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Exploratory study of organizational learning network within a Spanish high-tech company*

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Abstract

The paper presents an exploratory study of the intra-organizational learning network in the context of a Spanish high-tech company. It expands the generalization of the network perspective to intra-organizational learning. Based on an exploratory social network analysis, we formulated four propositions that will be developed and contrasted in a later confirmatory study. First, the exploratory analysis demonstrates the importance of industry experience and tenure within the company as a common denominator of most central employees within learning networks. Second, similarity in terms of experiential level breeds mutual learning. Third, complementarity of knowledge is important for the formation of learning ties. Fourth, physical proximity creates opportunities to learn. Future research will need to test these four propositions in a confirmatory study.

Key words*: organizational learning, social network analysis, intra-organizational learning network*

JEL classification*: M12, D83, D85*

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1. Introduction

Organizational learning is one of the most important sources of a company's sustainable competitive advantage (de Geus 1988), as well as an important driver of corporate performance (Stata 1989). Sustained learning is a key driver of an organization's ability to remain adaptive and flexible – that is, to survive and effectively compete (Burke et al. 2006). This is especially the case in turbulent and volatile business environments (Sorenson 2003, Tucker et al. 2007). Hence, it is crucial to manage organizational learning processes within these organizations in order to successfully compete. For this reason managers need to understand how organizational learning processes take place.

The network perspective on intra-organizational learning (Škerlavaj and Dimovski, 2006, 2007; Škerlavaj, Dimovski, Mrvar, and Pahor, 2008) offers an explanation that joins previously disparate participation and acquisition perspectives on organizational learning. By doing so it merges knowledge from the fields of social network analysis and organizational learning. Social networks are seen as a specific set of linkages among a defined set of persons, with the additional property that the characteristics of these linkages as a whole may be used to interpret the social behavior of the persons involved (Mitchell, 1969). The social network approach views organizations in society as a system of objects (e.g. people, groups, and organizations) joined by a variety of relationships. Not all pairs of objects are directly joined, and some are joined by multiple relationships. Network analysis is concerned with the structure and patterning of these relationships and seeks to identify both their causes and consequences (Tichy, Tushman, and Fombrum, 1979). Network analysis mainly examines the network effects as a whole and devotes less attention on the individual characteristics of the objects.

The network perspective on intra-organizational learning also builds upon the Learning Network Theory (Van der Krogt, 1995, 1998; Poell, Chivers, Van der Krogt, and Wildermeersch*.,* 2000), which states that a learning network is operating in every organization and describes the way learning is organized in the context of work organizations. People learn in every organization, even in a hierarchical or chaotic one, and the learning network merely represents how the learning is organized. This study extends our understanding of learning networks by filling in the research gap related to the way in which firms generate intra-organizational learning. Specifically, this study extends the generalization of the research findings of Škerlavaj and Dimovski, 2006, 2007, and Škerlavaj, Dimovski, Mrvar, and Pahor, 2007, which tested the intra-organizational learning network perspective in a Slovenian IT company present in Slovenia, Croatia, and Serbia. Therefore, our aim is to analyze the structures and patterns of learning networks in another context – in this case in a Spanish high-tech company.

The structure of the paper is as follows: Section 2 briefly presents the networks perspective on intra-organizational learning as a bridge between the acquisition and participation perspectives. It also presents elements of the learning network theory; Section 3 is empirical in nature and presents the company profile as well as the methodological framework. Section 4 presents the results of the exploratory analysis and four propositions for further confirmatory analysis. We conclude the paper with a discussion of the results and expose its main findings and limitations, as well as with possible directions for future research.

2. The network perspective on intra-organizational learning

2.1. Perspectives on organizational learning

This section provides a brief overview of the network perspective on intra-organizational learning which builds upon the previous two perspectives: acquisition and participation (Table 1).

Acquisition perspective. This is the most traditional approach that has been used to analyze organizational learning (March and Simon, 1958; Cyert and March, 1963; Huber, 1991) and, especially, the learning organization (Senge, 1990; Pedler and Aspinwall, 1998). It focuses on the individual acquisition of skills and knowledge as a point of departure for organizational learning. The mind is viewed as being a container, knowledge as a substance, and learning as the transfer and addition of substance to the mind. This approach is the most widely used because it embodies the understanding of "formal educational system" learning. Moreover, Argyris and Schön (1996) define organizational learning as individuals' acquisition of information, knowledge and analytical and communicative skills.

Participation perspective. This perspective derives from studies of learning in which no teaching was observed (Lave and Wenger, 1991). Furthermore, learning is generated within practice communities and flows from more experienced workers in the firms toward new workers. This perspective takes learning out of the individual mind and formal education settings and places it in everyday organizational life and work. Berends, Boersma, and Weggeman (2003) point out that organizational learning also emphasizes the individual component of the process, but places little importance on the learning environment structure.

Table 1: Organizational learning perspectives

	Acquisition	Participation	Network
Learning content	To be skilled and knowledgeable about organizations	To become a skillful practitioner in organizations	To be skilled and knowledgeable about organizations and to become a skillful practitioner in organizations
Learning method	Acquisition of skills and knowledge	Participation in communities of practice	Acquisition of skills and knowledge and participation in communities of practice
Organization	System	Communities of practice	The learning process needs to be contextualized within the framework of other social processes

Source: Adapted from Elkjaer (2004), Lazega (2001), and Škerlavaj and Dimovski (2006).

In the literature, there are some indications that the two perspectives are too incomplete to allow a full understanding of organizational learning. Elkjaer (2004) suggests the so-called "third way", which is an attempt to create a synthesis of the previous perspectives. The authors agree that the content and the process of learning are "not visible" as in a chemical experiment and that learning takes place as a social process, rather than a system or just in communities of practice. Nevertheless, the "third way" seems to put too much emphasis on the participation perspective and neglects some vital aspects of the acquisition perspective.

In the learning network perspective a synthesis is created in such a way that the individual is recognized as the primary source and destination for learning (the "first way"), while acknowledging that learning takes place primarily by means of social interactions (the "second way"). In addition, a broader structural theory of collective action (Lazega, 2001) needs to be considered in the context of organizational learning, while managing to connect the individual perspective with the organizational one. According to this theoretical framework, the learning process needs to be contextualizad as one of the processes that unfolds along with others and has to be related to these processes.

De Geus (1988) stated that the ability to learn faster than your competitors may be the only sustainable competitive advantage. In this way, Škerlavaj, Indihar, Škrinjar and Dimovski (2007) provide empirical support for the notion that higher level organizational learning contributes to increased value added per employee, return on assets, employee and customer satisfaction, and the quality of relationships with main suppliers. Knowing that higher-level organizational learning contributes to organizational success, one research question that remains inadequately explained is how learning occurs and if it can be explained using the acquisition, participation, or Elkjaer (2004) perspective.

Chan and Liebowitz (2006) and Liebowitz (2007) consider network analysis to be as a useful tool for researching the knowledge flows that are generated within a firm. For this reason, it is important to use the network perspective because it contributes to developing an organizational learning culture.

2.2. Learning networks

Cross *et al.* (2001) argue that a significant component or a person's information environment consists of the relationships they can tap for various informational needs. The paper expands this informational view to the learning perspective and introduces the concept of the learning network. Learning networks can be classified as internal or external (Birkinshaw and Hagström, 2002). The former are seen as an extended enterprise model and comprise relationships that a firm has with its customers, suppliers, and other stakeholders. This paper focuses on the latter form of internal organizational learning networks, which in our case form a set of internal relationships among individual members of the firm and other constituencies, such as product/service divisions and geographical units.

As we introduced previously, the Learning Network Theory (Van der Krogt, 1995, 1998; Poell *et al.*, 2000) points out that learning is generated in every organization, but the way it is generated differs. Learning networks can take various shapes depending on both actor dynamics and work characteristics (Table 2).

The main conclusions with regard to each type of learning are: (1) Liberal learning networks: Likely to emerge in organizations with a strong notion of employee empowerment and a tendency towards liberalization (Bloch and Bates, 1995; Filipczak, 1995; Andrews and Herschel, 1996); (2) Vertical learning networks: Common in large organizations. Despite the unpopularity of Taylorism, they still play an important role in organizational reality (Wilson and Cervero, 1997); (3) Horizontal learning networks: Gained popularity through the extensive literature on learning organizations. Advocates total integration of learning and work in teams (Senge, 1990); and (4) External learning networks: Common in environments where employees have a strong orientation towards their professional field. They are hard to control. (Poell *et al*., 2000).

Table 2: Theoretical types of learning networks

	Liberal	Vertical	Horizontal	External
Learning processes				
Development of learning policies	Implicit	Planning	Learning	Inspiring
Development of learning programs	Collecting	Designing	Developing	Innovative
Execution of learning programs	Self-directing	Guiding	Counseling	Advisory
Learning Structures				
Content structure (profile)	Unstructured (individually oriented)	Structured (task or function oriented)	Open or thematic (organization or problem oriented)	Methodical (profession oriented)
Organizational structure (relations)	Loosely coupled (contractual)	Centralized (formalized)	Horizontal (egalitarian)	Externally directed (professional)
Learning climate	Liberal	Regulative	Integrative	Inspiring

Source**:** Adapted from Van der Krogt (1995; 1998) and Poell *et al.* (2000)

3. Data collection and methodology

In order to understand the learning network perspective, we conducted a social network analysis within an industrial electronics and defence company. Social networks analysis is defined as "the mapping and measuring of relationships and flows between people, groups, organizations, computers, or other information/ knowledge processing entities" (Krebs, 2004) and provides a visualized graphic and mathematical analysis of a complex human interaction. The nodes in the network are the people and groups, while the links represent relationships or flows between the nodes. Rather than focusing on permanent attributes of people, objects, or events, the social network perspective views the characteristics of these people as arising out of relational processes (Wasserman and Faust, 1994).

3.1. Company profile

Tecnobit S.L. has 240 employees in its Valdepeñas (Ciudad Real) factory. The company was founded in 1976 as DOI-Associate Engineers and was located in Madrid. Its main activity centered on the control of industrial processes. In 1981, the company set up an industrial plant in Valdepeñas and the firm's name was changed

to Tecnobit. Over the next few years, it underwent considerable growth through a contract with the Ministry of Defence of Spain concluded in 1987. Currently, it has five business units with the following sales income distribution (Tecnobit Report, 2007): Aviatics (49%), Command and Control Systems (21%), Simulation Systems (14%), Optronics (8%), and Information Technology Systems (8%).

What is especially interesting about the evolution of the company is how it has diversified its business units based on the knowledge generated. Therefore, it is a technology intensive firm, where the technological component and knowledge generation have a key role. This fact, together the knowledge of the company of the authors of this research, led to the selection of Tecnobit for our study. In order to be competitive in a global market, Tecnobit has designed a dynamic and aggressive growth strategy, with the objective of generating synergies, essentially based on taking advantage of the knowledge that it possesses, and improving the value of the company. The diversification has been realised through both internal development and knowledge acquisition through cooperative agreements and the purchase of certain companies. (Guadamillas, Donate, and Sánchez de Pablo, 2008). The company had €12.2 million in EBITDA and € 50.4 million in revenue in 2006, and growth of 32.6% and 32.63% in the two last years, respectively. Due to the importance of the technological component in the company's operations, there has been an increase, on average 8.5 %, in sales revenue to R&D.

3.2. Methodological framework

In order to analyze the learning networks in Tecnobit we used a questionnaire developed by Škerlavaj and Dimvoski (2006). Data for measurement of the learning network was collected by asking respondents who the people are in their organization from whom they learn the most. They were given a coding scheme with the names of all employees and co-workers within the company. In addition, we also collected demographic data (gender, experience within the company, experience within the industry, department, educational level, and hierarchical level). All 240 people in the network received the questionnaire via e-mail in January 2008. In the following step, we also interviewed organizational members at different hierarchical levels with the aim of ensuring data validity and reliability. Data gathered through the questionnaires and findings from the interviews showed high consistency.

Among the employees who did not reply to the questionnaire we observed that a significant portion of them have been working in the company for too short a period of time to be able to generate significant social relationships with their new coworkers. For this reason, we excluded them from further analysis. After reducing the sample, it consisted of 209 employees that have been employed by the company for at least three months. At the end of the data collection process we obtained 175 completed questionnaires, which represents a response rate of 83.73%.

The company has six departments, shown in Table 3, which also presents the total number of responses and the frequency and average experience of the employees from each of the departments. We can observe that the main departments in terms of the number of employees and response rate are the first three (Design and Development, Production and Post-sales, and Manufacturing). The other departments represent a smaller part of the sample, and whose aim is to support the three key departments of the company.

In reference to worker experience, the highest average value is present in the General Services Department and the lowest in the Manufacturing Department. In addition, 44 years and 3 months of industry experience are the maximum and minimum values, respectively, in our sample. Moreover, in terms of worker experience in the company, the employees of the General Services Department also have the greatest average experience and the lowest is presented by the Manufacturing Department.

Table 3: Response rate and experience by department

Department	Employees number	Responses	Response rate	Average experience in firm (months)	Average experience in sector (years)
(1) Design & Development Engineers	75	72	96.0%	68.8	7.9
(2) Production and Post-sales	58	47	81.0%	56.5	6.23
(3) Manufacturing	49	39	79.6%	53.1	5.8
(4) General Services	11	7	63.6%	124.1	14.3
(5) Administration	9	4	44.4%	115.5	23.0
(6) Quality	7	6	85.7%	68.0	7.3
Total	209	175	83.7%		
Average				65.3	7.6

Source**:** Authors

Men represent 79.4% of the total responses and the Manufacturing Department is the main department in this regard, with men comprising 89.7% of employees. On the other hand, women comprise 50% of the employees in the Quality Department. The company has a very highly educated workforce with 70.3% of employees having a university degree (bachelor's or postgraduate degree), and only 4.6% of the workforce with only primary school education and 25.1% with secondary school education. For a high-tech company like Tecnobit, such an educational structure is a necessary but not in and of itself sufficient prerequisite for success. If we analyze the educational

level in the main departments, we can identify that 93.1% of the employees in the Design and Development Department have at least a bachelor's degree, followed by the Production and Post-sales (57.45%) and Manufacturing (41.03%) Departments.

The company is organized in projects, which also impacts its hierarchical structure, which is relatively flat and flexible. Tecnobit has a production and plant manager in Valdepeñas. Each project has a manager for each business unit, a program manager, a project manager (technical staff), and four technicians (quality, testing, manufacturing, and design). Among the technicians, there is a team leader who is accountable to the project manager. High flexibility is characteristic of Tecnobit because it promotes rotation between the various business units for different projects, in an attempt to develop "concurrent engineering", i.e., where employees have an understanding of the whole business (Cuquerella, interview 2007).

The production and plant manager provided us with information that was confirmed in the data analysis (this will be discussed in subsequent sections). We asked employees about their hierarchical position in relation to four categories: top management (0.6%), middle management (17.1%), project management (5.6%), and production, administration, and R & D operators (76.6%). The Valdepeñas plant has only top management, the production manager. Among the three main departments, the Design and Development department has the largest portion of employees at the high hierarchical level, with middle management comprising 19.44% and project management 9.72%.

3.3. Exploratory analysis of the learning network

The software used for data analysis was Pajek 1.04 (Batagelj and Mrvar, 2005; de Nooy, Mrvar, and Batagelj, 2005). We observed a directed inter-personal network with six departments located in the same geographical unit. The network represents the relationship "learning from" (Figure 1). For instance, the arrow directed from employee 52 to employee 66 means that employee 52 learns from employee 66. The departments are represented using different shapes, as described in the legend of Figure 1.

Figure 1 shows a strong connectivity within each of the departments. Learning relations between departments also are present but to a much lesser extent.
All departments have someone who learns from an employee in the Design and Development Engineering Department. This is mainly true for employees of the Production and Post-Sale Department. These two departments have more workers, and greater learning connections between them.

Learning relations between the first three departments are superior in number because: a) they have more employees; and b) the work effectiveness of each department depends on the outcome of the other two. The first department contains

design and product development engineers. Moreover, in the second department there are working production technicians, programmers, proof engineers, and post-sales technicians. Finally, the third department brings together inventory technicians, auxiliary production technicians, and production operators who have lower qualifications. In relation to the previous description of the employees' functions, we can perceive knowledge complementarities between them. For this reason, it is expected that learning relationships are generated between members of these departments. In addition to the findings of the network analysis, the interview showed that tacit knowledge transfer is reduced mainly to an exchange of ideas regarding certain problems, while explicit knowledge transfer is used to support projects in their initial stages (Cuquerella, interview 2007).

Indegree centrality

One of the main aims of our research is to analyze the characteristics of the most central employees. They are an extremely important source of knowledge for their coworkers. As such, they can increase the knowledge transfer within the company and have a strong impact on its performance. There are several ways to measure the centrality of the nodes in the literature, which can also be used to measure the relevance of an employee in a social network (Wassemanand Faust, 1994). One of the most often used is indegree centrality. The indegree of a vertex is the number of arcs it receives, i.e., it represents the percentage of workers within the organization who learn from him in reference to total employees. Table 4 shows the ten Tecnobit workers with the highest level of indegree centrality, who can be considered to be the main sources of learning within the company.

In order to manage learning networks, it is interesting to know what is common to the most central people within the learning networks. Table 4 shows that all of them are well educated (with the exception of employee 147). However, their educational level does not exceed the average educational level within the company on the whole. With reference to hierarchical position, 80.0% of these workers belong to middle management. This rate is much higher than the sample average (17.1%). Moreover, 60.0% of these workers are design and development engineers (contrasted with the sample ratio of the Design and Development Department, at 41.1%). The main characteristic of the top ten central workers is their high experience both in the industry as well as in the company (17.1 years and 161.9 months, respectively). Both of these ratios exceed the average value for the sample (7.6 years and 65.3 months, respectively).

Hence, the profile of the most central Tecnobit learning source is a middle level manager in the Design and Development Department (a software engineer) with exceptional experience in both the industry as well as the company. Based on our exploratory analysis, we offer the following proposition:

P1: The greater the experience of an employee in a certain field, the bigger the probability that coworkers will seek to learn from this person.

Table 4: Employees with the highest indegree rate

Employee Code	Indegree	Department	Worker's experience in the sector (years)	Worker's experience in the company (months)	Educational level	Hierarchy
66	0.08	1	7	36	UD	Operator
100	0.08	2	25	300	PD/TE	Middle Management
147	0.075	3	14	168	Secondary School	Middle Management
152	0.075	3	8	96	PD/TE	Middle Management
45	0.069	1	17	168	UD	Project Management
90	0.069	2	5.5	66	UD	Middle Management
12	0.063	1	14	168	UD	Middle Management
49	0.063	1	15	180	UD	Middle Management
22	0.057	1	43	168	UD	Middle Management
40	0.057	1	23	269	PD/TE	Middle Management
Top 10 average	0.0688		17.15	161.9		
175 average	0.016		7.60	65.25		
UD = 5 year University Degree (Bachelor's Degree) PD/TE = Professional Degree/Technical Engineering (3 year University Degree)						

Source**:** Authors

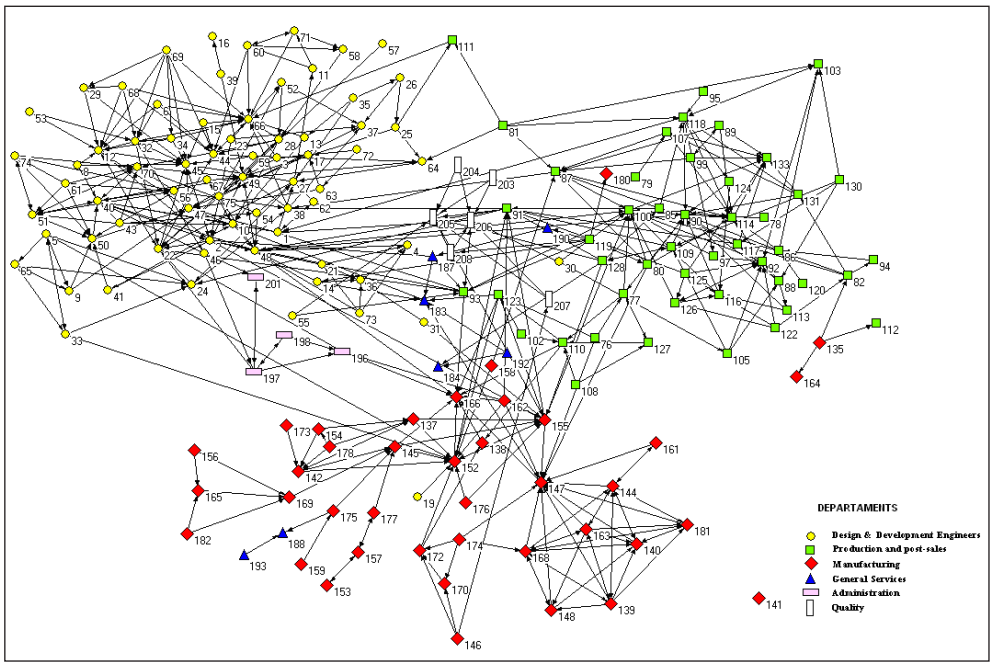
Cohesive sub-group analysis

Thus far we have analyzed the importance of individual employees in the learning network. However, on occasion there are cohesive subgroups within the network that foster learning between the employees who are a part of them. Furthermore, this learning is transmitted to the whole company through the individual connections they have with the rest of the workers in the network. There is a high probability that

cohesive sub-group employees have a certain solidarity, shared norms, an identity, and collective behavior, because there is significant social interaction between them.

In order to detect cohesive sub-groups, we will use social network and sub-network density (i.e., the number of lines – transfer of learning – in a simple network, expressed as a proportion of the maximum possible number of lines) as well as cliques[5] (a set of vertices in which each vertex is directly connected to all other vertices, i.e., a sub-network with maximum density). The density informs us of the cohesion of a group. Our goal is to explore what the common characteristics of the members of these groups are that promote learning among them. We believe that the similarities within sub-groups with higher density promote learning. In this case, the results of this study could provide relevant implications for managers, because they could come to know the key variables they have to assess in order to organize their employees in order to improve organizational learning.

Figure 1: Learning Network Map



Source**:** Authors

[5] For those interested in the social network analysis methodology, we suggest the works of Wasserman and Faust (1994) and De Nooy *et al.* (2005).

Table 5: Network and sub-network densities

Network	Density					
Whole learning network	0.016					
Sub-networks: Partition criteria	*Sub-network density (sub-network size - number of people)*					
Gender	Male 0.017 (139)	Female 0.022 (36)				
Experience in the firm	Lower Average 0.015 (101)	Higher Average 0.032 (74)				
Experience in the firm	Lower Experience 0.010 (96)	Average Experience 0.026 (66)	Higher Experience 0.124 (13)			
Hierarchical position	Top management - (1)	Middle Management 0.057 (30)	Project Management 0.020 (10)	Operator 0.011 (134)		
Educational level	Primary School - (8)	Secondary School 0.025 (44)	3 year university degree 0.018 (55)	5 year university degree 0.026 (61)	post-graduate/ Master's degree 0.06 (7)	PhD - (0)
Department	Design and Development Engineers 0.038 (72)	Production and Post-Sales 0.048 (47)	Manufacturing 0.059 (39)	General Services 0.102 (7)	Administration 0.555 (3)	Quality 0.250 (6)

Source**:** Authors

Table 5 shows network and sub-network densities. Density is a numeric value between 0 and 1. A network would have a value of 1 if everyone learned from everyone else, and 0 if there was no relationship among the members of the network. The Tecnobit learning network has a density of 0.016, which means that 1.6% of all potential learning relationships actually exist. Given the project-based nature of Tecnobit's work and the fact that the network is relatively large, the relative sparsity of the network is no surprise. The potential number of relationships that a person can maintain is limited.

Although it is not possible to compare densities between networks with different sizes, they are still informative if we observe different partitions. According to the gender criteria, no significant differences in sub-network density exist. The same is also true when we consider different educational levels. The contrary is true when we cluster organizational members according to the experience, department, and hierarchical level they belong to.

Due to the importance of experience in the company, we considered it suitable to make two divisions in the sample. Firstly, we classified workers into two groups (less and more experience than the average value). Then, we made a new group with workers with longer experience in Tecnobit. We found that the sub-group with more experience than the average value shows more learning connections, above all those employees with more experience in the firm (more than 15 years[6]). This is also evidence that relationships need time to develop.

One of the highest density values in relation to the size of the sub-network is showed by the middle management group. From the learning network graphic presentation, we can observe that middle managers are key players in maintaining and developing the learning network of the company. However, the operators' sub-group has a density lower than the network density. Therefore, the hierarchical position similarities could play an important role in determining the learning network. If we analyse the experience variable within each group, we can understand that density differences could come from the greater similarities in coworker experience in the middle management sub-group. Therefore, we can (again) appreciate the importance of the similarities in the level of expertise between employees in order to learn from them.

Another variable we had previously discussed is the department each employee belongs to. As Figure 1 shows, learning among workers within the same department is much more present than it is with other departments. Therefore, this is also an important criterion in determining cohesive social sub-groups within the company. Normally,

[6] It is true that this group has only 13 employees, but if we compare its density with the density of other subgroups with a similar number of coworkers (project management, post-graduate, and primary school), we find that this sub-group is more cohesive in relation to the learning relationship.

when workers share a department they have to work in the same areas (laboratories or offices), so it is common that employees learn from the workers they are proximal to. However, we have also found a significant number of interdepartmental relationships whose objective is to seek complementary knowledge from other departments. Complementarity becomes more evident in the relations between the first three departments. For example, in the production process, the production technician and/or test engineer who belongs to the Production and Post-sales Department often need information from the engineers in the Design and Development Department and also need to know the inventory level, which is in the domain of the inventory technician from the Manufacturing Department.

Conducting a cohesive sub-group analysis is necessary in order to point out that we have found three cliques of three vertices (a clique is a sub-group of members where everybody learns from everybody else). It is interesting to analyze the common characteristics of the workers who are in cliques because they indicate strong social cohesion within the network. The first two cliques occur between operators with a similar level of experience. So, there are two factors in common: hierarchical position in the company and level of experience. The workers of the last clique have average level of experience in common. Thus, we can propose that there is more probability that Tecnobit employees learn from co-workers with a similar level of experience and hierarchical position.

Finally, we have found a high number of relationships between three workers. In these relations, there is mutual learning in two of the three pairs of possible relations. In another relation the learning is produced only in one direction. So, we can point out that there are different cohesive sub-groups within the network. Most of these relationships occur within the same department, among workers with a similar level of educational and hierarchical position. Therefore, the department the employee belongs to may also influence the learning relations because of the concurrent largest number of similarities between workers (educational level) and the largest degree of geographic proximity. Based on these analyses, we can establish the following propositions:

P2: Similarity in the level of expertise augments the probability that co-workers will learn from each other.

P3: Complementarities in knowledge possessed augment the probability that co-workers will learn from each other.

P4: Physical proximity augments the probability that co-workers will learn from each other.

4. Discussion and implications

Our social network analysis of the learning network within the Spanish industrial electronics and defense company Tecnobit offers some insights regarding the research question of how learning within organizations occurs. Learning in a company can be acquired through participation in a community of practice and access to flows of previously acquired knowledge.

Evidence for both sides of the argument was found in our case. On one hand, learning often occurs in project settings and mainly involves the transfer of tacit knowledge through participation. Therefore, it is suitable to promote cohesive sub-groups (such as project groups) because such groups generate this type of learning. Moreover, the employees who are most often seen as a source of learning are those with above average tenure within the company as well as in the industry in general. Hence, the key players within the company have accumulated experience and knowledge over time and are willing and capable of sharing it with their colleagues.

In addition, we also provided exploratory evidence for homophily regarding expertise level and physical proximity within learning networks. The closer organizational members are in terms of their expertise level and the closer the location they work at, the more probable it is that they will form mutual ties. This is an important finding for the management of learning networks. If we wish employees to collaborate and learn from each other, opportunities for them to meet and build trust need to be created.

Analyzing learning networks seems to be a very appropriate way to approach the complexity of the learning processes among organizational members. Hence, we believe that we have provided an additional indication of how learning can be acquired through various modes that combine previously disparate acquisition and participation perspectives on organizational learning. That is, while it is true that learning takes place during participation in a community of practice, it is also generated through access to knowledge flows within the organization. Hence, a visualization and exploratory analysis of learning networks within organizations help us to understand and manage intra-organizational learning processes.

With reference to the various types of learning networks that have been analyzed in the theoretical part of this study, we find that the Tecnobit learning network has some characteristics of a vertical learning network with a tendency to become a horizontal network. The company fosters internal learning in an attempt to make its knowledge structure more explicit. Therefore, the company strives toward the integration of various departments with cross-functional teams. At the same time, Tecnobit develops products that require absolute confidentiality for its success. Hence, it needs to find an appropriate balance between openness to knowledge transfer and the protection of knowledge from outside parties. The learning is oriented towards tasks,

functions, and problem resolution. Thus, the Tecnobit learning network structure is in an intermediate situation between vertical and horizontal structures, but it is closer to the latter.

5. Conclusions

The main theoretical contributions of this paper are that it strengthens the generalizability of the previous research findings regarding the network perspective to intra-organizational learning and as well expands the understanding thereof. The study provides support for the notion that the experience of an individual employee contributes to his/her knowledge and that others are more likely to learn from such a person. A similar relation exists with employees in higher hierarchical positions because there are a high number of middle management personnel among the employees with greater indegree levels. Besides, the paper provides evidence for the possible explanatory variables for learning: (1) physical proximity (same department – office and geographical position), (2) similarities regarding level of experience, and (3) complementarities in knowledge possessed.

The results also indicate that firms must be flexible and they need to adapt continuously to changes in the environment. In order to achieve these aims, firms require an improved communication network among their employees in order to improve the internal knowledge flows which foster learning. A suitable tool could be the reorganization of the reward system. Therefore, this study offers tools for detecting the most important employees in a firm from a learning viewpoint. With this knowledge, managers can better develop reward systems and motivational schemes for their employees. Knowing the structure of relationships within their organization, managers can also adjust their style on a democratic-autocratic continuum. Such an analysis can result in significant implications for human resource professionals when planning necessary educational and training schemes in order to enhance learning, because these schemes may be adjusted to better suit the needs of employees.

This study also has its share of limitations. It should be noted that the high level of qualifications of the employees and the fact that the firm is knowledge- and innovation-intensive are factors that cause Tecnobit to possibly be different than other companies. Being based upon a single case study at one point in time, it calls for studies of companies from other countries, other industries, or even different sizes. A further extension of the study would also be to observe the learning network longitudinally in order to see how relationships form and dissolve and which managerial interventions affect them in what way. We also need to acknowledge the fact that it is an exploratory study which needs to be upgraded with statistical modeling of learning networks in order to test exact hypotheses.

Future research in the area will need to apply the learning network approach to other settings in order to find additional support for the propositions suggested. Valuable insights would come from similar analyses in still other companies of various sizes, different industries, or even other countries in order to control for the impact of various context variables. The organizational and national culture and the hierarchical structure of the company will also influence the generation of learning in social networks within a company. In this way, consideration is given to the fact that it is relevant to control for the effects of these variables in the learning network.

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Eksplorativno istraživanje mreže organizacijskog učenja u španjolskom poduzeću visoke tehnologije

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Sažetak

Tekst sadrži rezultate istraživanja mreže unutar-organizacijskog učenja u španjolskom poduzeću visoke tehnologije. Istraživanje poopćava mrežnu perspektivu i prikazuje njenu primjenu na unutar-organizacijsko učenje. Na temelju eksplorativne analize socijalnih mreža, predložene su četiri hipoteze koje će biti razvijene i kasnije provjerene u konfirmatornoj analizi. Prvo, eksplorativna analiza pokazuje važnost stečenog iskustva o industriji i kontinuitet vrhovnog menadžmenta poduzeća kao zajedničkog nazivnika većine središnjih zaposlenika u učećim mrežama. Drugo, sličnost u pogledu stečenog iskustva omogućuje uzajamno učenje. Treće, komplementarnost znanja predstavlja važnu podlogu u stvaranju poveznica za učenje. Četvrto, fizička blizina pruža mogućnosti za učenje. Kako bi se navedene hipoteze provjerile, u budućnosti je potrebno provesti i konfirmatornu analizu.

***Ključne riječi**: organizacijsko učenje, analiza socijalne mreže, mreža unutar-organizacijskog učenja*

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