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COLLABORATION STRATEGIES AND TECHNOLOGICAL INNOVATION: A CONTRACTUAL PERSPECTIVE OF THE RELATIONSHIP BETWEEN FIRMS AND TECHNOLOGICAL CENTERS[1].

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Abstract

In this paper, a theoretical framework for analyzing the selection of governance structures for implementing collaboration agreements between firms and Technological Centers is presented and empirically discussed. This framework includes Transaction Costs and Property Rights' theoretical assumptions, though complemented with several proposals coming from the Transactional Value Theory. This last theory is used for adding some dynamism in the governance structure selection. As empirical evidence of this theoretical explanation, we analyse four real experiences of collaboration between firms and one Technological Center. These experiences are aimed to represent the typology of relationships which Technological Centers usually face. Among others, a key interesting result is obtained: R&D collaboration activities do not need to always be organized through hierarchical solutions. In those cases where future expected benefits and/or reputation issues could play an important role, the traditional more static theories could not fully explain the selected governance structure for managing the R&D relationship. As a consequence, these results justify further research about the adequacy of the theoretical framework presented in this paper in other contexts, for example, R&D collaborations between firms and/or between Universities or Public Research Centers and firms.

Key words: Collaboration, Technological Innovation, R&D, Technological Center.

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INTRODUCTION

The adoption of an innovative attitude by firms is considered as a basic step for reaching competitive advantages and surviving in an environment characterized by constant changes, market globalization and increased competition. This innovative attitude must imply different scopes: the organizational one, the commercial one and finally the technological one. If we focus on the latter, technological innovation (TI) will be defined as the process that allows firms to attain new products, processes or services (radical innovation) or, alternatively, significant technological improvements (incremental innovation) [2]. This TI process finishes when a new (or improved) product or service is introduced into the market, or a new (or improved) process is used in the production system. That is why we would like to state that, while the innovation process could be produced within multiple institutions (Universities, Public Research Centers, Technological Centers, other firms, etc.), the end of the process must be achieved inside the firm.

This paper is focused on the collaboration agreements for reaching innovation. More precisely, we shall stress collaborations between firms and Technological Centers. Behind this selection there are empirical and theoretical motivations.

The empirical motivation is found in the fit of this strategy for a majority of firms acting in the industrial sector in Spain: the small and medium sized firms (SMEs)[3]. If we consider that an SME is one with fewer than 250 workers, we would find that 99.7% of the Spanish firms fit this category in 1998. Furthermore, these firms contracted 63% of workers of the industrial Spanish sector (Source: Ministerio de Trabajo y Asuntos Sociales,1999).

[2] It is a definition quite close to the definition presented in the Spanish "*Plan Nacional de I+D+I 2000-2003*", and it does not differ much from the ones provided by Schumpeter (1934), Stoneman (1983) or, more recently, Padmore et al. (1998).
[3] Reports presented by OCDE and/or the COTEC Foundation and the "*Plan Nacional de I+D+I 2000-2003*" point out this interest.

About the Technological Centers perspective, it can be observed how the importance of these institutions is increasing in Spain. Approximately 55 Technological Centers are integrated into the Spanish Federation of Innovation Entities (Federación Española de Entidades de Innovación), they attend more than 53,700 clients (1,540 are stable collaborators), have almost 2,680 full – time workers and their joint bill exceeded 30,000 million pesetas in 1999, generating activities assessed in 331,000 million pesetas (Source: FEDIT, 2000). Compared with the situation in 1980 when there were only 250 full - time workers and their combined bill did not reach 1,000 million, one can see that the growth and the relative weight of these institutions are rapidly increasing.

Concerning the theoretical motivation, it is found in the contractual and ownership issues of the agreements between Technological Centers (TC) and firms. This research line, initiated by Aghion and Tirole (1994a, 1994b), attempts to explain how the allocation of property rights of the innovations could affect both the frequency and the magnitude of these innovations. It also affects the allocation of control in the innovative process and the monetary compensations in play. However, their theoretical proposal is based on a particular conception of the relationship TC – firm. That is, a small and cash-constrained TC, which is developing an R&D project with a high level of uncertainty. In this paper a heterogeneous typology of contractual relationships among Technological Centers and firms shall be analyzed. Based on the analysis of four contracts we shall propose a theoretical framework amplifying the one used for explaining the selection of governance structures: a combination of Transaction Cost and Property Rights Theories.

The study is organized as follows: the first section presents the theoretical framework, while the second focuses on the empirical part of our research. The third section contains a discussion about the observed results and the proposal for a theoretical way for future development. We finish with the main conclusions of the study.

1. THEORETICAL FRAMEWORK

Initially, the firm (vertical integration, unified property) and the market (separability, scattered property) were considered the two pure and single forms of governing activities (Coase, 1937; Arrow, 1969, Williamson, 1975). The main difference between both pure forms is that all the needed information for governing one activity using the market is contained in the price, while price does not appear when the firm is the governance structure and the authority becomes the relevant aspect.

Due to the fact that the existence of an external price is the main difference between both structures, the market is only possible as a governance structure for governing any activity when the characteristics of the activity allow for establishing the price. That is why different authors, basically those related to the Transaction Cost Theory, have been focusing on the characteristic attributes of the activity for determining which one will be the governance structure finally selected[4]. Milgrom and Roberts (1992), following Williamson (1975, 1985) and other authors (for example, Klein et. al., 1978), identify the following characteristics of activities as really important in determining the governance structure selected:

1. Specificity of assets related to the activity.
2. Frequency and duration of the activity.
3. Uncertainty about the conditions in the future and the impossibility of describing them.
4. Difficulties for assessing the results of the activity.
5. Interrelation with other activities.

Williamson suggests that the uncertainty, jointly with asset specificity, create the conditions for a substitution of the market. Therefore, in those activities presenting the characteristics mentioned above, the market is not a valid option: bounded rationality prevents the market as a governance structure

[4] They also mention two characteristics of individuals: bounded rationality and opportunism.

because the lack of information demands a prediction and precision capacity transcending the limits of rationality. Under these circumstances, is the firm the only alternative? Does unified ownership always substitute the market in the government of transactions? We find the answer in the real world: for organizing activities presenting some of the characteristics mentioned before, to arrive at the hierarchy is not always necessary. We could use intermediate forms of organization. Williamson (1991) recognizes that the firm and the market are indeed two extreme forms in a continuum of structures. The structures between both extremes are identified as "hybrids", or collaboration agreements, because they combine principles and rules owned by each pure form, firm and market (Imai and Itami, 1984). Some of them are going to present more market characteristics, in the sense that many things related to the activity could be foreseen and then it is possible to specify a contract (referred to here as contractual agreements); while others are going to present more hierarchy characteristics, in the sense that to specify a contract is getting more and more difficult (referred to here as hierarchical agreements).

We can find different works in the literature focused on the selection of governance structures for implementing collaboration agreements (Pisano, 1989; Pisano and others, 1988; Osborn and Baugh, 1990; Gulati, 1995; Oxley, 1997; Gulati and Singh, 1998). In all of these papers, the basic underlying framework is borrowed from Transaction Cost Analysis. The basic assumption here is that contracts have limitations when they have to deal with intense interdependencies (Gulati and Singh, 1998) or when payoffs are difficult to assign *ex-ante* and verify *ex-post*, thus creating appropriability hazards (Oxley, 1997). Therefore, in certain cases, it is more efficient (i.e., it has lower transaction costs) to substitute or complement contracts with some of the principles and rules associated with the hierarchy system (administrative controls, formal coordination units, authority links)[5].

[5] As it is often the case, we consider the transaction costs as the explicit costs of the selected structure. We are not taking into account the residual losses, defined as the difference between the potential benefit and the obtained benefit with the selected structure.

However, the Transaction Cost Theory presents some limitations: accurate predictions about the structure of the collaboration arrangement when there are R&D activities implied in the relationship are not fully accomplished. Due to the fact that R&D activities usually show intense interdependencies and payoff uncertainty, Transaction Cost generally anticipates structures closer to hierarchy. Nevertheless, some empirical studies have not found this relationship at all (Rialp and Salas, 1999).

If governance structure moves away from the market, then the hybrids will be the considered governance structures, and price becomes less and less important: what is going to be the main aspect? Ownership. In a world where price can be fixed, ownership is irrelevant. But when the price cannot be fixed, the allocation of decision rights (ownership) matters in terms of incentives, for example, incentives to invest more or less *ex-ante* in specific assets[6], and in terms of results allocation.

In the property rights framework (Grossman and Hart, 1986; Hart and Moore, 1990; Hart, 1995), governance forms can be classified according to how residual-decision rights are allocated:

- Ownership of the assets related to the activity can be distributed among all the parties (separated ownership).
- If each of the parties has veto power over the use of the assets, the governance is known as joint ownership.
- If the residual-decision rights are allocated to a third party not directly involved in the activity (a third party arbitration is contemplated to resolve disputes), the governance form is known as trilateral governance.
- When all assets involved in the activity belong to one of the parties, we refer to single ownership because the decision rights are concentrated in only one party.

[6] To hold decision rights over the non-human assets of the transaction means to have rights to decide on any non-anticipated contingency. In this regard, to be the "owner" of an asset is to hold the residual-decision rights on the asset.

Aghion and Tirole (1994a, 1994b) attempted to explain how the allocation of property rights of the innovations could affect both the frequency and the magnitude of these innovations. In fact, they were trying to open the "black box" of innovation. Our proposal here is that Property Rights Theory could not be sufficient for explaining the selected structure for developing the relationship among Technological Centers and firms. We will prove that variables related to expectations of future rents should be considered in the analysis.

Mixing governance structures between markets and hierarchies from transaction costs economics (contractual and hierarchical agreements) and from the theory of property rights, the governance forms available for developing relationships among TC and firms can be described as follows: see Figure 1[7].

Insert Figure 1 about here.

Contractual agreements with separated ownership. This governance structure performs well for activities presenting all or some levels of the following attributes: the degree of specificity of the assets is low, the degree of incompleteness and ambiguity is acknowledged but it is not very significant, the period related to the execution of the activity is relatively short or it is not very frequent, to assess the result is relatively simple and high interrelations are not presented. As we can observe, it is a little bit more difficult to fix a price but a quite complete contract can be written. It is a governance form closer to the classical contract or pure-market exchange. Contractual agreements provide a framework under which the activity will take place. The ownership of the assets is separated among the parties, but the contract may include safeguards

[7] This classification is based on the governance structure typology proposed by Rialp and Salas (2000).

for the transacting parties in the form of information disclosure clauses, penalties for certain behavior, explicit dispute-resolution mechanisms (in some cases arbitration), etc[8].

Hierarchical agreement with joint ownership. These agreements are used when the specificity of the assets becomes relevant, the relation among the parties is foreseen quite long, the level of uncertainty is important, assessments of the results becomes difficult and interrelations are observable. Situations are able to be found here where the ownership of the assets in the activity is the result of holding ownership rights over the assets of the collaborating firms themselves (the clearest example is minority equity interest through cross-shareholdings[9], where the firms may also exchange seats in their respective boards of directors), as much as situations where the holder of the decision rights has individual veto power over the use of the assets involved in the collaboration. Such assets are clearly segregated and placed in a legally separated entity where they are administrated under this ownership condition. A joint venture with 50 – 50 equity holdings of the two parties is a clear example of joint ownership, although the veto condition can also be instrumented contractually, independently of equity holdings. The fact that a new firm is created suggests that the joint venture substitute the market for the hierarchy.

In the empirical part we present four real cases of relationship between TC and firm where the selection of the structures mentioned above could be analyzed. The question is: When should each one of these governance structures be selected for managing the relationship between TC and firms? Due to the fact that the classification of governance structures is based on Transaction Cost, complemented with the Property Right Theory, the selection of one of these governance forms should be explained basically by both theories. However, we believe the explanation must go beyond these theories: instead of considering the transaction cost perspective, and the effects of the assignment of property rights, we

[8] A detailed comparison between Classical and Neoclassical contracting is found in MacNeil (1974, 1978). Alternatively, see also Williamson (1991, p. 271-273; 1985, p. 70-72).

[9]Depending upon the size of the equity holdings and the statutory or contracted provisions, the holder of the minority interest will have more or less influence on the decision process affecting the control and management of the collaboration.

shall also consider the Transactional Value perspective. Under this perspective, the selection of one structure is more a function of anticipated value gains rather than anticipated losses due to the cost of constraining opportunism. A firm's inclination to act opportunistically is often dominated by the firm's estimation of the negative impact that the opportunistic behavior will have on the value of expected future exchanges with its partner (Zajac and Olsen, 1993, p. 137).

As Zajac and Olsen (1993) recognize, the Transaction Cost perspective presents two limitations: on one hand, a single-party cost minimization emphasis, neglecting the interdependence between exchange partners in the pursuit of joint value; on the other, an over-emphasis on the structural features that neglects important process issues. Transactional Value framework considers joint value maximization, rather than single-firm cost minimization, and the process by which exchange partners create and claim value. Therefore, under this approach, the crucial issue in a collaboration is not merely a single organization's concern for minimizing its transaction costs, but rather both organizations' concern for knowing the partner's preferences as a basis for exchanging and mutual gain. Furthermore, they would like to discover ways in which similarities or shared interests can be exploited to maximize cooperative joint gains that accrue to both parties.

Under the Transactional Value framework, the selected structure for managing the relationship between TC and firm should be the one maximizing the net value of the collaboration for all of the parties. This criteria could be positioning us far away from the structure that should be selected under the criteria of transaction cost and/or property rights theories: selecting the most efficient structure. As Zajac and Olsen (1993) and Stinchcombe (1985) show, the pursuit of greater joint value could require the use of governance structures that are less efficient from a transaction cost perspective.

Note, however, that while the Transactional Value approach represents an alternative framework, it is consistent with the implicit intent of the Transaction Cost theory in some ways. Transaction costs are a subset of total costs to be aggregated and compared with the set of total benefits/gains in an overall

calculation of the value of the collaboration. In this value, the second aspect related to the approach of the Transaction Value (to consider the process by which exchange partners create and claim value) becomes relevant, because it can result in a transformation that leads to greater expected net benefits for both parties.

It follows, then, that the type of analysis required is one that addresses how parties attempt to create and claim value within a relationship over time (Lax and Sebenius, 1986). Although in this paper the focus is the net value related to a TI collaboration between TC and firms, we shall to upset this collaboration process following the three temporal stages identified by Zajac and Olsen (1993):

Initializing stage: individual firms estimate the expected value that they foresee as accompanying a TI collaboration because the first rounds of exchange are produced at this stage (therefore, a more accurate calculation of value can be reached because the various components of the relationship become better known and understood). Perceptions of value from the partners' point of view also emerge in this stage, and firms engage in the process of projecting exchange into the future (MacNeil, 1983) and constructing net present assessments of alternative collaborations. Firms' behaviors at this stage can set a precedent for future exchange and provide useful information to learn about the expected behavior of the partners.

Processing stage: value-creating exchanges in the relationship are expected to occur. These exchanges occur simultaneously over multiple pathways. The level of actual value becomes clearer but, at this stage, value is not only created: it is also claimed and distributed among partners. Surrounding the issues of claiming and distributing value important elements as conflict, negotiation power and temporal horizon are found. A perceived compensated distribution of the value among the partners, obviously affected by their negotiation power, decreases the conflict issues, defined here as the perceived divergence of interest (Pruitt and Rubin, 1986). As a consequence, there is no obstacle to value maximization, which increases the likelihood of a cooperative relationship over multiple rounds;

in other words: an extension of the exchange horizon and a subsequent reduction in incentives for uncooperative behaviors (Axelrod, 1984) is produced. Partners feel a growing confidence in the expectations of the future, trust is being developed, and they can behave as if the expected value of interdependent activity were stable over the course of an uncertain future.

Reconfiguring stage: this stage is characterized by changes in the partners' perceived level of the relationship's value. Such changes may emerge from comparing actual to expected value creation or from a new and/or changing environment. Reconfiguring may imply that partners choose to exit the relationship, but it may also mean that partners will choose to link their interdependence more tightly by widening the scope of parallel collaboration processes. Therefore, the reconfiguring stage may only involve a change in the process of interaction within the existing collaboration. This stage will typically loop back to the initializing stage (value forecasts are re-specified) or the processing stage (where the forms of exchange are revised).

Therefore, considering the previous arguments, the main proposal of this paper is that the selected governance structure for implementing TI collaborations agreements is not always explained under the Transaction Cost and/or Property Rights frameworks. It is necessary to consider relational aspects such as the expected value, negotiation power or temporal horizon, in other words, the Transaction Value Theory, for understanding the final selection.

2. EMPIRICAL SECTION

2.1. METHODOLOGY

For obtaining initial evidence about the assumption presented, we use qualitative methodology research in this paper. More precisely, we use an embedded case study. Yin (1989) distinguishes between *single case study* vs. *multiple case study* (one main unit of analysis vs. more than one). Furthermore, he

distinguishes between *holistic case study* (with one main subunit of analysis) vs. *embedded case study* (with one or more subunits of analysis inside the main one.). As we have said, a single case study with different subunits inside is presented here.

We know that to use this methodology implies that it is not possible to generalize the results in the same way as if quantitative methodology research were being used. The generalization depends on the purpose and the research design as much as in the methodological qualities of the case due to the results derived from the analysis. Yin (1989, 1998) distinguishes between statistic generalization vs. an analytical one: use the case study for representing or generalizing a theory. The idea is that the results of a case study can be generalized to other cases with similar theoretical conditions.

Maxwell (1996, 1998) points out the components of a case studies: purposes (which are the main purposes with the study); conceptual context (which are the theoretical backgrounds guiding the study); research questions (what we want to understand from the study); methods (what is done for running the study); validity (what the possible mistakes are). Eisenhardt (1989) specifies what the stages related to *theory-building* are using research based on case studies as well as the activities to develop in each stage. The stages are the following: choose the case/s, design the instruments and protocols, do the groundwork, analyze the data, build the hypothesis and review the literature. Yin (1989, 1998) also identifies the different phases related to the design and execution of these kinds of studies: determine the purpose of the research, establish theoretical models and the resources for running the research, design the research, define and select the unit of analysis, collect and analyze the data and develop the main conclusions of the study. We have followed the stages proposed by Yin in our research.

In the design stage of the research we have adopted a logical sequence connecting the empirical data with our initial questions and, later on, with the conclusions. Due to the fact that we want to obtain some kind of robust conclusions, we need to apply the *triangulation* concept (the evidence related to the case is robustly established when it comes from different sources). One of the attributes of the case

study letting us obtain construction validity is to use different evidence sources. We have used written information as well as information coming from in-depth interviews with more than one of the agents participating in the relationships.

Finally, internal validity has been obtained through *explanation building* (due to the fact the study presents only one case, we tried to observe if data go through a logical sequence of the events that seems to explain the results of the case) instead of using the well-known *pattern matching* procedure (to compare an empirical pattern against a pre-defined one) or the analysis of temporary series; and reliability is obtained because the same protocol was used for each subunit related to the case: the proposal by the TC that must be signed by the client if he agrees with the specifications presented there.

2.2. DATA SOURCE

2.2.1. ASCAMM Technological Center (ATC)

The ASCAMM Technological Center (ATC), a project hosted by the ASCAMM Association[10], has become, since its start-up in 1987, a key reference for the tooling and machining industry in Spain, with total assets on the order of 1,300 million pesetas and over 60 collaborators.

The main purpose of this Foundation is "to foster the economy by promoting and stimulating, primarily in the Autonomous Community of Catalonia (Northeast Spain), the improvement of the competitive standing of companies via technological development, quality, innovation and internationalization in the moulds and dies sector in particular, and in the metal-mechanical and plastics transformation and other related industries in general, providing the services necessary to achieve such ends".

[10] As a business association, ASCAMM (The Catalonian Association of Mould and Die Manufacturers) was already established in 1979.

ATC's organizational structure is made up of by two main sets of divisions which are clearly identifiable: the innovation and technology division and other support divisions[11]. The basic goal of the innovation and technology division is to contribute to improving competitiveness of those companies belonging to the mould and die sector and, in general, to the metal-mechanical and plastics transformation sectors, by promoting innovation and actively supporting technological developments. The achievement of this goal rests on three major lines of action, with a primarily industrial orientation within this internal division: a) R&D and Technological Innovation; b) Technological Services and c) Training issues.

Two kinds of projects are clearly distinguishable inside the *R&D and Technological Innovation*: *R&D and technological transfer projects* and *support activities to firms*. The former has, as its major activities, the generation or assimilation of new technologies by the Center itself (generic research), such as high-speed machining and rapid tooling; the conception and execution of projects in cooperation with other research centers and companies (pre-competitive research) including, for instance, the design of CAE Software for die simulations; high-technological content innovative product and process development projects carried out jointly with an industrial partner company (competitive research) such as, for example, an application study of gas injection in large pieces, and several other diffusion and technology transfer activities carried out from this know-how. In addition to the R&D programs and dissemination or technology transfer actions, ACT offers a wide range of *support activities* to companies on a one-to-one basis in order to facilitate their access to databases and, specially, to the R&D and innovation programs offered by the various government administrations. EUROIT, REDAUTO, XARDEC and OPTI projects are outstanding examples of this issue.

[11] For example, the ATC's Testing Laboratory that allows the testing of moulds in real operating conditions, to check their performance before introducing them into production processes and to optimize injection-process conditions. The most fundamental aspects of the Laboratory's activities are: *technological improvements, the quality control system* and i*mprovement of customer needs of information and staff training.*

Inside *Technological services* ASCAMM strives to make new design, manufacturing and dimensional quality control technologies available to industrial companies in the metal-machining and plastics transformation sectors, especially mould and die companies, offering them the opportunity to learn about and apply these technologies without requiring their immediate implementation in the company, so that they may be evaluated in current services and projects[12]. Hence, new techniques and technologies can be tested practically in real-life situations while their results and efficiency are conveniently assessed. This support to industrial companies has been intensified mainly, but not exclusively, by means of assistance to product-engineering and to process- and manufacture-engineering. This department has also turned into a basic tool for promoting technology transfer, allowing companies access to new technology without resorting to immediate investments. Also, with the object of improving services offered to companies and covering the needs of the market, some of the technical equipment available in this department has been recently upgraded. The improved hardware and software have also been complemented by the incorporation of highly qualified staff.

2.2.2. Unit analysis: the contracts.

The contracts we shall analyze are a representative sample of the most usual situations among ASCAMM and its clients for developing TI activities. More precisely, we shall analyze four contracts with some common characteristics: all of them have an explicit price for the innovation created by the Technological Center (TC), delivery date is specified and the conditions are also explicit. The question, then, would be: if the contracts seem to be completed, where is the interest in analyzing them?

[12]The most relevant services that the ATC's Technological Services Department is currently offering are: product engineering (integral development of plastic pieces using CAD, CAE tools), process and manufacturing engineering (metal and plastic transformation using CAM, CAE), technical and technological assessment and consulting program and dimensional metrology services

ASCAMM suggested the contracts, arguing that they have the most representative characteristics of the TI agreements among the TC and firms in general. Once the contracts had been studied, we believe the selection made will lead us to interesting reflections.

Two first contracts, close to technological services, differ in the way the final agreements have been reached. In the first one, the client says nothing to the TC offer. In the second one, renegotiations appear about the initially offered conditions. Considering more aspects, both contracts are similar because they are quite complete, the TC has the intellectual property of the innovation and the firm does not call for confidentiality.

In the third contract the client calls for confidence and also for the intellectual property of the product innovation. Although in this contract the price and the delivery date are fixed, we detect more specific investments and uncertainty due to the fact that the client does not belong to the same sector where the TC acts. Therefore, ASCAMM might not have the required experience for reaching the optimum result.

A different element of the fourth contract is the bigger involvement of the client in the project. More uncertainty is also detected, in this case identified by the difficulty of fixing a date when each stage of the R&D project should finish and the price for each one of them. In Table 1 the main characteristics of the four projects are summarized.

Insert Table 1 about here

2.3. CONTRACTUAL ANALYSIS

Can we justify the governance form in each case only considering the Transaction Cost Theory (TCT)? And only considering the Property Rights Theory (PRT)? Are these theoretical frameworks enough for justifying the observed contractual solution?

2.3.1. Transaction Cost Theory perspective.

Considering the TCT (Coase, 1937; Williamson, 1975), we wish to test whether the contractual form comes conditioned by aspects such as the specificity of the assets, the frequency and duration of the activity, the uncertainty, the difficulties for assessing the results and interrelations between activities.

- Presence of specific investments

Specific investments that could imply larger transaction costs can be detected in the third contract because the developed activity is not habitual for ASCAMM. Therefore, the results cannot be directly applied by the firms belonging to the sector where ASCAMM gives service in a regular way.

In the other three cases, ASCAMM is applying technology and knowledge that come from its internal research activity. Furthermore, and as a general rule, these activities are usually financed through public resources (the state, the regional government or European Union). As a consequence, neither the TC nor the client must make specific investments in the activities they contract (services and technological developments).

- Frequency and duration of the activity

Between the firm and the TC a long term relationship could appear, due to the association of the firm to the Center or because the firm becomes a habitual client. However, if we focus on the four projects, the TC considers that the kind of activity which has been contracted with difficulty will be contracted again with the same client. That is why we consider that in the contracts between ASCAMM and the firms, the frequency and duration of the activities are not going to be a source of transaction costs.

- Uncertainty

In the first two contracts, the presence of an explicit compromise of ASCAMM to deliver the innovation with specific characteristics on a precise date is a signal of the almost null presence of technical risk. As we have mentioned in the descriptive section, some elements of the third and fourth

contracts would be indicative of some degree of uncertainty. Under the TCT, this degree of uncertainty should lead us towards more hierarchical governance forms.

- Difficulties in assessing the results

In the third contract, although a date is fixed for delivering the innovation, to preview the value of the innovation *ex–ante* will be more difficult than in the two previous contracts. The reasons that could be argued are basically two: the client belongs to a different sector than the TC and/or the TC has to face a project without previous experience. The intrinsic difficulty of the fourth project makes foreseeing the value of the innovation complex.

- Interrelation with other activities

Considering the description of the contracts and the thoughts of the ASCAMM managers, the contracts cannot be related to other projects developed among the firms asking for the services and the TC. As a consequence, this aspect will not be a source of transaction costs.

2.3.2. Property rights perspective.

Following the PRT framework (Grossman and Hart, 1986; Hart and Moore, 1990; Hart, 1995), the uncertainty of the technological innovation activities, plus the existence of some non-verifiable variables, could imply that any mistake assigning the property rights bears the apparition of **contractual inefficiencies** (Aghion and Tirole, 1994a,b). We shall analyze what the implications of the assignment of the residual rights in the considered contracts, the contributions of the partners and the distribution of the results of the project are.

- Assignment of the residual rights

As a rule, the TC decides on its participation in the project (what it has to do, how and when), during the days the project is going on. On the other hand, the firms have a different level of implication in the

four cases. In the first two, the firms just validate the results and then they decide if they will pay or not. In the third contract the firm gives a more precise orientation about what the new product must accomplish[13] (what application it is going to have, what its useful life must be, its production costs,...), however, the firm is going to take no decisions during the project. Finally, in the fourth contract, the firm participates actively in different stages of the process, taking some joint decisions with the TC.

- Contribution of the partners

The TC will contribute with its technological resources and knowledge for developing the activities that shall end with the innovation by the fixed date. None of the analyzed cases are going to allow the firms to verify the intensity and quality of the efforts of the TC. These characteristics are not relevant in the first two contracts due to the fact that the value of the innovation can be approached more easily than in the third and fourth contracts.

The firm will contribute with the required information by the TC for helping to obtain the innovation and will contribute financially (it will pay the TC). Furthermore, in the fourth contract, the firm will contribute with its knowledge during the development of the project.

- Distribution of the results of the project

The TC obtains the fixed price and the intellectual property of the innovations in the first two contracts and also in the fourth one. In these cases, the firms obtain the incomes derived from the innovation, although not exclusively because the firms do not ask for a confidentiality clause. As we have mentioned, these incomes can be understood as reductions in the cost of the manufacturing process because they are three process innovations.

In the third contract, the TC only receives the price because the intellectual property rights are assigned to the firm, which obtains the income of the innovation exclusively because it has the confidentiality

[13] That is reasonable because it is the first time that it has contacted the Technological Center.

clause of the product innovation. Following Aghion and Tirole (1994a,b), this aspect could imply contractual inefficiency (less investment in efforts by the TC side) that leads to sub-optimum result.

3. DISCUSSION

After the previous contractual analysis, two aspects are considered: a) the explanatory capacity of the TCT and PRT frameworks; b) the heterogeneity related with TI activities.

Following the framework presented in the theoretical background, the four contracts fit with the **contractual agreement with separated ownership**. However, in Table 2 it can be seen how the characteristics of the third and fourth contracts should lead towards a different governance form. Under the TCT perspective, both agreements should be closer to the hierarchical governance form. Based upon the PRT framework, the third contract could reach a sub-optimum result.

In the first two contracts transaction costs do not present an important impact, so we are moving towards agreements close to the market, where the relevant element is the price (as has been justified in the descriptive section). Although in the second contract some renegotiations of contractual aspects appear, which could imply higher transaction costs, the absence of conflict among the TC and the firm implies that the increase of the transaction costs are not significant. Furthermore, the possibility of fixing a price, plus the basically null level of uncertainty, allows us to consider that the agreements have to be closer to complete contracts and, therefore, the property rights assignment is not going to influence in their efficiency.

Insert Table 2 about here

With these two contracts we are not able to refuse the explanatory capacity of TCT and PRT in the selection of governance structures. However, the following idea can be reinforced: amplifying the term

of technological innovation to the Oslo Handbook's (1997) arguments, close the contracts is possible (because uncertainty is relative) and hierarchical forms do not need to appear. Therefore, the traditional result that we find in the literature (Oxley, 1997; Gulati, 1995) could not be accomplished under some circumstances. Firms can innovate technologically without entering directly in R&D activities, so risk is lower (it happens in the two services considered). Furthermore, talking also about R&D activities, it should be pointed out whether we are considering basic research (whose uncertainty could be really important) or technological development (where the risk could be under more control). Taking these aspects into account, results in the literature could have been very different.

In the third contract, both theoretical frameworks lead us to erroneous conclusions. Following TCT, uncertainty and difficulties in assessing potential innovation should address themselves towards the hierarchical solution. This fact is not observed because in the agreement the partners maintain the separated ownership structure. Under the PRT framework, uncertainty and the impossibility of verifying the TC efforts should imply the assigning of the property rights to the TC: its marginal effort is higher[14]. However, in this project the firm calls for, and gets, the intellectual property. This result, following the PRT arguments, should signify an inefficient result because the TC would not optimize its efforts. Contradicting this argument, we suggest that the TC will look for maximum effort because it is interested in the optimum value of the innovation, although it does not have the property rights.

The managers of ASCAMM pointed out that in this agreement strategic interests were really very important. They wanted to establish future relationships with the new client. Under a theoretical perspective, the TC expects future benefits of the relationship larger than the future benefits that could be generated through the patent. Furthermore, as another element reinforcing the previous one, we would like to remind that the client belongs to a different sector than the one where the TC belongs.

[14] It is a reasonable assumption because it has the technological knowledge and develops all of the project.

Therefore, the patent, in the case of remaining in the hands of the TC, could have been applied to its usual clients and affiliates with difficulty.

The perception of greater future benefits, if the TC passes the property rights to the firm, disciplines the TC to make the maximum effort. Therefore, the result of the agreement tends to be more efficient, although the governance structure does not correspond to the one suggested by TCT and/or PRT. Behind this argument related to the future benefit of the relationship, or the transaction, the framework presented in the theoretical section of the paper: the **Transactional Value Theory (TVT),** is found.

Finally, the analysis of the fourth contract does not imply any conflict with the PRT because the agent possessing the higher marginal efficiency (the TC) has the property rights in a context with uncertainty and non-verifying efforts. However, the TCT would suggest a more hierarchical governance structure due to the cost related to the transaction. As we observe, although some uncertainty and difficulties for assessing the innovation are in the project, they remain under the agreement with separated ownership. We are faced with a clear R&D cooperation (the client gives something more than money in the agreement), but the project does not go towards joint ownership.

In this case, the PRT would be useful for explaining the contractual solution. That is why our suggestion of considering the TVT for analyzing agreements with a technological innovation component is not exclusive but complementary. Our proposal is an analytic framework where TVT proposals will be integrated into the principles of TCT and PRT, also considering some aspects coming from the literature on technological change (due to the specific context we are considering). Therefore, the governance structure that will be implemented in a cooperation for innovating will be more or less hierarchical, and more or less complete, depending on the following components:

1. **Project attractiveness:** it depends on *the expected value of the project* and *the related uncertainty*. Furthermore, these two variables would move according to sector aspects (demand of the product, technological opportunity and ownership conditions) and also the kind of innovative activity

contracted (basic research, applied, technological development, technological services, formation and/or design).

2. **The relative positions of the partners:** these positions depend on *the negotiation power among parties*. This is a function of financial and technological resources and knowledge.

3. **The future perspective of the relationship** (or dynamic perception of the relationship). This aspect could motivate the property rights assignment to have no effect on the efficiency due to confidence and future reputation or benefits.

CONCLUSIONS

After the discussion section, we would like to state two main conclusions. First, we believe we need to break with the direct association between uncertainty and R&D and technological innovation. It will allow us to develop a more rigorous analysis of reality. This shall allow us to observe results that fit better with the TCT proposals (Oxley, 1997; Gulati, 1995). Furthermore, it will contribute to convincing the firms (basically small and medium firms) about the goodness of these activities because it will relativize the uncertainty related to technological activity.

Secondly, although we take into account the precision related to R&D, some limitations exist on the TCT and PRT frameworks that do not allow some contractual structures. A theoretical structure considering the spirit of the TVT and based on variables such as *the project attractiveness, the relative position of the partners and the future perspective of the relationship* would complement the traditional theoretical frameworks (TCT and PRT), but it also allows for considering dynamic aspects in the analysis.

The limitations of this study open, from our point of view, future research paths. First of all, we believe that to test the theoretical framework, presented in Section One, with data from some cases where the

contracts were non-complete (with a variable price and without delivery date) would allow us for the reinforcing of the theory. We have to say that this extension is being worked on with information from projects coming from different TCs. Likewise, to test this theoretical proposal in other context, for example, relationships between firms or between firms and Universities, is also needed for proving its validity. Secondly, we propose to use large data bases to contrast some intuitions that have appeared in the analysis about the relevance of the property rights depending upon whether the innovation is in product or in process, the tendency to cooperate with TC, the sector of the firm and/or its level of previous knowledge. Our thoughts are:

- The firm is less worried about property rights if the innovation is in process.
- More cooperation with the TC exits in sectors with more spillovers.
- Firms without an R&D department are less worried about property rights.

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Figure 1. Typology of Governance Forms

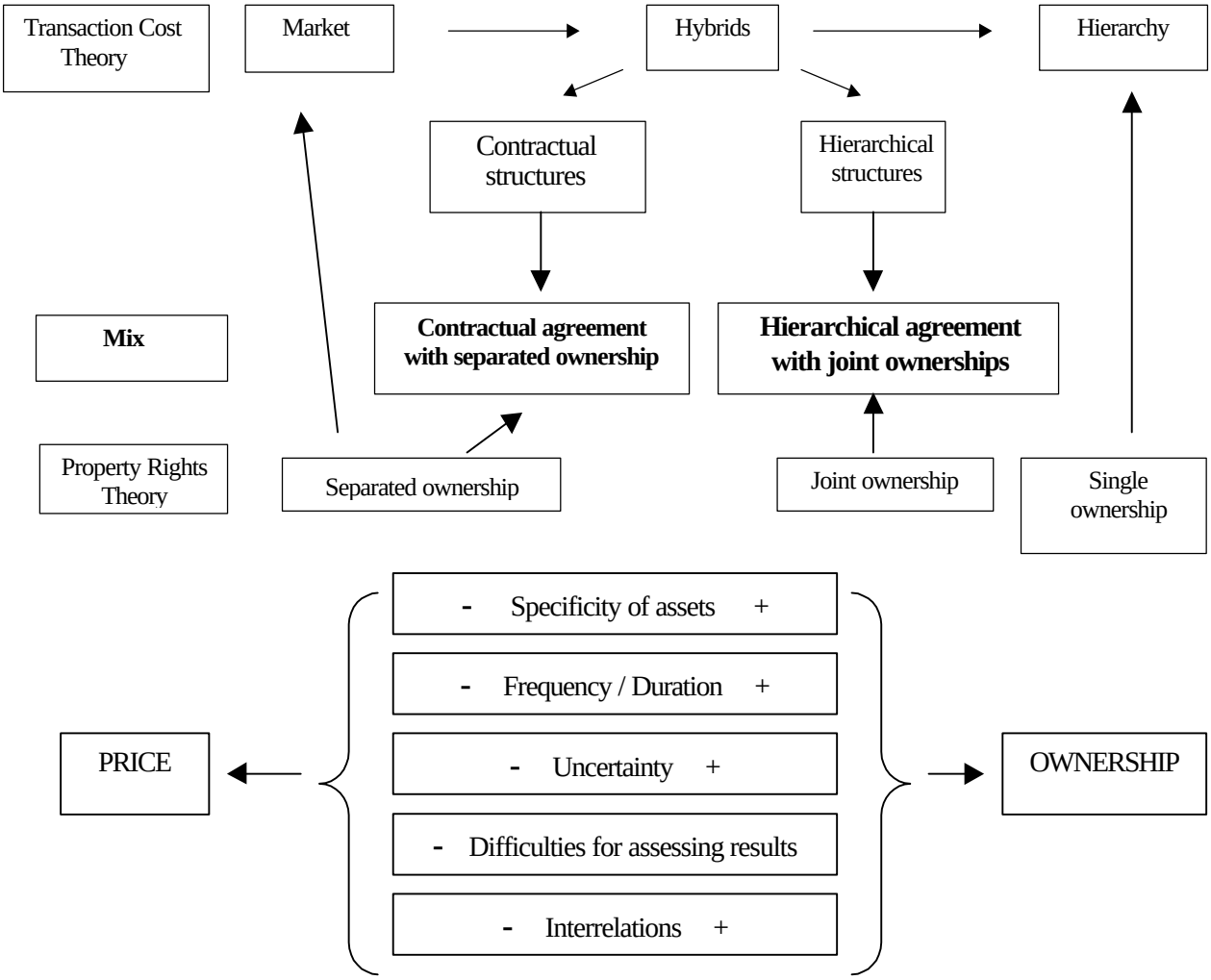

Table 1: Main characteristics of each contract.

Aspects	First Contract	Second Contract	Third Contract	Fourth Contract
Renegotiations	**NO**	YES	YES	YES
Confidential	NO	NO	**YES**	NO
Intellectual Property	T.C.	T.C.	**CLIENT**	T.C.
Client involvement in the innovation process.	NO	NO	NO	**YES**
Uncertainty	LOW	LOW	**MEDIUM**	**MEDIUM / HIGH**
Kind of innovation	PROCESS	PROCESS	**PRODUCT**	PROCESS
Firms associated to TC	YES	YES	**NO**	YES
Specific investment	NO	NO	**YES (TC)**	NO

Table 2: Contractual aspects from TCT and PRT.

		First Contract	Second Contract	Third Contract	Fourth Contract
Aspects that could imply more hierarchical structures.	**Specific investments**	WITHOUT INFLUENCE		**Could influence**	WITHOUT INFLUENCE
	Frequency and duration of the activity	WITHOUT INFLUENCE			
	Uncertainty	WITHOUT INFLUENCE		**Could influence**	**Could influence**
	Difficulties in assessing results	WITHOUT INFLUENCE		**Could influence**	**Could influence**
	Interrelation with other activities	WITHOUT INFLUENCE			
Aspects that could imply contractual inefficiencies	**Residual rights assignment**	WITHOUT INFLUENCE			
	Contributions of the partners	WITHOUT INFLUENCE		**Could influence**	WITHOUT INFLUENCE
	Distribution of the results of the project	WITHOUT INFLUENCE		**Could influence**	WITHOUT INFLUENCE

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