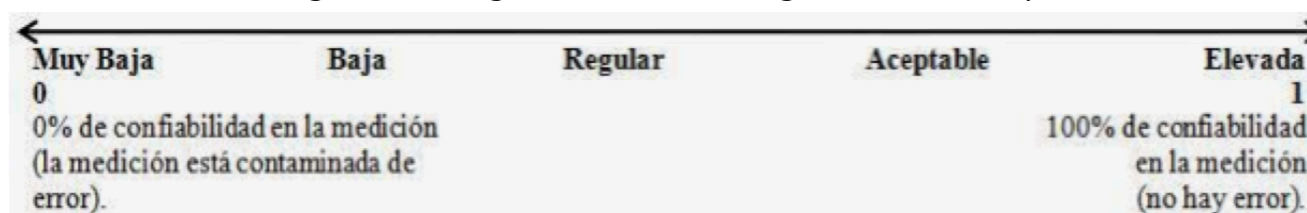
Measurement

It was initially debugging data base with 61 innovative companies that were surveyed in Medellin - Colombia, organizing each of the variables that were to be used in the measurement.

Then the realization of a parsimonious model and the unification of the ratings given by the companies in each of the survey questions, giving a weight assigned by the expert to then add them and create a single rating. Then validated through Cronbach's alpha for variance.

Validation, through the Cronbach's alpha for variance, aims to verify whether the instrument used collects reliable information, the results show that from 0.7 to 0.8 for each variable indicators are reliable. From 0.8 are highly reliable, according to George and Mallery (2003, p. 231). Figure.4.

Figure. 4. Weight validation through Cronbach's alpha



Source: George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference*. 11.0 update (4th ed.). Boston: Allyn & Bacon. pp 215-236.

Variable	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
ADQ	1.22	2.54	2.82	2.92	3.26	4.20
ASIM	1.22	2.60	3.08	3.03	3.44	4.62
TRANS	1.82	2.74	3.38	3.26	3.78	4.82
EXPL	1.38	2.54	3.20	3.15	3.80	4.50
INN	1.40	2.29	2.68	2.72	3.21	4.15
INNID	1.36	2.23	2.92	2.83	3.46	4.30
INNESF	1.00	2.00	2.80	2.61	3.20	4.20

Table. 3. Summary rating companies in absorptive capacities and innovation activities

Source: Own elaboration

From Figure.4 analysis of the application of Cronbach's alpha is made for each of the variables used in the research (acquisition, assimilation, transformation, exploitation, innovation R & D and innovation efforts), showing that the items used in the measuring instrument are reliable or very reliable. It is inferred that for variables: Assimilation, Exploitation and Innovation its Cronbach's alpha is strongly Acceptable, according to George and Mallery (2003, 231 p.). In addition, when the 5 main variables join a Cronbach's alpha of 0.8838, ie that is very reliable (George and Mallery, 2003, p. 231), validating the items of each of the variables is obtained. Table4.

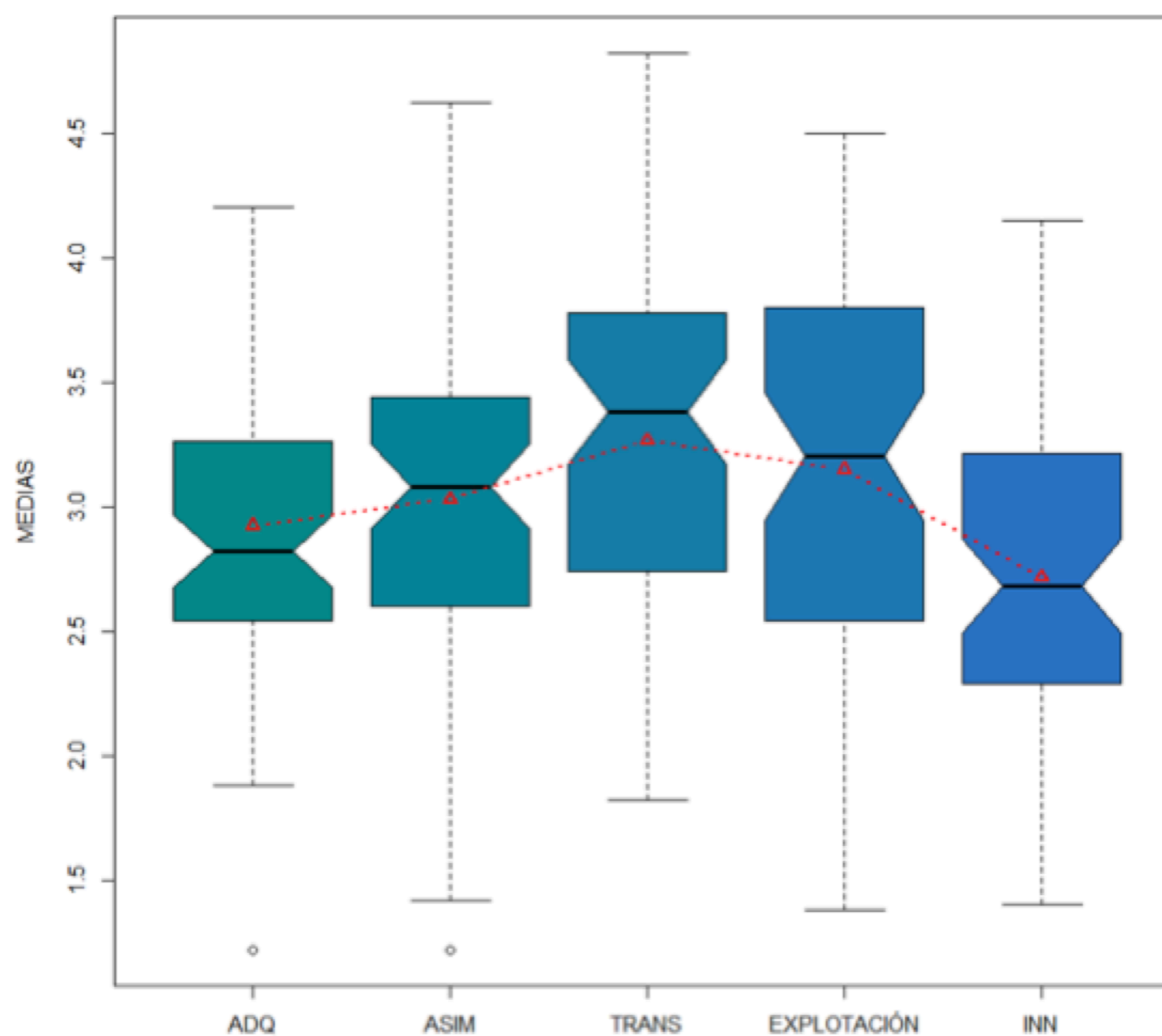
Table.4 Results of the application of Cronbach's alpha to variables

Variable	Cronbach's alpha value	
Acquisition	0.6957	Reliable
Assimilation	0.8125	Very Reliable
Transformation	0.7801	Reliable
Exploitation	0.8984	Very Reliable
Innovation	0.8586	Very Reliable
Innovation R&D	0.7628	Reliable
Innovation innovative efforts	0.7501	Reliable

Source: Own elaboration, based on field work

After validation, carried out a cluster analysis (Figure 6), which is a group of multivariate techniques used to classify individuals or companies in different groups. The aim of this technique is to form as homogeneous as possible and different clusters including (Hair et al., 1999).

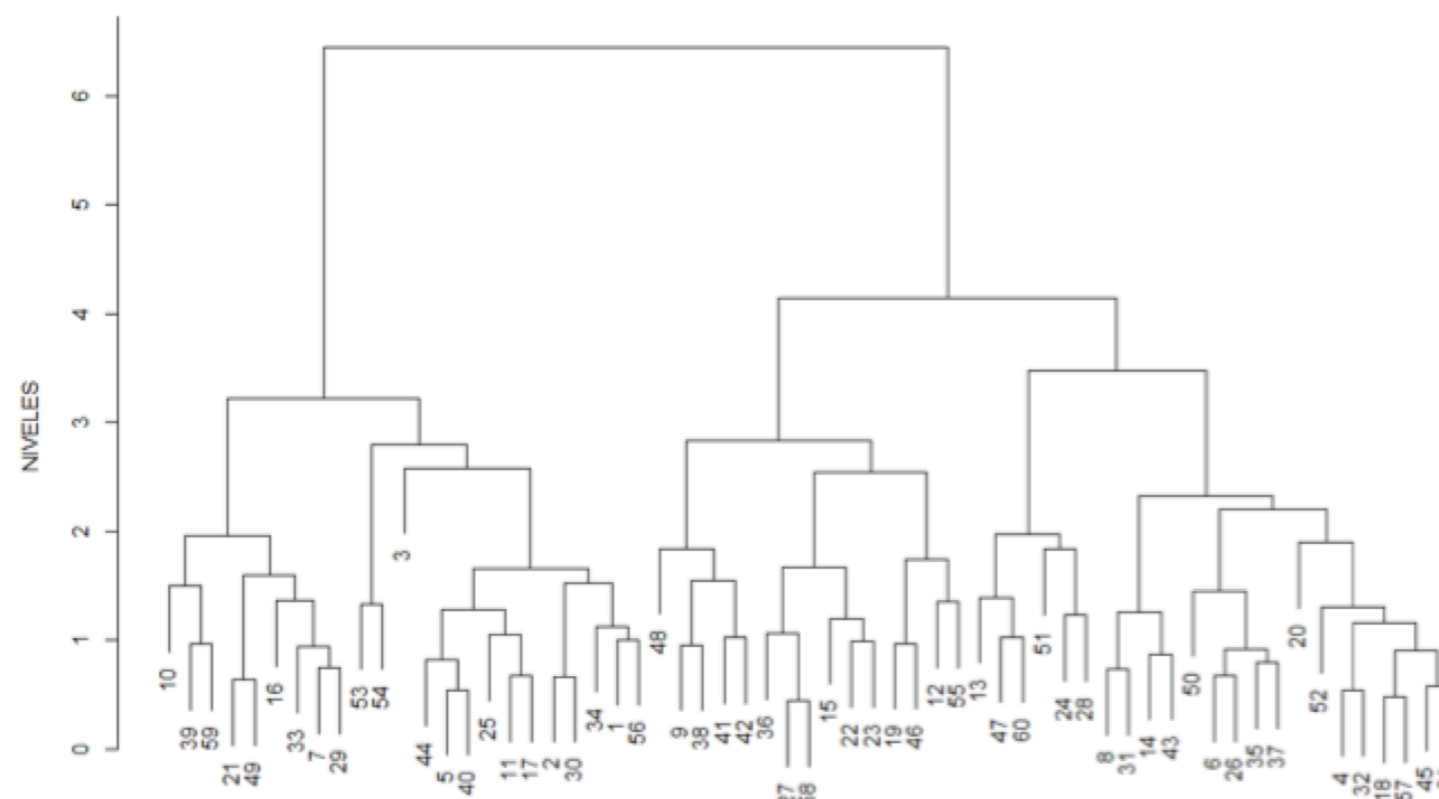
Figure 5. Absorption capacity rating interval and innovation activities



Source: Own elaboration, based on field work

The analysis of clusters results in the existence of 6 groups of companies, a result ratified with the Bayesian criterion of information that allows to know the distribution of these companies within each cluster or cluster, showing the variables that measure the phases of the absorption capacity (Acquisition, assimilation, transformation and exploitation) and innovation activities (innovation R & D and innovation efforts), with significant differences of 95% confidence level within the different groups. The conglomerate 1 comprises 22.95% of the companies in the sample (14 companies), the conglomerate 2 groups 27.86% of the sample (17 companies), the cluster 3 groups 14.75% of the sample (9 companies), Conglomerate 4 groups 8.19% of the sample (5 companies), cluster 5 groups 16.39% of the sample (10 companies) and cluster 6, groups 9.83% of the sample (the 6 Companies). In addition, Figure 4 shows how groups were organized by clusters.

Figure 6. Clustering of clusters



Source: Own elaboration, based on field work

5. Analysis of results

The results allow the identification of six conglomerates, each grouping one of the companies studied, taking into account affinity criteria, a detailed analysis is done in each of these conglomerates.

Conglomerate 1

In this group are Medellín median companies with more than 11 workers, who have more than 6 years in the market. The companies in this group have low capacity to acquire learning through the communication of the company with laboratories and universities and little capacity to carry out systematic searches of external information relevant to the organization; Invest less than 0.9% of the R & D budget, perform few training processes oriented towards innovation projects with employees and present a low level of knowledge management in the organization. In addition, the results show that there is a low capacity of the organizations of this conglomerate for the assimilation of

knowledge that comes from outside the organization. Equally, the organizations of this group have a low level in transformation and exploitation of knowledge. This is related to the results of these organizations in relation to innovation activities (innovation R & D and innovation efforts), which are the lowest of all the organizations analyzed.

Conglomerate 2

In this group are 17 companies, almost all of services (15 of the 17 companies that are part of this group are services) All with more than 50 workers, and more than 10 years old. In terms of absorption capacities, the companies in this group have a low acquisition capacity, and in general they have a good assimilation capacity, since they identify, understand and adopt the innovations that others develop; In addition they present a good capacity of transformation, especially in relation to the linkage of the knowledge of the company with the innovations of the market and the integration between the technology created by its company and the one that comes from outside; In addition, they have a good capacity of exploitation since they use the knowledge obtained from the environment in favor of new services of the companies and develop new services using the innovations and ideas developed in other places, which is reflected in the commitment of the organization with Innovation activities.

Conglomerate 3

In this conglomerate are located 9 companies, of goods and services, the majority of the companies of this group have more than 50 years of existence in the market. In terms of absorption capacities, the companies in this conglomerate have a very low acquisition capacity, especially reflected in R & D investment, which is lower than 0.9%, and in the little promotion of knowledge management in The employees, especially in what has to do with the exchange with other companies or between the same units and the search for relevant external information.

The capacity for assimilation is also low and it is noteworthy that the transformation capacity of the companies in this group is that of the lowest results, which shows their difficulty in assimilating knowledge that comes from abroad and is reflected in a low level Of exploitation in the products or services. The innovation activities of the companies in this conglomerate are the least successful of all groups, showing that companies, in addition to having a low investment in R & D, do not have plans for the development of innovation activities, nor is there great concern.

Conglomerate 4

This conglomerate is made up of 5 companies that represent 8.19% of the sample, made up of service companies with more than 10 years in the market. In relation to absorption capacities, the companies in this group have a good capacity Of the acquisition of knowledge, only surpassed in the results by the conglomerate 6. In the assimilation of knowledge the companies in this group present the highest result, standing out their ability to understand, adopt and assimilate the knowledge coming from outside the organization and The internal flow of communication to make this new knowledge circulate in an agile way for all units. There is a good capacity for transformation and exploitation of new knowledge, highlighting the ability of these organizations to use the knowledge gained from the environment in favor of their products or services. This is reflected in a good development of innovation activities, especially in innovation efforts, where companies present interesting advances especially in relation to the quantity and quality of new products or services designed and developed according to the Needs of the market.

Conglomerate 5

In this conglomerate are located 10 companies, showing a mixture between new companies in the market (under 5 years) and companies already consolidated with more than 30 years in the market, with two companies with less than 50 workers and the others with more Of 50 employees. In the development of the absorption capacities these companies have good capacity of acquisition and assimilation of knowledge; A very good ability to transform knowledge, highlighting here his ability to adjust the strategic decisions of the organization based on the knowledge they get from the environment and apply new knowledge in the work of each employee. Despite the good capacity for transformation of knowledge the results in the exploitation of knowledge are not so good for this group of companies, showing some shortcomings to achieve the development of new products or services using innovations or ideas developed elsewhere. On the other hand, the results of the innovation activities show a low capacity of the organizations of this conglomerate to make plans that allow a better development of the activities of innovation, a better development of new products in alliance with other companies and to make a better valuation Of the quality and quantity of organizational knowledge.

Conglomerate 6

It groups 9.83% of the sample, that is, a total of 6 companies, which have more than 10 years in the market and have between 11 and 49 workers. The companies of this conglomerate show a very good development of the absorption capacities, invigorated by an investment in R & D over 2%, which allows a very good search of external information relevant to their businesses, the realization of very Good training processes with employees and promotion in knowledge management organizations, especially because employees always want to "go beyond" in each of the activities they do, seek to generate change and make permanent interactions with other units and Business; They also have a good capacity for assimilation of external knowledge, a good capacity for transformation. The organizations of this group also show the highest results in the exploitation capacity, since they use external knowledge in favor of their products, take advantage of external knowledge for the benefit of their products and processes and are constantly modifying the products or Services based on the knowledge acquired from others. All of the above is reflected in a very good level of innovation capacities both in R & D and in innovation efforts, shown by the organizations.

6. Discussion and conclusions

The results of the research coincide in large part with what the theoreticians put forward, since the concept of absorption capacities is very difficult to conceptualize, especially if it is to characterize in a specific context (Murovec and Prodan. , Foss and Lyles., 2010).

In addition, it is considered important to take into account the criticism made by Todorova and Durisin (2007) when they point out that the reconceptualization of Zahra and George (2002) does not seem to start from the initial concept of absorption capacities proposed by Cohen and Levinthal (1989) Three reasons. The first, because they eliminate the step of recognition of the value of new knowledge. The second, because it seems that the beginning of the process of transformation is a consequence of the process of assimilation of new knowledge and, thirdly, it is very complex to establish relations between the processes of acquisition, assimilation, transformation and exploitation of new knowledge, arguing That each step can influence the next without being able to see the linearity between one and the other.

The results of the research show the existence of a relationship between R & D investment and the development of absorption capacities. According to the companies that are part of the conglomerate 6, where there is a good development of the absorption capacities, stimulated by a high investment in R & D, which is above 2%, or that allows a good search of information External environment relevant to their business, good training processes with their employees and promotion in knowledge management organizations, especially in

relation to employees always wanting to "go further" in each of the activities that they realize, they look for to generate changes and they make permanent interactions with other units and companies; They also have a good ability to assimilate external knowledge, a good transformation capacity and high results in the exploitation capacity, since they use external knowledge in favor of their products, take advantage of external knowledge for the benefit of their products and processes, and are constantly modifying products or services based on the knowledge gained from others. All of the above is reflected in a good level of innovation capacities, both in R & D and in innovation efforts, shown by the organizations. In contrast, the results of the cluster 3 show how the low R & D investment generates a low absorption capacity in the organizations of this group. The results are different from those found by Schmidt (2005) who presented in their results that the current R & D expenditure of a company does not have a special contribution to the development of absorption capacities. Instead, it helps develop the skills and knowledge needed to access the external source of knowledge over time. In this sense, the absorption capacity is cumulative. In particular Schmidt, T. (2005), found that the intensity of R & D does not significantly influence the development of intra- and inter-industrial knowledge absorption capacity.

One of the conclusions that could be reached in light of the results found in the research, is that it seems that the companies that have more developed the capacity of acquisition and the capacity of assimilation, which conform what Zarha and George (2002) are called potential absorptive capacity, they are the companies that present better results in innovation activities, both in R & D and in innovation efforts, noting that this group of companies are also the ones that make the most R & D investment. Approaching the results to what Van den Bosch, F.A., J., Volberda, H. W., and J.P. Jansen, M. (2003, p. 21) conclude in their studies how potential absorptive capacity induces particular adaptations in organizations and from potential absorptive capacity improves a unit's ability to renew its stock of knowledge, which generates greater impact on innovations and develops the capacity of a unit to create revolutionary inventions.

On the other hand, the research coincides with that proposed by Camisón and Forés (2010: 709), which suggest that when the company wants to integrate new tacit external knowledge, regardless of its relation to the base and structure of previous knowledge in the company, this knowledge must be understood, analyzed and processed. The results show that when companies have good transformation capacity, there is a good exploitation through the application of knowledge in new products and services and better results are seen in the activities of innovation related with R & D and innovation efforts.

It was also found, coinciding with, Lane et al. (2001), Jansen et al. (2005), Liao et al. (2007), Camisón and Forés (2010), Jiménez-Barrionuevo et al. (2011) and Flatten et al. (2011), who propose that in order to avoid falling into one-dimensional studies that do not clearly differentiate each of the subprocesses that are part of the absorption capacities, the best alternative is to use measurement scales with multiple indicators that capture their multidimensional nature, which was what we tried to do in this research.

We conclude with Camisón and Forés (2010) that despite the proliferation of different models and applications of absorption capacity, there is still no commonly accepted conceptual and methodological basis, which makes it difficult to compare and disseminate results between studies.

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[Índice]

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