The relationship between top management teams and innovative capacity in companies

Carmen Camelo-Ordaz
Departamento de Organización de Empresas, University of Cádiz, Cádiz, Spain, and
Ana Beatriz Hernández-Lara and Ramón Valle-Cabrera
Departamento de Economía y Empresa, University of Pablo de Olavide, Seville, Spain

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Abstract

Purpose – The aim of this research is two-fold: to examine the effects of certain characteristics of top management teams (TMTs) on innovative performance in their companies; and to determine if this influence is direct or if it is influenced by other factors, such as the existence of strategic consensus in the team.

Design/methodology/approach – The research is developed using Upper Echelon Theory. This study was conducted with a sample of 100 companies from innovative sectors. Different regression analysis were undertaken in order to test the established hypotheses.

Findings – Three main conclusions can be drawn from this research. First, it cannot be stated that all types of diversity related to TMT activity or work have a positive effect on innovation in companies. In this way, diversity in TMT tenure appears to have a negative influence. Second, the incidence of diversity on innovation cannot be direct in all cases. Therefore, functional diversity has a positive effect on innovation, but always when there is a context of strategic consensus in the management team. Finally, TMT educational level exerts a positive effect on organizational innovation degree, independently on processes, which may occur within the team.

Originality/value – The paper has tried to improve and clarify the contributions about the direct relationship model proposed by Upper Echelon Theory between TMT demographic characteristics and innovation. The results have confirmed, in support of the critics of the theory that it is necessary to introduce and analyze, along with demographic variables, other factors and processes which affect TMT decision making.

Keywords Team management, Decision making, Innovation

Paper type Research paper

Introduction

There is a significant body of research analyzing the direct impact of the characteristics of top management teams (TMTs) on decisions and results pertaining to their activities (Hambrick and Mason, 1984; Wiersema and Bantel, 1992; Bantel and Jackson, 1989; Bantel, 1993; Hambrick *et al.*, 1996). However the contradictory and non-conclusive results of recent studies have demonstrated the pitfalls of this type of research (Tushman and Romanelli, 1985; Murray, 1989; Smith *et al.*, 1994; Knight *et al.*, 1999). The logic behind this emerging line of thought is based on the fact that it is not merely TMT characteristics which influence organizational results, but also some of the processes which occur within the TMT. Thus processes like the existence of consensus, communication or agreement-seeking may modify the direct relationship initially established between TMT characteristics and organizational decisions or

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organizational results (Eisenhardt and Schoonhoven, 1990; Keck, 1991; Hambrick and D'Aveni, 1992).

Examining these two lines of research developed within Upper Echelon Theory, our aim was two-fold. An initial goal was to determine if certain demographic features of TMT, linked to proactive, innovative and creative attitudes have a direct influence on the innovative performance of their companies. There is a wealth of empirical evidence which maintains that TMT diversity and high levels of education benefit the groups involved in complex decision making and a company's innovative performance may depend, overall, on the vision developed by its TMT (Bantel and Jackson, 1989; Bantel, 1993; Pegels *et al.*, 2000; Wiersema and Bantel, 1992; Tihanyi *et al.*, 2000).

A second aim, in line with Upper Echelon Theory critical thinking, focuses on determining if certain processes which may be developed through TMT decision making, affect and explain any possible direct relationship. This latter analysis was undertaken because conflict appears as a factor produced by demographic team diversity which can distort its positive effects on innovation. Through certain processes, such as agreement-seeking and informal communication within the group, strategic consensus can be achieved within the TMT, reducing the negative effects of conflict and redirecting the positive effects of diversity towards a greater propensity for innovation.

This study is organized in seven parts. After this brief introduction, we outline the innovation dimension to be analyzed. Then, in the third and fourth parts, we develop the two theoretical approaches which explain the direct relationship and mediated relationship between TMTs and innovative performance in companies. The following sections describe the sample, establish variables values, and present the data analysis and results. Finally, we summarize the most relevant conclusions from our analysis.

Innovation

The nature of innovation is not always clear, and because the literature provides different interpretations of its meaning, a definition is necessary (Wolfe, 1994; Rowe and Boise, 1974). According to some of the more developed approaches, innovation in an organization is more than the creation and acquisition of new ideas, because the product must be successfully marketed (Mohr, 1969; King, 1974; Amabile, 1989). Along these same lines, Rowe and Boise (1974, p. 285) point out that innovation in an organization is:

> ... the successful use of processes or products which are new to the organization and which are the result or consequence of decisions taken within the same.

Tushman and Nadler (1986), define the concept as:

> ... the creation of a product, service or process which is new for the business unit.

For Damanpour (1996, p. 136), innovation involves:

> ... the adoption of an idea which is new for the organization which adopts it.

Thus the term "innovation" covers the creation as much as the acquisition of a product or service which is new for the adopting unit.

In general, three dimensions which underline the different definitions of the concept can be established: innovation in results, which would be the creation of a new product to the business unit (Tushman and Nadler, 1986; Damanpour, 1996); innovation in

process (O'Sullivan, 2000); and innovation as an attribute of organizations (innovative companies) (Bantel and Jackson, 1989; Kimberly, 1981).

Bantel and Jackson (1989) note that these different approaches to the concept of innovation may be different aspects of the same reality – that an innovative process culminates in an innovation result, both in products or processes, and both can enhance a company's innovative status.

This duality of innovation underlines a need to focus on partial or specific aspects in order to conduct a proper study. In this paper we focus on the technological innovation of products – in the material result of innovation – which, according to the *Oslo Manual* (1997), includes assets as well as goods, both totally new or improved. The product is considered to be new when its technological features or uses differ significantly from those previously obtained by the company. Such innovations may involve radically new technologies, they may be based on a combination of existing technologies which have been given a new use, or they may be derived from the use of new knowledge (*Oslo Manual*). On the other hand, the company product is considered to be improved either through the use of better components or materials or through the improvement of one of the physical parts (*Oslo Manual*).

In the study of company innovation, operationalized as innovative performance, the incidence of TMT decisions is especially relevant (Ireland *et al.*, 2001). Innovation is an accumulative, collective and uncertain process, a fact that management directs, promotes and encourages (O'Sullivan, 2000). The preferences of its leaders can impose serious restrictions on a company's innovation, compromising its ability to identify and act on profitable opportunities (Penrose, 1959). Therefore, in this study we try to establish how certain TMT characteristics influence innovative performance in companies, conceptualized in terms of levels of product innovation.

Innovation and the TMT: a direct relationship

The TMT comprises individuals with the power and authority to make strategic decisions, and, therefore, to develop strategies aimed at innovation. Upper Echelon Theory states that TMTs exert a fundamental influence on strategic choice in their organizations, and, hence, in their results (Wiersema and Bantel, 1992; Finkelstein and Hambrick, 1990). In this theoretical framework, it is argued that the leaders' cognitive bases are the mental guidelines which support their decisions, and which consequently affect the results obtained by their companies (Pegels *et al.*, 2000; Hambrick *et al.*, 1996; Wiersema and Bantel, 1992; Smith *et al.*, 1994; Kilduff *et al.*, 2000; Knight *et al.*, 1999).

A basic principle of Upper Echelon Theory is that the observable characteristics of TMTs are connected with psychological and cognitive traits. Based on this assumption, the theory uses certain observable demographic characteristics as a subrogate of the cognitive bases and values of executives. Thus, the theory states that there is a relationship between the demographic characteristics of a TMT and its company's results (Canella *et al.*, 2001, Hambrick and Mason, 1984, Wiersema and Bantel, 1992; Knight *et al.*, 1999; Smith *et al.*, 1994).

Within this perspective, two main lines of research can be identified. The first analyzes the direct effect of such concrete demographic variables as the age, education and tenure of TMT members on organizational results and decisions (Bantel and Jackson, 1989; O'Reilly and Flatt, 1989; Smith *et al.*, 1994; Finkelstein and Hambrick, 1990; Michel and Hambrick, 1992; Knight *et al.*, 1999; Hambrick *et al.*, 1996; Tihanyi

et al., 2000; Grimm and Smith, 1991; Wiersema and Bantel, 1992; Keck, 1991; Hambrick and D'Aveni, 1992; Kilduff *et al.*, 2000; Forbes and Milliken, 1999). The second approach analyzes the effects of TMT diversity, measured through the dispersion of a grouping of demographic variables on organizational results (Bantel, 1993; Bantel and Jackson, 1989; Hambrick *et al.*, 1996; Wiersema and Bantel, 1992; Murray, 1989; Ancona and Caldwell, 1992). Through these two approaches, we try to determine if the TMT's diversity and the educational level of the TMT members have a positive effect on the company's innovative performance.

The impact of TMT diversity on organizational results is not conclusive. Some studies have linked diversity to favourable results (Bantel and Jackson, 1989) and others have linked it with unfavourable performance (Murnighan and Conlon, 1991). Regarding the level of education, there is empirical support, albeit scarce, that it relates to innovation (Bantel and Jackson, 1989; Wiersema and Bantel, 1992). It is, therefore, necessary to develop further research which can contribute to the construction of a theory supported by greater empirical evidence.

In summary, this paper focuses on an analysis of the types of diversity and demographic characteristics that have been considered in the literature – functional diversity, diversity in TMT tenure and average level of education in TMTs – and examines the effects of these variables on innovation.

Functional diversity

Executives with different functional experiences will probably possess different types and levels of knowledge and different perspectives and attitudes (Hambrick and Mason, 1984; Bantel and Jackson, 1989). Functional diversity will have a positive effect on innovation and creativity, both of which require a combination of skill and knowledge (Leonard and Sensiper, 1998; Iansiti, 1993; Calori *et al.*, 1994).

Other authors argue that functional diversity stimulates group discussion and disagreement, which lead to more innovative and higher quality solutions (Ghiselli and Lodahl, 1958; Hoffman and Maier, 1961; Hambrick *et al.*, 1996; Lant *et al.*, 1992). Diversity of approaches can be a basic resource for companies because it stimulates the opportunity to learn. When diversity causes disagreement over opportunities, threats, or the future development of markets, TMT members become aware of and accommodate more perspectives, and they develop other courses of action. All of this can promote more innovative vision and action in companies (Bantel and Jackson, 1989; Lant *et al.*, 1992; Miller *et al.*, 1998).

Functional diversity causes conflict over work-related aspects and subjects. This conflict produces enriched problem analyses and diverse solutions, creating a positive effect on innovation (Pelled, 1996; Ancona and Caldwell, 1992; Sessa and Jackson, 1995; Milliken and Martins, 1996):

H1a. Functional diversity within a TMT is positively related to innovative company performance.

TMT tenure

Bantel and Jackson (1989) discovered that diversity in tenure is a poor predictor of innovation. However, we have adopted their analysis because there are strong theories to suggest the positive effect of this diversity on innovation (Ancona and Caldwell, 1992; Sessa and Jackson, 1995; Milliken and Martins, 1996; Pelled, 1996).

Diversity in TMT tenure suggests a confluence of experiences, perspectives, attitudes and values (Lant *et al.*, 1992) and it seems to stimulate a diversity of approaches in the team. Thus TMT fails to maintain the status quo, creating a greater predisposition towards change and innovation (Boeker, 1997; Wiersema and Bantel, 1992). Pelled *et al.* (1999) argue that diversity in TMT tenure causes the same type of conflict and that it is also associated with functional diversity. Both types of diversity are associated with work; they produce enriched points of view and, consequently, a positive effect on innovation (Pelled, 1996; Ancona and Caldwell, 1992; Sessa and Jackson, 1995; Milliken and Martins, 1996):

H1b. Diversity in TMT tenure is positively related to innovative company performance.

Educational level

The level of education among TMT members reflects their varying degrees of knowledge and skill, thereby affecting the capacity of the team to generate more or less creative solutions to resolving complex problems (Bantel and Jackson, 1989). Therefore, a high level of education in the team will result in:

- a greater awareness of the need to change and innovate (Wiersema and Bantel, 1992; Bantel and Jackson, 1989);
- a greater understanding of information;
- a greater capacity to analyze many-sided, complex problems thoroughly (Bantel, 1993; Calori *et al.*, 1994).

Some authors claim that people with a high level of education generate more creative solutions because they are more receptive to innovative attitudes (Kimberly and Evanisko, 1981; Rogers and Shoemaker, 1971). Based on these arguments we propose the following hypothesis:

H1c. A high average level of education in TMTs is positively related to innovative company performance.

Influence of TMT characteristics and strategic consensus on innovation

Upper Echelon Theory is undergoing an enriching process relative to its traditional viewpoint – the fruit of an emerging critical line of thinking based on the contradictory results of empirical research. Some authors have firmly criticized the direct link this theory establishes between TMT demographic characteristics and organizational performance (Lawrence, 1997; Smith *et al.*, 1994; Knight *et al.*, 1999).

The most critical arguments are both theoretical and methodological (Miller *et al.*, 1998; Pitcher and Smith, 2001):

- The hypothesis that demographic diversity has a direct effect on demographic diversity has not been substantiated, and could well be erroneous (Miller *et al.*, 1998).
- The *per se* composition of the group may not have a direct influence on results; rather it may be the interaction among group members that plays the defining role. Consensus or conflict may or may not be independent of the composition of the management team (Smith *et al.*, 1994; Knight *et al.*, 1999).
- The values of dependent or independent variables are not adequate.

Because this paper focuses on the second criticism, we analyze the effect of conflict on the direct relationship between TMT diversity and organizational results. This analysis allows us to state that conflict appears to be an unavoidable consequence of diversity, such that the latter can affect results through conflict (Pelled *et al.*, 1999; Bantel and Jackson, 1989; Amason, 1996; Amason and Mooney, 1999; Eisenhardt *et al.*, 1997).

As Amason (1996) points out, conflict is a paradox. Conflict can be necessary, as it increases the quality of decisions, possibly rendering them more innovative and creative; but it can prevent consensus, consequently thwarting effective acceptance, which in turn has repercussions for the implementation of the decision. Therefore, conflict is neither good nor bad in itself; rather its effects depend on its impact on the team's capacity to act and to make decisions. Some authors have highlighted this multidimensional facet of conflict, underlining its two sides: cognitive conflict and affective conflict (Pelled *et al.*, 1999; Amason, 1996; Eisenhardt and Zbaracki, 1992).

Cognitive conflict is functional in nature and arises when there are differences of opinion within the team about how to achieve better joint aims. This conflict, if channelled properly, increases the innovative character and quality of decisions, because innovation and quality depend on a common perspective which arises from the combination of different focuses (Amason, 1996, p. 127).

Affective conflict, on the other hand, is associated with emotional or personal relationships. Affective conflict causes dysfunction in decision making because it debilitates the capacity of the team to work as a unit and reduces shared thinking about the strategy to be followed by the company (Smith *et al.* 1994; Amason and Schweiger, 1994; Knight *et al.*, 1999; Amason and Mooney, 1999). As Amason (1996, p. 127) points out, conflict arises when disagreements are perceived as personal criticisms.

Some researchers have demonstrated a relationship between affective and cognitive conflict on the one hand and the different types of diversity and demographic characteristics on the other (Pelled, 1996; Amason, 1996, Knight *et al.*, 1999). Therefore, affective conflict might derive from diversity produced by demographic characteristics like age, gender, and race, which cannot be easily modified and cognitive conflict could derive from the diversity of demographic characteristics connected with the activity, training and function of the team (functional background, tenure in the team).

We have argued that cognitive conflict has a positive effect on creative and innovative decisions. Pelled *et al.* (1999), on the other hand, suggest that this conflict could lead to emotional conflict if there are no processes within the team to channel the richness which would derive from the divergence of opinions and attitudes. In this way the introduction of some processes within the group would allow the different outlooks, experience and knowledge to arise though diversity and to be capitalized on, thus achieving a consensus approach towards innovation.

In summary, through these processes the aim is that diversity is focused on matters which are relevant to work and innovation, and is not diverted towards an interpersonal conflict which could lead to internal fighting among group members. Among the decision-making processes which could be introduced into TMTs, we highlight the search for consensus and ways of communicating among members, as this may enable the members to integrate the various visions into one innovative and enriching consensus approach. Based on these arguments we now analyze briefly each of these processes and their relationship with the necessary strategic team consensus.

Agreement-seeking

Agreement-seeking behaviours have been defined as "those which are tried to produce consensus or agreement among TMT members regarding firm strategy" (Knight *et al.*, 1999, p. 448). They can be utilized in decision making to channel the wealth of team diversity in a way that capitalizes on the advantages of cognitive conflict and avoids the drawbacks of affective conflict (Amason, 1996; Amason and Sapienza, 1997; Knight *et al.*, 1999). Some authors have discovered that groups engaging in agreement-seeking behaviour achieve higher consensus levels – or put another way, that they mitigate affective conflict within the group (Schweiger *et al.*, 1986, 1989; Knight *et al.*, 1999).

Among these types of behaviours, we can highlight various types:

- On one hand, it is possible to observe techniques and procedures which incorporate conflict, or the freedom of controversial opinions in decision making, to then guide consensus. Among these techniques are "dialectical questioning" and "the devil's advocate." However, the efficiency of these techniques has been questioned by some authors (Schweiger *et al.*, 1989).
- Other group processes which can be used to search for consensus are debate and understanding of the decision by the group (Simons *et al.*, 1999). This method searches for consensus directly, without previously introducing conflict. The development of this technique produces a series of positive benefits, among which is the possibility that the team will work with more information obtained through different visions of reality, creating multiple options and synthesizing them into common objectives and plans of action, which include sufficient consensus (Eisenhardt *et al.*, 1997).

All of these objectives are geared towards the reduction of affective conflict, while fomenting consensus with regard to the need and importance of certain strategic approaches for the company, such as the promoting innovation.

Informal communication

Communication is a basic process in group behaviour and is the essence of social systems (Smith *et al.*, 1994).

Among the different facets of communication which could be relevant, the informal communication stands out. Informal communication has a positive association with other facets of this variable, such as frequency and the level of social integration within the group (Lott and Lott, 1961; Shaw, 1981). This relationship occurs because informality in communication leads team members to interact frequently and increases integration and cohesion within the group (Smith *et al.*, 1994).

Empirical research shows that in a context of high TMT diversity, if informal communication flows, relevant information is transmitted and perspectives and beliefs are broadened (Wagner *et al.*, 1984; Katz, 1982). Thus, on one hand, informal communication would allow disagreement and typical conflict in a heterogeneous group to be geared towards an exploitation of its wealth of information and outlooks, which is a considerable advantage in the process of the adoption of strategic decisions. On the other hand, with a high level of informal communication, a greater and deeper interaction between group members is achieved, permitting a greater proximity and trust between the members and favouring team cohesion (Smith *et al.*, 1994).

When TMT members manage to channel their diversity and the team is cohesive, they can achieve agreement over the necessity to initiate strategic decision of great transcendence for organizational development, such as innovation.

The arguments put forward by this study enable us to state the following hypothesis:

H2. Agreement-seeking and informal communication processes are positively related to the growth of strategic consensus within the TMT.

The arguments already established lead us to consider the study of a context of the strategic consensus could have on the relationship between TMT demographic characteristics and innovative performance in companies.

In this sense, we could opt for the establishment of two types of possible relationship models. The logic of the first model is based on the fact that certain processes which occur in TMTs interact with TMT demographic characteristics, and thus affect organizational results (Murray, 1989; Eisenhardt and Schoonhoven, 1990; Keck, 1991; Smith *et al.*, 1994; Knight *et al.*, 1999). This means that the model makes that the influence of demographic characteristics on results depends on processes which may arise within the team. These relationship models are defined by Smith *et al.* (1994) as intervening or mediating models. A second research group has established what is known as a "process model" (Smith *et al.*, 1994), characterised by the TMT processes, which directly affect the result. The model predicts that both demographic variables and processes are directly and independently connected with organizational performances (Smith *et al.*, 1994, p. 417).

In this study we opt for the establishment of a mediated relationship, which implies that strategic consensus can channel the wealth generated by the different types of TMT diversity. In short, the existence of strategic consensus within the team, brought about by processes which dilute affective conflict (agreement-seeking and communication) can channel divergent and creative points of view and decisions towards more innovative action (Wooldridge and Floyd, 1989).

Also, in this model, we have chosen to introduce the average level of education variable. We aim to analyze if in situations of strategic consensus within TMTs, the average level of education is improved or exerts a greater influence on innovative performance. So, the effect we suppose that consensus may have on the two categories of demographic characteristics analyzed is different. In the case of diversity, its direct interaction with consensus redirects the divergent effects, however, we suppose the average level of education has a positive effect on innovation, so consensus could only intensify this effect.

These arguments lead to the following hypothesis:

H3. The interaction of consensus strategy on TMT diversity and the existence of a high level of education have a positive effect on innovative results in companies.

The models proposed can be seen in Figure 1.

Methodology

The sample for this study, selected from the Dun & Bradstreet (2000) database comprises 960 companies with more than 50 employees that belong to the three Spanish sectors which, according to statistics supplied by the Spanish Office of Patents and Trademarks,

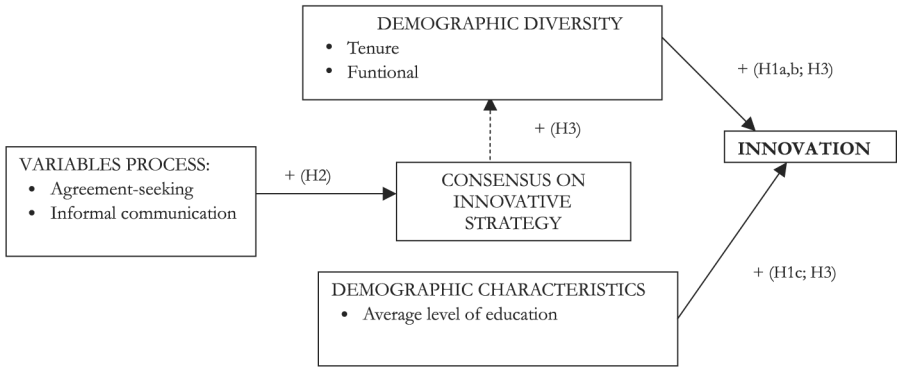

Figure 1.
Direct and mediated relationships established by the hypotheses of the model

have greatest number of registered patents: construction of industrial and agricultural machinery, electric and electronic machinery and material, and the base chemical industry. Results were obtained from 366 companies, 100 of which complied with our minimum requisite – that at least four questionnaires be completed by executives, including the managing director. We consider the analysis of 100 executives teams to be within the standard number used in this type of research. We can see, for example, that Knight *et al.* (1999) analyzed 83 executive teams and Ancona and Caldwell, 45.

The Dun & Bradstreet database was chosen because it provides a great deal of information that is relevant for this study: sector, size, and address of firms, for example. Furthermore, it is a potent instrument because it offers useful qualitative and quantitative information about these firms.

In order to obtain the required information, a 28-item survey questionnaire was designed, with a total of 28 items based on previously published works (Knight *et al.*, 1999; Hambrick *et al.*, 1996; Coombs *et al.*, 1996; Smith *et al.*, 1994; Wiersema and Bantel, 1992; Cordero, 1989), with the items directed at members of the top management team. With the aim of establishing the validity of the content in a Spanish context, the questionnaire was pre-tested on ten companies. To guarantee reliability of the executive's participation, it was verified by telephone that the persons questioned currently took an active part in the strategic decision-making processes in their companies.

The questionnaire was structured in four parts:

(1) five items designed to determine the TMT demographics (Wiersema and Bantel, 1992; Smith *et al.*, 1994, and Hambrick *et al.*, 1996);

(2) six items aimed at identifying such agreement-seeking mechanisms as might exist (Knight *et al.*, 1999) and one item addressing informal communication systems (Smith *et al.*, 1994);

(3) 13 items examining the extent to which consensus was required for the team's innovation (Knight *et al.*, 1999); and

(4) three items designed to determine the companies' innovative performance (Coombs *et al.*, 1996; Cordero, 1989).

Values of variables

Demographic diversity. To evaluate TMT demographic diversity, Upper Echelon Theory utilizes different procedures according to the variables' characteristics (Knight

et al., 1999; Wiersema and Bantel, 1992; Hambrick *et al.*, 1996; Bantel and Jackson, 1989). Therefore, for quantitative variables, variation coefficient (typical deviation divided by the average) was used. For the category variables, the Blau Heterogeneity Index (Blau, 1977) is calculated ($H = (1 - \Sigma i^2)$); where "i" is the percentage of individuals in the executive team in the " i-esima" category. An index value close to the unit represents high functional diversity among management team members; a value close to zero indicates functional homogeneity.

In the present research, TMT diversity has been evaluated through the demographic characteristics of tenure and functional career. Therefore, diversity in tenure was determined through the variation coefficient. To measure the functional diversity of the management team, we asked the executives to indicate the functional areas in which they had occupied the position of maximum responsibility throughout their professional career. The profiles studied were: general management, marketing, finance, production and R&D, and human resources. Based on this information, the Blau Heterogeneity Index (Blau, 1977) was calculated.

Education. Average education of the TMTs was evaluated by averaging the various categories of training listed in the questionnaire: doctorate, graduate/engineer, diploma holder/technical engineer and other studies.

Innovation. To determine innovation within the sampled companies, three variables directly related to innovative performance were evaluated: the number of new products, the number of improved products and the number of registered patents. These three variables have been utilized in numerous studies as indicators of innovation in companies, and their positive correlation has sufficiently demonstrated (Cordero, 1989; Ministerio de Industria y Energía, 1994; Coombs *et al.*, 1996). The least innovative companies were classified with a value of 0, and the most innovative with a value of 1. Through the method of principle components it can be seen that the established indicators comprised a construct which evaluates innovative results in companies.

As can be seen in Tables I and II, the weighting coefficients of the first component are all positive and statistically significant (z1 = 0.358776 * Npatents+0,661255 * Nprodexist + 0.658803 * Nnewprods). All the variables have a positive weight, but the number of patents is the least influential. This component may be called a component

Table I.
Analysis of principle components

Component number	Eigenvalue	Percent of variance	Cumulative percentage
1	1.61642	53.881	53.881
2	0.909	30.300	84.181
3	0.474579	15.819	100.000

Table II.
Analysis of principle components – table of component weights

	Component 1	Component 2
Npatents	0.358776	0.93335
Nprodexist	0.661255	−0.245306
Nnewprods	0.658803	−0.262072

Notes: Npatents = number of patents; Nprodexist = number of products; Nnewprods = number of new products

of innovative size, representing the output or innovative performance in the companies. High values in the three initial variables will correspond to high values in the first principal component. Thus, through this first component, companies can be classified as innovative (large size) or less innovative (smaller size). This first principal component is the best one-dimensional linear predictor of the original data, with which no other linear combination of the original variables exists to explain more clearly the total variability of the observations.

The second component presents the number of new products and the number of improved product variables with the number of patents variable. The classification we obtain is different ($z2 = 0.9335 * \text{Npatents} - 0.2345306 * \text{Nprodexist} - 0.262072 *\text{Nnewprods}$). This component shows how innovation variables have an internal dimension in which the previous effects are put forward. We find companies with a high number of patents but with few new or improved products, and vice versa. This variable does not define innovative size, but is better defined as a type of innovation. It shows us, therefore, two different forms of innovation: with or without patents.

The third component explains little, and should be not considered (self value = 0,474579 << 1). So the final dimension of the data is reduced to two principal components.

In this study we consider only the result of the innovation component established in terms of the size of innovation of the company, which will enable us to distinguish between greater or lesser innovative companies, which is the aim of this research.

Figure 2 shows the distribution of results of innovation of the companies included in the sample.

It can be seen that the right-hand side of the graph is asymmetrical; therefore a greater percentage of non-innovative companies can be expected. The percentage of companies with a value below the average comprises 65 percent of the sample, and we could consider the companies which are above average to be innovative. However, we could equally well demand a greater degree of innovation (average plus a percentile). To establish this definition of innovation, we used the *k*-average technique of conglomerates and pre-suppose the existence of two company profiles; the results are similar to those obtained by taking 30 percent of the most innovative companies, 70 percent of less innovative companies via the first principal component: Through cluster analysis we obtain two groups: a high-innovation group and a low-innovation group in which the values of the innovation variables are homogeneous within each grouping. Therefore, we consider Value 1 as representing the more innovative group with only 30 percent of the sample with the highest scores in the principal component; with all the other companies, represented by Value 0, being less innovative.

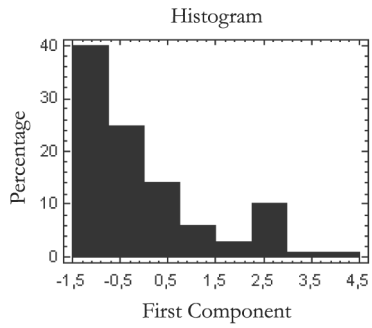

Figure 2.
Distribution of levels of innovation in companies

Strategic consensus. Through the variable of strategic consensus we attempted to determine the degree to which the top management team shares a common strategic vision on questions of innovation, measured by 13 items on a Likert scale (1-5), taken from the questionnaire used by Knight *et al.* (1999). These items were chosen because they referred to the value that executives place on strategic attitudes and actions geared towards innovation, proactivity and risk (see Appendix). The 13 standard deviations from the replies given to each of the 13 items were calculated, and these figures added for each management team. Because this variable should reflect the degree of consensus or agreement in the team, we inverted the direction of the scoring by multiplying it by (-1).

This value constitutes a direct estimator of the degree in which TMTs share an innovative strategic vision. It is important to note that this value is not an objective evaluation of the company's present strategy; rather it is a subrogate of the degree to which the TMT has a shared vision – a common mental model – of the importance of an innovative and creative capacity in its company (Knight *et al.*, 1999). Crombach Alpha was $\alpha = 0,7416$.

Agreement-seeking. In order to evaluate the "agreement-seeking" variable, we adapted the questionnaire designed by Knight *et al.* (1999), using six items evaluated with a five-point scale (see Appendix).

Following the procedure adopted in previous studies (Bourgeois, 1980; Dess, 1987; Knight *et al.*, 1999), the value of the variable was obtained by calculating the average of the replies given by the team to each of the six items[1]. We then calculated an overall average for each team using the six averages obtained. Cronbach Alpha was $\alpha = 0,9179$.

Informal communication. The level of informal communication, which exists in the management team, was established through one item, evaluated with a five-point Likert scale. Each executive was asked to evaluate the degree of informal communication existent in the TMT ($1 =$ low informal communication, $5 =$ maximum informal communication). For each team, the value of the variable was resumed in the average of the replies given.

Control variables. Research has demonstrated that the size of the company may be linked to a greater or lesser tendency for innovation (Bantel and Jackson, 1989; Cohen and Mowery, 1984; Rothwell and Zegveld, 1985; Ettlie *et al.*, 1984).

Some scholars establish that an increase in the size of the organization adds complexity to the structure, the formalized control systems and planning, and the resources localization (Quinn and Cameron, 1983). Others consider that large organizations have more complex and diverse facilities that aid the adoption of a large number of innovations (Nord and Tucker, 1987). Greater resources give to large organizations the leeway to tolerate the potential loss due to unsuccessful innovations (Damanpour, 1992). On the other hand, some organizational scholars argue that small organizations can be more innovative because they have more flexibility, a higher ability to adapt and less difficulty in accepting and implementing changes (Damanpour, 1992). Anyway, a difference in organizational size may stimulate or create resistance to change, and a greater or lesser organizational agility (Tushman and Romanelli, 1985). Thus, organizations may show a greater or a lesser likelihood to innovate or change as a function of their size. Therefore, the introduction of size as a control variable enables us to analyze the incidence of TMT demographic characteristics on innovative results of the company, once the effect has been isolated.

Organization size variable has been determined through the number of workers in the firm. The values of this variable fluctuate between 50 and 2,250 workers. Because of its wide dispersion, neperian logarithm of the number of workers in the firm has been used to estimate it, in order to avoid the scale effect, which could be produced if we consider the original variable.

Description and analysis of data

With the aim of detecting the possible existence of colinearity among the independent variables, we have conducted the pertinent statistical analysis. The descriptive statistics for each of the variables are shown in Table III.

As can be seen in Table III, the only relevant correlations among independent variables within a same hypothesis is that which exists between strategic consensus and functional diversity. Therefore, with the exception mentioned, we could state that in the model symptoms of multi-colinearity are not apparent. Also, auxiliary regressions of the correlated independent variables give coefficients inferior to the original regression.

Once these initial checks were conducted, we proceeded to test the hypothesis by applying different regression analyses. To test the first hypotheses (*H1a*, *H1b* and *H1c*), which established a direct link between TMT demographic characteristics and innovative results in companies, a logistic regression analysis was undertaken (see Table IV).

Variables	N	Min	Max	Media	Desv. Tip.	1	2	3	4	5	6	7
1. Dfun	83	0	0.66	0.4586	0.1339	1.00						
2. DanEq	100	0	1.73	0.5397	0.3661	0.204	1.00					
3. Nedu	99	1	3	2.2778	0.4158	−0.116	0.069	1.00				
4. Cinf	100	1	6	2.64	1.618	0.209	0.041	0.171	1.00			
5. Bac	100	1.33	4.94	3.9028	0.7043	−0.096	−0.027	0.216*	−0.066	1.00		
6. CEI	100	−24.25	0	−10.525	4.3531	−0.280*	−0.179	0.163	0.035	0.461**	1.00	
7. Size	100	2.89	7.71	4.9693	0.8342	−0.072	0.009	−0.064	−0.143	0.119	0.067	1.00

Notes: * The correlation is significant to 0.05 (bilateral); ** The correlation is significant to 0.01 (bilateral)

Table III.
Descriptive statistics and correlation matrix (independent variables)

Variables	Coefficient (*B*)	Wald statistic	Exp (*B*)
Dfun	1.453	0.440	4.276
Daneq	− 4.100	11.423	0.17*
Nedu	1.683	4.677	5.384**
Size	0.032	0.008	1.032
Constant	− 4.048	1.901	0.017

Notes: * $p < 0.01$; ** $p < 0.05$. Value of variables: Dfun = Blau Index regarding TMT functional background; Daneq = Coefficient of variation of seniority in management team; Nedu = Average of different levels of education; Size = Neperian logarithm of company size (no. of workers); GIN = Degree of innovation

Table IV.
Analysis of logistical regression: *H1a*, *H1b*, *H1c*: direct relationship

In this analysis the dependent variable is the result of innovation in companies and the three independent variables are diversity in TMT tenure, functional diversity and the average level of education of the team. The goodness values prove that the model selected matches the data well. In this case, the analysis of predictive efficiency is 81 percent accurate. Elsewhere, the overall significance of the independent variable coefficients is supported,($\chi^2 = 19.592$; $p \leq 0.01$).

The significant variables obtained are diversity in TMT tenure in the negative direction ($p \leq 0.01$) and the average level of education, in the positive direction ($p \leq 0.05$). Therefore, diversity in TMT tenure seems to have a negative influence on innovative results in companies, and the level of education has a positive influence. The size of the company control variable seems to have no influence on innovative performance in the sample.

With respect to *H2*, we conducted a linear regression analysis. The dependent variable in this case is consensus on innovation strategy, and the independent variables are the agreement-seeking and informal communication variables.

The analysis of linear regression (Table V) shows that the model is 100 percent significant and explains 20.2 percent of the established relationships/links ($p = 0.000$; R^2 corrected $= 0.202$).

The agreement-seeking process in the team appears to be decisive when it comes to reaching a consensus on innovation strategy, as it has a 100 percent positive and significant relationship. However, the level of informal communication appears not to affect the formation of consensus in the management team. Furthermore, this variable has a direct effect on the low explanatory power of the model.

To test the mediated relationship established in the third hypothesis, another logistic regression analysis was conducted. The independent variables of the model are composed of the different diversity values, as well as two interaction terms obtained by the product of the strategic consensus variable with each of the previous variables. We introduced the interaction terms because we wished to establish the influence of the moderator variable, strategic consensus, on the other variables which represent TMT diversity, and to determine if this interaction affects its relationship with innovative performance in companies in any other way.

Baron and Kenny (1986) state that, in general terms, a moderator variable can affect both the direction and the strength of the relationship between an independent and dependent variable. The authors establish that in the event that the moderator variable and the independent variable are continuous and if one presumes that the effects of the independent variable (X) on the dependent variable (Y) varies linearly with respect to

Variables	Coefficient	Statistic "t"
Constant	−21.988	−9.344*
Cinf	0.130	0.532
Bac	2.870	5.131*

Table V.
Analysis of linear regression: *H2*

Notes: *$p < 0.00$; $F = 13.175$ ($p = 0,00$) R^2 corrected $= 0.202$. Values of variables: Cinf = Average of informal communication variable; Bac = Sum of average of items of agreement-seeking variables; CEI = Sum of standard deviations from strategic consensus variables

the moderator (Z), then the moderator effects can be captured by an XZ product (Baron and Kenny, 1986, p. 1176).

To contrast this hypothesis, company size is again used as the control variable. The results of the analysis seen in Table VI show that the goodness values have a level of accuracy in the analysis of predictive efficiency of 79.7 percent. In addition, the study of the overall significance of the independent variable coefficients is supported ($\chi^2 = 25.683$; $p \leq 0.01$).

The significant variables were diversity in TMT tenure, functional diversity, average educational level and the interaction of consensus with functional diversity. As in the analysis of *H1*, tenure has a negative relationship with innovation ($p \leq 0.05$) and educational level has a positive relationship with innovation ($p \leq 0.05$). Functional diversity and the interaction between this variable and consensus affect innovation in a positive way ($p \leq 0.10$), indicating that, in situations of strategic consensus, functional diversity exerts a positive effect on innovation, both directly and in a mediated way. The other variables, including the control variable, appear to have no influence in the innovative capacity of the companies in the sample.

The results obtained from the hypothesis can be seen in Figure 3.

Variables	Coefficient B	"Wald" statistic	Exp (B)
Dfun	16.453	2.941	13,975,718*
Daneq	−7.413	5.450	0.001**
Nedu	2.233	5.778	9.325**
CEI	−0.692	2.194	0.500
TiFun	1.731	2.859	5.645*
TiDan	−0.285	1.289	0.752
Size	0.139	0.127	1.150
Constant	−11.473	3.975	0.000

Notes: *$p < 0.01$; ** $p < 0.05$. Value of variables: Dfunc = Blau Index regarding TMT functional background; Daneq = Coefficient of variation of seniority in management team; Nedu = Average of different levels of education; CEI = Sum of standard deviations from strategic consensus variables; Tifun = term for interaction functional diversity and consensus; TiDan = term for interaction diversity in seniority in team and consensus; Size = neperian logarithm of company size (no. of workers); GIN = Degree of innovation

Table VI.
Analysis of logistical regression: *H3*

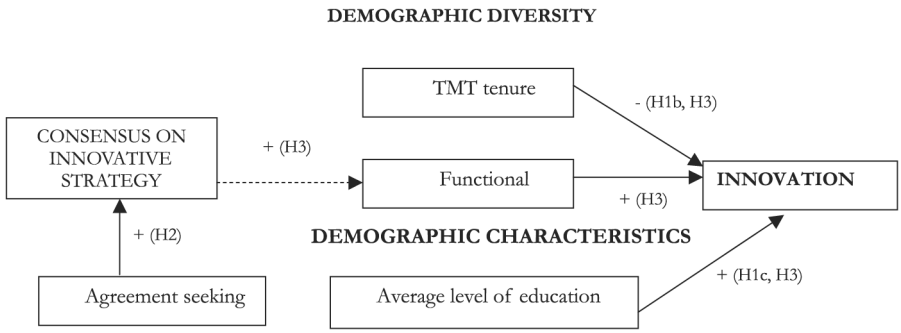

Figure 3.
Direct and mediated relationships extracted from results of the empirical analysis on the chosen sample

Discussions and conclusions

The aim of this research is two-fold:

(1) to determine if certain characteristics of TMTs affect the degree of innovation in companies; and

(2) to determine if that influence is direct or if it is mediated by other factors such as strategic consensus in the team.

To develop the analysis of these points, three working hypotheses were established. The results of the first hypothesis can be expressed in three main findings:

(1) a positive relationship between level of education and innovation;

(2) a negative relationship between TMT diversity and innovation in the case of TMT tenure; and

(3) no significant relationship between functional diversity and innovation.

First, a higher level of education in TMTs has a positive effect on innovative results in the company, a result that is widely supported in the literature (Wiersema and Bantel, 1992; Bantel and Jackson, 1989; Kimberly and Evanisko, 1981; Rogers and Shoemaker, 1971). Educational level reflects the skills and abilities of the people. Thus the higher the level of education, the more creative solutions may be generated (Bantel and Jackson, 1989), creating greater receptivity towards innovation, as previously established. Therefore, the results support our arguments.

Second, there was a direct, negative link between TMT diversity and innovation, in the case of TMT tenures which is inconsistent with Wiersema and Bantel's (1992) findings of no link between diversity in age and tenure in TMTs with strategic change. O'Reilly and Flatt (1989) found a negative link between diversity in tenure and innovation and Bantel and Jackson (1989) found a non-significant link between age and diversity in tenure with innovation. These findings lead us to question the arguments which maintain that diversity in TMT tenure may be linked with cognitive conflict (Pelled, 1996; Amason, 1996). In fact, some research indicates that extreme levels in this diversity may generate dysfunctional effects, which have a detrimental effect on the adoption of strategic choices such as innovation (Bantel and Jackson, 1989). Furthermore, demographic and cognitive diversity will benefit the adoption of complex decisions when the team interacts frequently, and it is not common in TMTs, which are usually isolated in their organizational units (Wiersema and Bantel, 1992).

Third, we have found no relationship between functional diversity and innovation, although functional diversity is one of the variables most commonly linked with the development of strategies of innovation and change (Bantel and Jackson, 1989; Wiersema and Bantel, 1992). The lack of relationship in our study may be due to the way in which this variable has been conceptualized and evaluated. The positive effects which can derive from this diversity will arise if there is no affective conflict. As Bunderson and Sutcliffe (2002) state, when functional diversity is established in terms of diversity in the different functional categories which are dominant among team members, they may not be prepared to share their heterogeneous knowledge in order for ideas and creative decisions to take place. The reason is that people tend to feel part of a social group (functional) to which they assign superior or at least more positive, characteristics, skills and knowledge, with a tendency to assign negative characteristics to other groups. These stereotypes and tendencies can undermine collaboration, inhibiting the capacity

for creativity and innovation. Rather than generating direct conflict, however, this can lead to distancing or a reluctance towards effective collaboration. In short, establishing functional diversity in terms of the most common different functional categories in each of the TMT members can lead to problems of functional identity for a particular group, which restricts communication and collaboration (Bunderson and Sutcliffe, 2002). Therefore, the existence of processes to promote integration and consensus in the group with the aim of exploiting the wealth of functional diversity, may be necessary. These results lead us to believe that functional diversity does not directly affect innovation, unless there is a consensus context in the TMT.

The results of the analysis of the second hypothesis show that on one hand, in order to achieve strategic consensus, the existence of agreement-seeking processes in TMTs is important. On the other hand, we have found no evidence that informal communication affects team consensus. In spite of the existence of theoretical arguments which support these relationship (Wagner *et al.*, 1984; Katz, 1982), these results are consistent with other research indicating that informal communication appears to have no clear effect on group integration, especially when the size of this group is excessive (Smith *et al.*, 1994). It appears that when informal communication levels increase, conflict can appear if team members deal work matters and emotional ones. Therefore, we cannot draw definite conclusions about the role played by informal communication in the achievement of strategic consensus. Perhaps, the contradictory results of this research is telling us that the consensus relationship is not linear or direct or that it depends on the effect of other variables such as TMT size. In any case, the relationship model established in this hypothesis has little overall significance, so the second hypothesis has not been supported.

The findings obtained under the third hypothesis reconfirm the results of the first, in that the level of education has a positive effect on innovation and that diversity in TMT tenure has a negative effect on innovation. However, the principal aim of this hypothesis is to analyze the mediated relationship between diversity and consensus on innovation. So we have found that functional diversity affects innovation, both direct and indirectly. The data indicate that in the strategic consensus context in TMTs, functional diversity affects innovation. The basic argument is that consensus can channel a wealth of visions and points of views drawn from diversity, having a positive effect on greater innovative results in companies. Finally, our analysis reconfirms that no wealth of opinions or enriched divergent approaches appear to arise from diversity in TMT tenure, which could explain that strategic consensus does not have to be a variable with a capacity to extract a positive effect from this diversity.

Four main conclusions can be drawn from this research:

(1) We cannot state that all types of diversity related to TMT activity or work have a positive effect on innovation in companies. To the contrary, diversity in TMT tenure appears to have a negative influence.

(2) On the other hand, the incidence of diversity on innovation appears not to be direct in all cases. Therefore, functional diversity has a positive effect on innovation, but always when there is a context of strategic consensus in the management team.

(3) The level of education of the TMT exerts a positive effect on the degree of innovation in companies, independently of the processes which may occur within the team.

(4) We have tried to contribute to the improvement and clarification of the direct relationship model proposed by Upper Echelon Theory between TMT demographic characteristics and innovation.

Our results have confirmed, in support of the critics of the theory, the need to introduce and analyze, along with demographic variables, other factors and processes which affect TMT decision making. Moreover, with the results of this research we suspect that the effect between TMT demography and innovation may not be linear, depending on the influence of other factors and of the TMT's own degree of diversity. All these observations leave important lines of research open within the field of study relative to top management teams.

Note

1. In order to evaluate if it is appropriate to include individual replies on a team level, the r(WG(J)) (James *et al.*, 1984) index was obtained. The value of the index confirmed that inclusion was appropriate.

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Appendix

Strategic consensus

(1) We believe that unstable environments and with quick changes, will provide opportunities rather than threat.

(2) Our competitive priority is the development of new products.

(3) For us, speed in the development of new products in relation with out competitors, is a priority.

(4) The sector in which the company operates is characterized by quick changes in production technology.

(5) The sector in which the company operates is characterized by quick changes in products.

(6) We put a strong emphasis on R&D, technological leadership and innovation.

(7) We define our strategic aims long term (around five years).

(8) We introduce completely new products rather than products which simply incorporate improvements to our existing ones.

(9) We value, in the long term, the implications which technological developments can have on our products and services.

(10) We look for advantages from all functional areas when we take important strategic decisions.

(11) We get frequent ideas from clients and suppliers on new products and processes.

(12) When we see a business opportunity we can appraise it faster than our competitors.

(13) I value the potential of our strategic resources to compete in the future.

Agreement-seeking

(1) Decisions of the managing committee are not considered definite until each member is in agreement or has accepted them.

(2) The ideas of all members are incorporated into decisions.

(3) All members of the managing committee are committed to achieving the company objectives.

(4) When important decisions must be made the team works hard to do so.

(5) The members of the managing committee are in agreement with the decisions finally taken.

(6) In your opinion, before a decision is made, all the options which can increase the company's efficiency have been considered.