

Collaboration between companies and universities: an analysis of structural and behavioral contingency factors

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Abstract:

Nowadays, in a constantly evolving socio-economic environment, companies are increasingly relying on university resources to maintain or gain a competitive advantage. For its part, the university also aims to enhance the value of research developed by its scientific expertise. This article falls within this perspective. Based on the results of a study conducted among 150 Algerian firms, we have identified the most significant factors influencing the research cooperation strategy with universities.

Keywords: Business-university cooperation, Research and development, Contingency factor, Structural, Behavioral.

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1. INTRODUCTION

In a knowledge and technology-based economy, the survival of businesses has become dependent on their innovative capacity. Therefore, innovation has become the driving force of the competitive advantage whose creation involves resource mobilization. The latter are not only commercial, but also technological, partly held by universities and other research centers. The variety of these resources and the complexity of their ownership drive businesses today to make connections with partners to carry out their development strategy. It is through these means that the constraints hindering the innovation process may be lifted.

This so-called cooperative approach marks the transition from « intramural » enterprise-inclusive research, which has been proven to have limitations, to collaborative research which favors the association between partners that implement common means to create better synergies. In this study, we are particularly interested in the cooperative relationships that emerge between businesses and universities.

The university is generally regarded as the sphere of knowledge and a key link in the social and economic development. The University is no longer the institution that operates in a « vacuum » on fundamental research projects. In addition to its role of education, the university is considered as an institution which provides new ideas that can take part of innovation development processes, resulting from « industrial and commercial applications of a certain discovery or another invention »: a useful, valued and patented creation which enables the university to better follow up economic and technological evolution as well as acquire the necessary resources at the same time.

Being aware of the position held by the university in applied research, businesses no longer hesitate to seek external expertise in order to build their development projects. Seminars and symposia on the business-university relationship are being held and much work is being carried out on centers of excellence and competitively clusters.

In the case of Algeria, despite having a legal arsenal that is embodied with the definition of a legal framework and the implementation of certain

operational instruments, businesses' use of external expertise, illustrated with universities, is slow if we consider field findings, obtained from the agreements signed between the two parties.

The lack of enthusiasm shown by Algerian businesses towards research offers, provided by the university, brings us to attempt to find explanations that are likely to shed light on this situation, by answering:

What are the (structural and behavioral) contingency factors that impact the businesses which are involved in partnership processes with the university?

To our best understanding, this study provides an original contribution within the Algerian context, in so far as the link between the decision to cooperate and the characteristics that are peculiar to the businesses has not been yet studied empirically.

Based on previous studies that were conducted in other contexts, we were able to showcase the determining variables that can explain the businesses' decision to cooperate with universities. However, before proceeding to present the findings of our study and achieve our aim, we will present the theoretical framework of the study, followed by the research methodology, which is based on a quantitative study conducted with 150 Algerian firms. Lastly, we will present our findings by identifying the attributes that drive Algerian businesses to develop cooperation strategies with universities.

2. Theoretical framework.

2.1 Cooperation between Businesses and Universities.

Based on the literature, fourteen patterns may be identified on the cooperation modalities between businesses and universities (Laperche, 2002; Bekkers et Freitas, 2008):

- Research projects developed in partnership;
- R&D services and service provision, which stands for all the services that are provided by scientific research and for which the industry is the sponsor. Businesses seek the expertise of academic researchers to carry out research projects (research contract) or to have access to services, such as specific tests and studies.

- Staff mobility, which refers to the transfer of researchers from university to the industry and vice versa, from the industry to university.
- Industrial property rights, which result from the granting of licenses held by the university or the co-filing of patents by the business and the university.
- Scientific publications, which refer to the co-publication of scientific articles, written by industrials and university researchers. The objective is to merge the academic vision with the practical vision to create knowledge.
- Joint participations in scientific meetings, which refers to the conferences and symposia in which both industrials and academicians participate, - recruitment of academics by businesses;
- Continuous training of industry staff, provided by the university;
- Graduation and post-graduation internships.

2.2 Contingency factors.

The authors of the contingency theory are considered as the first to attach an importance to the business environment and its relation to the business structure, by questioning the existence of an ideal structure. The theory of contingency suggests to underline a set of factors that impact the choice of the organizational structure. According to Mintzberg (1982), they stand for the size of the organization, the age, the technical system, the environment in which it evolves, in addition to the exercise of power and technology, according to Jean Woodward (1965).

The scope of this theory transcends the simple traditional framework, which is concerned with the study of the relation between the structure and the environment to study the relation between contingency factors and innovation, along with the internalization or externalization of functions, information and communication technology as well as the form and degree of cooperation...

In this study, we distinguish between two types of contingency factors, which are, amongst others, behavioral contingency factors that include, the manager's age, educational level, training and his ability to take risks, in addition to structural contingency factors, which include, the business' size, sector of activity, market competitive intensity, the importance attached to

R&D activities and invention patents, respectively. According to Lavigne (2002), structural contingency factors are related to organizational characteristics, whereas behavioral contingency factors are related to organizational actors, according to Chapellier (1994).

This article aims to study:

- The relation between structural contingency factors and cooperation strategies with universities.
- The relation between behavioral contingency factors and cooperation strategies with universities.

2.3 Structural Contingency Factors and Cooperation Between Businesses and Universities.

The research that attempted to study structural contingency factors with an impact on the universities which maintain scientific partnership relationships (universities), highlights the existence of a set of attributes that are particular to these businesses. The authors adopted a quantitative approach, based on the different surveys conducted on innovation.

In the case of Algeria, to the best of our knowledge, no study has been conducted on the subject of the characteristics of businesses that cooperate with universities. We were able to locate only one doctoral thesis that was concerned with the key incentives for innovation in SMEs. Thus, our first primary research hypothesis is the following:

H1: Structural contingency factors have a significant impact on the businesses' decision to cooperate with universities.

a. The Size of the Business:

The size factor has been used to explain the businesses' ability to innovate. Schumpeter is the first to highlight large businesses' ability of large businesses to innovate, compared to small businesses; according to Schumpeter, large firms have the financial means to support innovation. In the last twenty years, other research sparked and found out that, in different contexts, the proportion of large businesses that cooperate with public research institutions (universities and research centers) is greater than that of SMEs (Warda, 1995; Miotti Sachwald, 2003; St Pierre & Hanel, 2005; Schimdt, 2007; Segarra, 2011; Al Bachawaty, 2015). On the other hand,

Todtling et al. (2009) also found out that large firms are more adept to cooperate with universities and research organizations, regardless of the type of relations they maintain with them (informal information exchange, contractual relationship, network relationship). This phenomenon can be explained by the importance of the resources held by these businesses (Dachs et al, 2004), their social and commercial notoriety as well as their potential job offers. St Pierre & Hanel (2005) add that large businesses cooperate more than small businesses because they have contact networks, reinforced with their experience in cooperation.

Other authors equate the size of the business with other factors. Miotti & Sachwald (2003) find that the size of the business goes hand in hand with market share and group membership. Thereby, the businesses that hold a large market share and those that belong to a group are the most likely to cooperate in R&D.

Therefore, we can formulate the following secondary research hypothesis:

H1. a. The size of the enterprise has a significant impact on the businesses' decision to cooperate with universities.

b. The Sector of Activity:

Bourezak (2001) notes that businesses in the high technology sector (central sector) and those in the low technology sector (sector other), are the entities that cooperate most with universities. For their part, St Pierre (2002) and St Pierre & Hanel (2005) find that businesses in the central sector (high technology) are more likely to cooperate with universities. According to the aforementioned authors, cooperation is weak in the sector « other » because of the fact that this sector uses innovations that require practical knowledge, which cannot be found in university expertise.

Tether (2002) maintains that high technology businesses are the most likely to cooperate with external parties.

By comparing cooperation in the field of innovation between Austria and Finland, Dachs et al. (2004) conclude that cooperation in Austria is strongly related to the sector of activity, unlike its Finnish counterpart, where high, medium and low technology businesses opt for external cooperation.

Todtling et al. (2009) consider that the fact of belonging to a high

technology or services sector does not justify the act of cooperation. These conclusions are consistent with the findings of Olosutean (2011) which concludes that SMEs can perfectly not belong to a technology-intensive sector and build cooperations.

Therefore, we can formulate the following secondary research hypothesis:

H1. b. The technological intensity of the sector has a significant impact on the businesses' decision to cooperate with universities.

c. Competitive Intensity

Warda (1995) reveals that national businesses which face foreign competitiveness are the most likely to develop cooperation agreements with universities.

On the other hand, Baldwin & Hanel (2000) note that competition prevents firms from collaborating with research organizations, universities more particularly.

It appears that other contexts produce different outcomes. All that can be said at this stage is that the businesses that cooperate with universities have certain characteristics which influence their decision to cooperate. In the following, we will identify these characteristics within an Algerian context.

H1. c. The competitive intensity has a significant impact on the businesses' decision to cooperate with universities.

d. The importance attached to R&D activities.

Berman (1990) took an interest in the impact of public research funding on R&D spending. He notes that businesses that cooperate with universities increased their spending, in result of this cooperation.

In different contexts, a multitude of authors indicate that conducting in-house R&D activity goes hand in hand with external cooperation (Miotti Sachwald, 2003; St Pierre & Hanel, 2005; Segarra, 2011). Therefore, cooperation in terms of innovation is not a substitute to in-house R&D activities, but the two alternatives are complementary. Industry researchers that work in an enterprise which has an in-house research structure can work with academic researchers to jointly develop a new innovation. An enterprise carrying on in-house R&D activities can also directly seek academic researchers to develop an innovation. In both scenarios,

knowledge is complementary.

According to St Pierre and Hanel (2005) and Merzouk, F., & Mancer, I. (2023), businesses that have an in-house R&D structure and cooperate with public research institutions are large in terms of size and form part of the high technology sector. These findings support the idea that large businesses have the resources which allow them to carry out R&D activities as well as contribute to academic research funding. These findings confirm the idea that businesses in the central sector have a greater need for R&D, which explains their level of collaboration with the university.

Therefore, we can formulate the following secondary research hypothesis:

H1. d. The importance attached to R&D activities has a significant impact on businesses' decision to cooperate with universities.

e. The Importance Attached to Invention Patents

St Pierre & Hanel (2005) reveal that, unlikely to businesses that do not cooperate, businesses that work in collaboration with academic institutions, attach greater importance to the different means of protecting intellectual property rights.

In their work of comparing research cooperation on innovation between Austria and Finland, Dachs et al. (2004) note that in the case of Finland, there is a link between the importance attached to invention protection strategies and the proportion of external cooperation, contrarily to Austria where the likelihood of cooperation is not really related to intellectual property rights.

As for Belgium, according to Cassiman and Veugelers (2002), the fact of using protection methods increases the likelihood of cooperation. The findings of Schmidt (2007) support these results, in regards to Canadian businesses that resort to patent and trademark protection.

Therefore, we can formulate the following secondary research hypothesis:

H1. e: The importance attached to invention patents has a significant impact on businesses' decision to cooperate with universities.

2.4 Behavioral Contingency Factors and the Cooperation Between Businesses and Universities.

Cooperation between businesses and universities is a key element in the

development of innovation, the acquisition of new knowledge and the improvement of organizational processes. This cooperation can take various forms, such as research partnerships, internship programs or collaboration in technological development projects. However, the literature highlights that there are numerous factors which influence this cooperation, including the manager's behavioral characteristics, such as age, educational level, area of training and risk aversion which have a crucial role. These factors can affect the way a manager perceives and initiates partnerships with universities, therefore, influencing the business' innovation strategy.

Thus, our second primary research hypothesis is the following:

H2. Behavioral contingency factors have a significant impact on the businesses' decision to cooperate with universities.

a. The Manager's age.

The age of the manager is a fundamental factor which influences his/ her strategic decisions, including the decision to cooperate with universities. According to several studies, age can influence the manager's propensity to take risks, embrace new innovations or establish partnerships with academic institutions.

Younger managers, with less experience in the sector, may be more inclined to seek academic partnerships to reinforce their knowledge and develop new technologies (Vázquez et al., 2017). On the contrary, older managers, usually with more experience, may tend to favor more conservative practices that are less dependent on academic cooperation (Miller & Le Breton-Miller, 2005). This dynamic shows that age could play a significant role in the openness or resistance to innovation and external collaborations.

Therefore, we can formulate the following secondary research hypothesis:

H2. a: The manager's age has a significant impact on businesses' decision to cooperate with universities.

b. The Manager's Educational Level.

The educational level of the manager is another determining factor of his openness to cooperate with universities. Managers with a higher educational level, especially a master or doctorate degree, are usually better suited to understand the importance of academic research and more likely to

see the interest in making connections with academic institutions (Dyer et al., 2019). These managers, usually have a better understanding of research and innovation processes and may perceive universities as strategic partners in improving the competitiveness of their business. However, less educated managers may be less familiar with these processes. Thereby, they may be less inclined to develop academic partnerships.

H2. b. The manager's educational level has a significant impact on the businesses' decision to cooperate with universities.

c. The Manager's Area of Training.

The manager's area of training, whether in science, management or in another area, influences also the way he/ she perceives the advantages of cooperating with universities. Managers with a technical or scientific training are usually more inclined to establish partnership with universities for research purposes and the development of new technologies (Mowery et al., 2001). For instance, a manager with a background in engineering may seek collaborations with universities on applied research projects or technological innovations (Mowery et al., 2001; Benhamma & Hemissi, 2021). In contrast, those with a non-technical background, as in social sciences or humanities, may be less sensitive to the advantages of academic research in terms of technological innovation and product development (Etzkowitz et al., 2000).

H2. c. The manager's area of training has a significant impact on the businesses' decision to cooperate with universities.

d. The manager's risk aversion.

The manager's risk aversion may influence his/ her willingness to get involved in partnerships with universities, the latter are usually perceived as a risky long-term investment. Managers with a low risk aversion are generally more open to explore new opportunities, including collaboration with universities. These managers may perceive the partnerships as one way to accelerate innovation, improve competitiveness and acquire specialized knowledge in specific fields (Zahra & George, 2002). Conversely, managers with a high-risk aversion prefer to avoid getting involved in collaborations that may entail uncertainty or high financial costs, thereby, reducing

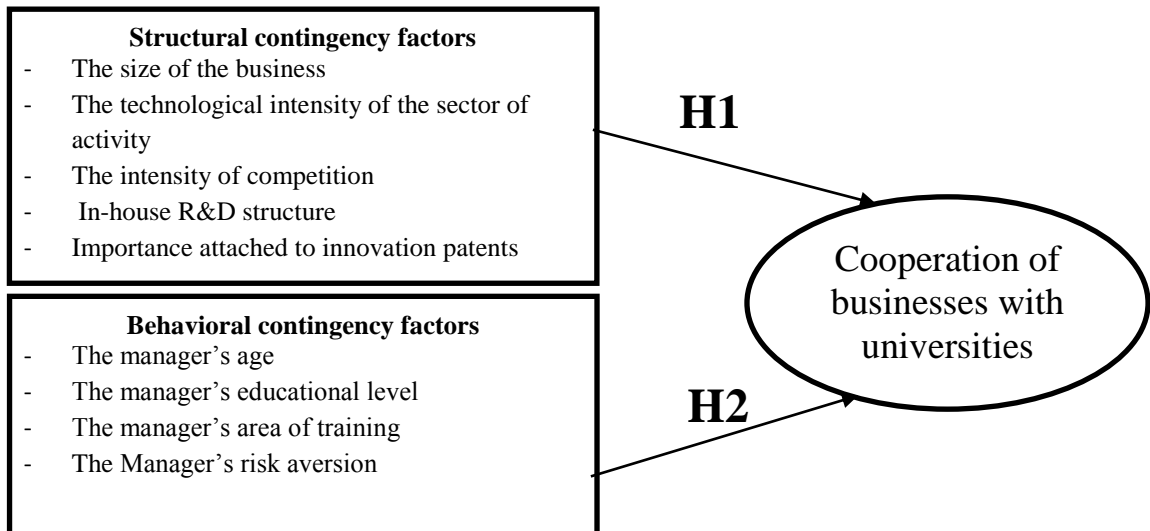
opportunities for cooperation with universities (Kleindorfer & Saad, 2005).
H2. d. The manager's degree of risk aversion has a significant impact on the businesses' decision to cooperate with universities.

3. Research methodology.

3.1 Research Model.

Nowadays, an ever-growing importance is given to cooperation strategies between businesses and public research institutions (university laboratories and research centers). This observation motivated us to adopt an empirical approach to examine the profile of businesses that cooperate with universities. Our research model consists of studying the influence of structural and behavioral contingency factors (independent variables) or the decision to cooperate with universities (dependent variable).

Figure N° 1. Research model.



Source: elaborated by the authors.

3.2 Data Collection and Analysis Method.

In order to collect data for our survey, we opted for a questionnaire survey that we distributed over 180 businesses. We obtained 150 responses, equivalent to a response rate of 83.3%.

Before administering our questionnaire, we had it tested on a pilot sample of a limited number of businesses. The latter confirmed that the questions were clear, unambiguous and did not touch on confidential aspects.

Before proceeding to analyze the answers obtained from our questionnaire survey, we carried out a descriptive analysis to calculate the frequencies of different variables. Subsequently, we used the multiple regression model to check the hypotheses. This method allows us to examine the relationship between the dependent variable (cooperation with universities) and the explanatory independent variable (structural and behavioral factors).

3.3 Operationalization of Variables.

3.3.1 Operationalization of the Variable of “Structural Contingency Factors”.

In order to collect data on the structural contingency factors, we maintained the following variables:

- **The size of the business:** This variable was measured using a single-item question on the number of employees. This allowed us to group businesses into two categories: large businesses on the one hand and small and medium businesses (SMEs) on the other hand.
- **The technological intensity of the sector of activity:** This variable was measured using a single-item question on the nature of the sector to which the business belongs. This allowed us to group businesses into three categories: low, medium and high technology.
- **The intensity of competition:** This variable was measured using a single-item question on the level of competition in the sector of activity. This allowed to divide competition of activity into three levels: low, medium and strong competition.
- **Presence of an in-house R&D structure:** This variable was measured using a single-item question on the presence or absence of a structure that is specifically dedicated for research and development activities (R&D).
- **Importance attached to invention patents:** This variable was measured using a single-item question on the possession or otherwise of one (or more) invention patents.

3.3.2 Operationalization of the Variable of “Behavioral Contingency Factors” In order to collect data on the behavioral contingency factors, we maintained the following variables:

- **The manager’s age:** to classify managers according to the age factor, we

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created three age groups: from 25 to 35 years, from 36 to 45 years and from 46 and older.

- **The manager’s educational level:** to identify the educational level of managers, they were asked a question with seven response choices: self-taught, primary education, secondary education, higher technician diploma, bachelor degree, master degree or PhD.
- **The manager’s area of training:** this variable was measured using a question with three answer choices: scientific stream, management science stream or humanities stream.
- **The manager’s risk aversion:** to assess the degree of the managers’ risk aversion, they were asked a question with three answer choices: low, medium or high.

3.3.3 Operationalization of the Variable “Decision to Cooperate with Universities”

To measure the degree of cooperation between businesses and universities, 9 items were elaborated and assessed using a five-point Likert scale: never, rarely, occasionally, frequently and very frequently.

4. Results and discussion.

4.1 Findings of the Descriptive Analysis.

4.1.1 Analysis of the variable “Structural Contingency Factors”.

Table 1. Descriptive analysis of the variable “structural contingency factors

Variables	Components	Frequency %	Standard Deviation
Size	SME	40%	0,49
	Large business	60%	0,49
Technological intensity of the sector of activity	Low technology	10%	0,41
	Medium Technology	20%	0,46
	High technology	60%	0,50
Intensity of competition	Low	15%	0,36
	Medium	35%	0,48
	Strong	50%	0,50
In-house R&D structure	Yes	70%	0,46
	No	30%	0,46
Importance attached to invention patents	Yes	65%	0,48
	No	35%	0,48

Source: developed by the author based on (SPSS, 21)

The analysis of table No 1 allows to deduce the following:

- The majority of businesses surveyed are large in terms of size (60%), however we witness a significant representation of SMEs.
- Technology-intensive sectors are predominant in the sample (60%), which may influence business strategies.
- Strong competition appears to be a key characteristic for these businesses (50%), which may drive them to innovate or adapt rapidly.
- A majority of businesses invest in R&D structures (70%), which reflects their orientation towards innovation.
- Patents are valued by a majority of businesses (65%), which reflects a strategic orientation towards intellectual protection.

4.1.2 Analysis of the variable “Behavioral Contingency Factors”

Table 2. Descriptive analysis of the variable “Behavioral contingency factors”.

Variables	Components	Frequency %	Standard Deviation
Manager’s age	25-35 years	10%	0,30
	36- 45 years	50%	0,45
	45ans- and older	40%	0,50
Manager’s educational level	Self-taught	1%	0,10
	Primary education	4%	0,25
	Secondary education	5%	0,30
	Higher technician	15%	0,35
	Bachelor degree	5%	0,20
	Master degree	40%	0,40
	Doctorate	30%	0,45
Manager’s area of training	Scientific stream	40%	0,48
	Management science stream	35%	0,45
	Humanities stream	25%	0,50
Manager’s risk aversion	Low	60%	0,50
	Medium	30%	0,45
	Strong	10%	0,30

Source: developed by the author based on (SPSS, 21)

The analysis of table No 2 allows to draw the following conclusions:

- Half of the managers aged between 36 and 45 years and 40% are 45 years old and older. This indicates a predominance of managers with advanced professional experience, which may reflect stability and

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renowned expertise in business management.

- Only 10% of managers are aged between 25 and 35 years, which suggests that the majority of managers take a little extra time before assuming significant responsibility.

- The majority of managers have higher degrees. 40% of them have Master degrees and 30% have a PhD. This shows that managers are often highly qualified on the academic level, with a strong presence of highly qualified graduates. 15% of managers have a higher technical diploma, which indicates that a certain number of managers may have technical or professional training before assuming managerial responsibilities. 5% of managers have a Bachelor degree, which is the lowest recorded, whereas 5% have secondary education and 4% have a primary education. This suggests that the majority of managers have a higher educational level, although a few of them have a less academic background. 1% of managers are self-taught, which shows that some managers acquired their skills and knowledge through direct experience rather than formal education.

- 40% of managers have a background in scientific streams, which demonstrates a high proportion of leaders with a technical or scientific training. This may reflect businesses in the technological or innovation sectors. 35% of managers have a background in management science stream, which also indicates that there is a strong component that is related to business management and strategy. 25% of managers have a background in humanities stream, which may indicate a more diverse intake in terms of perspectives and human management, business culture or psychology.

- 60% of managers have a low risk aversion, which means that they are often open to investments, innovation and risk taking in their businesses. This is often an essential characteristic for businesses that seek development and innovation. 30% of managers have a medium risk aversion, which indicates that they take a more cautious approach in management, perhaps in industries with higher risks or more uncertain environments. 10% of managers have a strong risk aversion, which suggests that a minority prefers more conservative approaches in business management.

4.1.3 Analysis of the variable “Cooperation with Universities”.

Table 3. Descriptive analysis of the variable “cooperation with universities”.

	Average	Standard Type	Evaluation
The business enters into formal agreements with universities/ research centers	3.93	0.84	Frequently
The business allocates a significant proportion of the R&D budget to develop collaborative projects with universities	4.01	0.82	Frequently
The business files innovation patents jointly with universities/ research centers	1.00	0.00	Never
The business seeks university expertise for the provision of services	3.90	0.83	Frequently
The business invests in employee training through university programs	4.00	0.82	Frequently
The business participates in the creation of a joint research center or a mixed research team	1.53	0.50	Rarely
The business participates in scientific meetings (seminars, workshops, conferences...) held by universities	3.94	0.81	Frequently
The business gives importance to recruiting university graduates	3.96	0.83	Frequently
The business offers internships for university students	4.03	0.80	Frequently

Source: developed by the author based on (SPSS, 21)

The analysis of table No 3 shows that businesses in our survey sample frequently collaborate with universities within the framework of formal agreements (average= 3.93 and standard deviation= 0.84), participation in scientific events (average= 3.94 and standard deviation= 0.81), employee training (average= 4 and standard deviation= 0.82) and the establishment of internship programs (average= 4.03 and standard deviation= 0.80). Concerning development and research projects, a significant proportion of the budget is allocated to collaborative initiatives with academic institutions (average= 4.01 and standard deviation= 0.82) which demonstrates a strong willingness to innovate through partnerships. Nonetheless, even if these partnerships are frequent, certain practices remain under-utilized, such as joint filing of invention patents (average= 1.00 and

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standard deviation= 0.00) as well as the creation of mixed research centers (average= 1.53 and standard deviation= 0.50), which are hardly present in the businesses' answers. These findings suggest that there is a considerable potential to further integrate universities in more structured innovation processes, especially through collaboration on intellectual property and long-term research projects.

4.2 Multiple Regression Results.

4.2.1 Factors of Structural Contingency.

Table 4. Multiple regression between structural contingency factors and cooperation with universities.

Model	Standardized coefficients (Beta)	T	Sig
(Constant)	1,2	2,5	0,015
Size (Headcount)	0,45	3,5	0,001
The technological intensity of the activity sector (low, medium and high technology)	0,3	2,8	0,005
Intensity of competition	0,2	1,9	0,06
In-house R&D structure	0,5	4,2	0,000
Importance given to patents	0,35	3	0,003
R= 0,85; R-two= 0,72; Durbin-Watson=1,95			

Source: developed by the author based on (SPSS, 21)

The coefficient R is equal to 0,85 which allows us to say that the two variables are significantly correlated. The value of the determination coefficient of R^2 is equal to 0,72, which indicates that the regression performed on the explanatory variables explains the 72% of total variance.

The results of multiple regression show that the size factor is a determining factor in the decision of Algerian businesses to cooperate with universities. The results demonstrate that the size of the business has a significant impact on the decision to cooperate with academic institutions (correlation coefficient 0,45 with a significance of 0,001 less than 0,05).

Large businesses are more likely to build relationships with universities, which means that hypothesis H1. a which indicates that the size of the business influences the decision of cooperating with universities is confirmed.

These findings are consistent with those of previous studies (Warda, 1995; Miotti Sachwald, 2003; St Pierre & Hanel, 2005; Schimdt, 2007; Segarra, 2011; Al Bachawaty, 2015) as well as Todtling et al. (2009). This

phenomenon is attributed to the many advantages or substantial means held by large businesses compared to SMEs. In fact, large businesses have the resources which allow them to fund research projects (Dachs et al, 2004), woven social networks, in addition to the notoriety and reputation they acquired (St Pierre & Hanel, 2005).

If we consider the variable of the technological intensity of the activity sector, we notice that the variable, related to the degree of technology, has an impact on the propensity to cooperate, with a correlation coefficient of 0,3 and a significance of 0,005 less than 0,05. Therefore, it could be said that Algerian businesses which make part of the highly innovative sector are more likely to build relationships with universities. Our findings are consistent with those of previous studies of St Pierre & Hanel (2005). This means that hypothesis H1. b which stipulates that the technological intensity of the sector of activity has a significant impact on the businesses' decision to cooperate with universities is confirmed.

As for the relation between the ownership structure and the likelihood of collaboration, it seems that, generally speaking, the relation between these two variables is negative (coefficient B of -0,25 and a significance of 0,035 less than 0,05). This means that hypothesis H1.c which indicates that the nature of ownership has a positive impact on the decision of cooperating with universities is rejected.

The literature mentions the strong complementarity between R&D activities and cooperation with universities (Miotti Sachwald, 2003; St Pierre & Hanel, 2005; Segarra, 2011). If we take the multiple regression results of the variables of cooperation and the level of organization of the R&D function, we find that the businesses which have an in-house R&D structure are the best disposed to cooperate with universities (coefficient B of 0,5 with a signification of 0,000 less than 0,05). Therefore, hypothesis H1. d indicating that businesses which have an in-house R&D structure are more receptive to collaboration with universities and, generally speaking, probably more attentive to the scientific environment, is confirmed.

The multiple regression results also show that businesses which give an importance to innovation patents are most likely to cooperate with

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academic institutions (coefficient B of 0,35 and a significance of 0,002 less than 0,05). This means that hypothesis H1. e which stipulates that the decision of cooperating with universities is impacted by the fact the business gives importance to innovation patents is confirmed. These findings are consistent with the conclusions drawn by St Pierre & Hanel (2005), Dachs et al. (2004), Cassiman and Veugelers (2002) and Schmidt (2007).

Thus, it can be deduced that structural contingency factors that have more impact on the decision to collaborate with universities are the importance given to R&D, the size of the business and the importance of patents. On the other hand, the intensity of competition has a minor and non-significant impact. These findings demonstrate that large businesses which have an in-house R&D structure and invention patents are the most inclined to build collaborations with universities.

4.2.2 Behavioral Contingency Factors.

Table 5. Multiple regression between behavioral contingency factors and cooperation with universities

Model	Standardized coefficients	T	Sig
(Constant)	1,2	2,5	0,013
Manager's age	0,18	2,2	0,028
Manager's educational level	0,4	5,0	0,000
Manager's area of training	0,25	2,8	0,006
Manager's risk aversion	0,35	4,5	0,000
R= 0,80; R-two= 0,64; Durbin-Watson=1,95			

Source: developed by the author based on (SPSS, 21)

The coefficient R is equal to 0,80 which means that it could be said that the variables of behavioral contingency factors and the decision to collaborate with universities are significantly correlated. The value of the determination coefficient R^2 is 0,64, which indicates that the regression performed on the explanatory variables explains the 64% of the total variance.

The results of multiple regression reveal that the manager's age has a moderate but significant effect on the decision to cooperate with universities (coefficient B of 0,18 and a signification of 0,028 less than 0,05). This suggests that managers aged 36 and older are slightly more

inclined to cooperate, probably due to their maturity, network or strategic understanding of the benefits of such collaboration. These findings are in contradiction with the conclusions drawn by Vázquez et al., (2017), which stipulate that younger manager, with less experience in the field, may be more inclined to seek academic partnerships in order to reinforce their knowledge and develop new technologies.

As for the variable of the manager's educational level, survey findings reveal that the latter has the most significant effect among the other surveyed variables with a coefficient B of 0,4 and a significance of 0,000 under 0,05. Managers with a higher degree (master and doctorate) are much more likely to cooperate with universities. This may be explained with their better understanding of scientific research, openness to innovation and ability to value collaboration through complex projects. These findings confirm those drawn by Dyer et al., (2019) according to which managers with a higher educational level are generally better suited to understand the importance of scientific research. This academic expertise allows them to understand the strategic advantages of collaborating with academic institutions, which drives them to actively seek such partners so as to support innovation and development in their business.

Table No 5 also makes it clear that the variable related to the manager's area of training also has a significant impact coefficient B of 0,25 and a significance of 0,006 under 0,05). Managers from scientific or management science streams are more inclined to collaborate with universities. This reflects a greater proximity with the stakes of research and development or the valorization of innovations, resulting from academic collaborations. These findings are consistent with the findings of Etzkowitz et al., (2000), according to which managers with a non-technical background, such as those with a background in humanities, may be less inclined to perceive the advantages of academic research, particularly in relation to technological innovation and product development.

The variable related to the manager's risk aversion has also a significant impact on the decision to collaborate with universities (coefficient B of 0,35 and a significance of 0,001 under 0,05). Managers with a low risk aversion

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are significantly more inclined to collaborate as these projects often entail uncertainty about outcomes or long-term investments. Meanwhile, managers with a high-risk aversion tend to avoid collaborations that are likely to entail uncertainty or high financial costs. This reluctance to take risks may limit their willingness to get involved in partnerships with universities, which are often perceived as risky initiatives, especially in relation to investments in research and development (Kleindorfer & Saad, 2005).

Therefore, it could be said that behavioral contingency factors that have the greatest impact on the decision to collaborate with universities are the manager's educational level as well as his degree of risk aversion. These outcomes demonstrate that qualified managers from scientific or management science streams with a low risk aversion are the most likely to favor business-university collaborations.

From the multiple regression tables, (tables No and No), we can elaborate the following equation:

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + b_8 X_8 + b_9 X_9$$

Y : dependent variable (decision to cooperate with universities)

a : constant of regression

$b_1 \dots b_9$: standardized coefficient of independent variables

Thus, the equation of the surveyed model is the following:

$$Y = 1,2 + 0,45 X_1 + 0,3 X_2 + 0,2 X_3 + 0,5 X_4 + 0,35 X_5 + 0,18 X_6 + 0,4 X_7 + 0,25 X_8 + 0,35 X_9$$

5. CONCLUSION

The multiple regression model provides a solid foundation to understand the behavioral and structural factors with an influence on the decision to cooperate with universities. It highlights the key role of the importance given to R&D, the size of the business, the importance of patents, in addition to the manager's educational level, risk aversion and area of training. These findings can guide public policies and managerial strategies to reinforce academia-industry partnerships.

Thus, we can infer that structural contingency factors which have more impact on the decision to collaborate with universities are the importance

given to R&D, the size of the business and the importance of patents, whereas the intensity of competition has a minor and non-significant impact. These outcomes demonstrate that large businesses with an in-house R&D structure and invention patents are more likely to establish collaborations with universities.

Our analysis model has several advantages:

- The results show clear and significant relations between several behavioral variables and academic cooperation.
- Standardized coefficients (beta) make it possible to rank the importance of variables.
- The factors that are identified as significant (the importance given to R&D, the importance given to patents, the manager's educational level, risk aversion, age and area of training) are consistent with the theories of strategic decision-making and innovation management.
- The model provides clear indications on the characteristics of businesses and the attributes of the external environment as well as the profile of managers that are likely to cooperate with universities, which allows to target specific actions (training, incentives).

However, in order to gain a better understanding, it would be relevant to complete this analysis to address certain limitations, such as:

- Certain variables, such as the intensity of competition ($p=0,06$), are not significant at a level of 5%. This suggests that their incorporation in the model could be reviewed or reformulated.
- The interpretation of these outcomes could be influenced by the sample size or sectorial biases. Additional analysis could explore the differences between activity sectors.
- The model does not directly incorporate environmental or institutional variables, which could also influence the decision to cooperate (for instance, public policy or institutional support).

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