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# THE INFORMAL ORGANIZATION: A NETWORK ANALYSIS PERSPECTIVE

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## ABSTRACT

The paper illustrates the results of a research on the subject of the informal networks proposing the case study of the Euris Group, an Italian knowledge intensive company operating in the information systems industry. The research focused on the in-depth analysis of the informal structure of the company using the social network analysis. The methodology was used with the aim to enhance the comprehension of the informal organization and to identify the key (informal) roles and to support the integration and collaboration within and among the strategic groups of the company. In particular, the authors identified a new key (informal) role, called *pilus prior* (first lancer), synthesis of problem-solver, knowledge and accessibility attributes. The case suggests that *pilus priors* are the emerging leaders in the company. Finally, we provide some suggestions to increase the collaboration and the knowledge sharing and to align the formal structure to the informal one. These actions are suitable for the specific case but could be valid for any company.

**Keywords:** Informal organization, Informal network, Social Network Analysis, Case study

## 1. INTRODUCTION

The concept of informal organization born in the organizational studies and it was likely conceived in the “Human Relations School”. The founder of this research stream is Elton Mayo, who is celebrated for his studies at the Hawthorne Work at the Western Electric company (1933). Mayo’s vision exceed the mechanistic one, typical of former studies (e.g. Taylor – *Scientific Management*), which were characterized by the idea of a total rational behaviour of the organization’s members. Mayo asserted that workers form autonomously groups with their customs, tasks, duties, routines and rituals, both consciously and unconsciously; managers are successful (or unsuccessful) according to the extend to which they are accepted as authorities or leaders by such groups. The concept of informal organization has been used by Barnard (1938), Roethlisberger and Dickson (1939) and Argyris (1957). Simon (1976) revised this concept stressing the relationship with the formal organization and highlighting the spontaneous emerging of roles within an organization.

Recently, some scholars and consultants have addressed their studies on the analysis of informal networks. An informal organizational network is a network of relationships that employees form across functions or division to accomplish tasks fast (Krackhardt e

Hanson, 1993; Cross *et al.*, 2002a e 2002b; Cross e Parker, 2004; Morton *et al.*, 2004). The research stream which studies informal organizational networks using network analysis is at the same time part of the organizational research field as well as of the network research field.

The methodology used to study informal networks is the social network analysis (SNA). Its origins date back to the '40s, when a group of important researchers, working in Harvard, started to study social relations. One of these researchers, Lloyd Warner, influenced Mayo's studies. See Scott (1991) for an excellent review of the history of SNA from its origins to the 70s. The concept of Social Network has been widely used in scientific publications especially since the 70s, after some important works were developed, e.g. Granovetter (1973) on the strength of weak ties. See Borgatti and Foster (2003) for an in-depth review on the network paradigm applied in organizational research. The network paradigm applied on social science achieved both widespread success (Mizruchi, 1994) and disagreement (Salancik, 1995).

The paper illustrates the results of a research carried out on the topic of informal networks. It is organized as follow. The first section (par. 2) describes the research on informal network in organizational studies. The second section (par. 3) proposes some fundamental concepts of social network analysis and the network analysis measures applied in the case study. The third section (par. 4) describes the research methodology used in the case study conducted in the Euris Group, an Italian knowledge intensive company operating in the information systems industry. The subsequent section (par. 5) discusses the analysis of the informal structure of the Euris Group. The discussion is focused on a new key role, which we called *pilus prior* (first lancer), synthesis of problem-solver, knowledge and accessibility characteristics. Finally, we provide some suggestions to enhance knowledge sharing flows and to align the formal structure to the informal one, derived from the specific case but valid more general for any company.

## 2. STUDIES ON INFORMAL NETWORKS

The performances of organizations, even if affected by the formal structure representing the skeleton, are determined by the informal structure. This is the real central nervous system, which drives the collective process, the actions, and the relationships of the own business units (Krackhardt e Hanson, 1993).

The importance of informal networks within the organizations is easily comprehensible. Nevertheless, it is also clear how this relationships are invisible in the standard representations of formal organizations (e.g. organization charts). Social network analysis is the fundamental methodology to analyze and visualize informal networks, which otherwise would be invisible. Cross *et al.* (2002b) asserts that the growing interest on social network studies, and therefore on informal organizational networks, derives from changes in the managerial approach, which took place in the '80s. In particular, these changes regarded an enhanced inclination to work team or continuous improvement projects inside companies and to the creation of joint ventures, strategic alliances, integrated supply chains and extended enterprises among companies. Such practises necessitate of more flexibility and effectiveness to companies. Meanwhile, they contributed to knock down the barriers obstructing communicational flows. In dynamical and rapidly changing business environments, information should be spread and decisions should be taken fast. In such contests, informal structure becomes

particularly important due to its flexibility and dynamism. Cross *et al.* (2001), confirming a previous research (Allen, 1984), studied the behaviour of 40 managers of a company characterized by the most efficient technologies to manage and to share information. The authors found that the most trustworthy and dynamical source were people.

The interest in social network analysis, particularly in management, follows some researches which demonstrated the strong impact of informal structures both on individual performance (Brass, 1984; Burt, 1992; Krackhardt e Brass, 1994, Cross e Cummings, 2004), internal organizational network performance (Krackhardt e Hanson, 1993; Cross *et al.* 2002a, Cross *et al.* 2002b; Cross e Prusak 2002;), and external organizational network performance (Mizruchi e Galaskiewicz, 1994; Bouty, 2000; Baker e Faulkner, 2002).

According to Cross *et al.* (2002a), the objectives of an informal network analysis, within an organization, concerns the support to:

1. Integrations and efficient collaboration among strategic groups;
2. Integrations and efficient collaboration within strategic groups;
3. Key roles.

In order to reach these objectives, the objects of the analysis are:

1. The distribution of relationships among homogeneous groups of actors;
2. The distribution of relationships within homogeneous groups of actors;
3. The key actors.

In order to identify both key actors and homogeneous groups and to analyze their relationships, Krackhard and Hanson (1993) proposed the analysis of three informal organizational networks:

1. Communication network: network of working information within the organization;
2. Trust network: network of trust relationships within the organization;
3. Advice network: network of advice relationships within the organization.

More recently, Cross *et al.* (2002a) suggest to study five informal organizational networks:

1. Communication network: network of working and not-working information within the organization;
2. Information network: network of working communications within the organization
3. Problem-solving network: network of advice relationships within the organization; the focus is on relationships which allow to solve working issues;
4. Know network: network of knowledge within the organization, describing how the knowledge and competences are spread.
5. Access network: network of accessibility to knowledge within the organization.

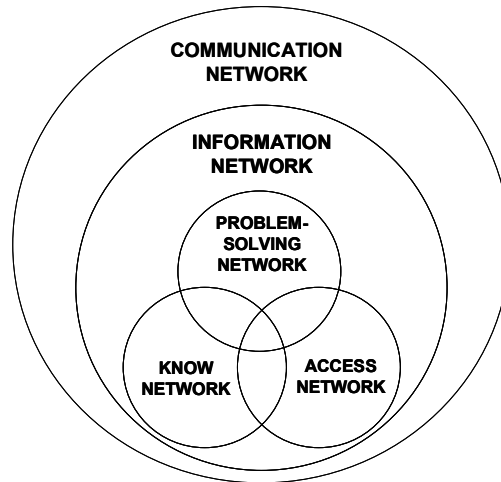


Figure 1 – Intersection among the 5 informal networks.

The five social networks previously described can be split into two classes: non-working domain and working domain.

With reference to the communication network it is possible to focus on friendship and trust relationships among people interacting and exchanging information which belong to the non-working domain. Individuals in these networks, the opinion leaders, own strong ability to interact with others. These charismatic people can influence the attitude of other workers regarding organizational changes (Krackhardt, 1992) and they act as information brokers among strategic groups (Smith, 2005). This last role was identified by Cross and Prusak (2002), who studied 50 medium-large US companies and identified other three key roles within companies or within groups, which were established spontaneously or by formal constraints:

1. Central Connector: who connects many people in an informal network;
2. Boundary Spanner: who connects an informal company network to other groups or people;
3. Information broker: who supports the information exchange among groups;
4. Peripheral specialist: who provides specific knowledge to an informal network (but peripheral in the information network).

The working domain is identified by the remaining four networks among which the information network is the widest. In particular, as shown in Figure 1, the information network contains the problem solving network, the know network and the access network. The join among these last three networks is not identical to the information network. The actors central in these four networks are people with capabilities, like knowledge and problem solving ability which are recognized by others actors. These people have important informal roles within the organizations which will be discussed in the section 5.

### 3. SOCIAL NETWORK ANALYSIS: FUNDAMENTAL CONCEPTS AND ANALYSIS MEASURES

Network Analysis (NA) is the mapping and measuring of the relationships and flows among a set of actors (Burt, 1982, Scott, 1991). NA has been used in different areas,

such as linguistics, epidemiology, ecology, sociology, psychology, anthropology, political sciences and management (Borgatti, 2002). Social network analysis (SNA) is the process to map and measure social relationships among social entities (Wasserman and Faust, 1994), which are people, groups and organizations.

The general objective of SNA is to gather and analyze data and information, in order to identify models of relationships and interactions among social entities. SNA attempts to visualize informal structures which are invisible but strongly influence network performance. The three objectives in studying informal organizational networks using the SNA methodology are: (1) theory building, (2) theory testing and (3) the improvement of informal structures' performances. The third objective consists in studying how it is possible to enhance the access and the sharing of information in order to improve organizational performances. Specifically SNA is used to assess the fit of the social network to the organization's goals.

This section is aimed to clarify the fundamental concepts and the measures used in the case study analysis. The fundamental concepts in studying networks are four (represented in Figure 2):

- Actor: the simplest unit of analysis, that is individual or agent;
- Attribute: proprieties, qualities or characteristics of the actors (e.g. workplace, age, formal role, ...);
- Relationship: contacts, constraints, memberships which establish a relationship between two actors and which don't derive from actor attributes;
- Network: set of homogeneous actors (nodes) and relationships (ties) among them (Wasserman e Faust, 1994).

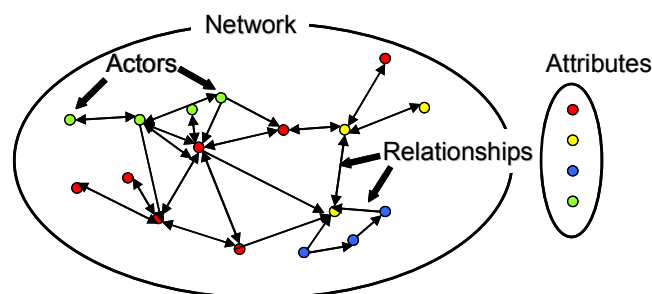


Figure 2 – Actors, relationships, attributes, networks.

In network analysis, the data are organized in matrixes, where actors are placed in rows and in columns. The values in the cells indicate the presence and the strength (e.g. in terms of frequency) of the relationships among the actors. Two connected nodes are adjacent and the matrix is called adjacency matrix, if actors have homogeneous nature, and incidence matrix, if they are heterogeneous (e.g. membership). The direction of the relationship is read from rows to columns. If the edges are no-directed, the matrix is symmetric.

Two common measures in network analysis, regarding the connection among the nodes (actors), are length and distance:

- Length: number of edges in a path connecting two nodes;
- Distance between two nodes: length of the minimum path.

Two important measures can be computed for each node (Kilduff and Tsai, 2003):

- In degree: number of edges coming into a node in a directed graph;
- Out degree: number of edges going out of a node in a directed graph.

In no-directed graphs, the “in degree” is equal to the “out degree”. Another concept widely used in network analysis is the density of a network. The density is the ratio between the number of edges in the graph and the potential number of edges in the same graph.

The cut point is an important positional characteristic of a node in a network, useful to identify key roles connecting different groups within an organization. A node is a cut point if the number of components of the graph without it is minor than the number of components with it.

Centrality is a common concept in network analysis due to its efficacy in analyzing the power of an actor within a network. There are two types of centrality, the first one concerns single actors within a network, the second one, called centralization, is referred to the whole network. Regarding the centrality referred to a single actor is possible to use:

- Centrality degree (Nieminen, 1974): a node is locally central if it has many ties to other actors in its surroundings.

The centrality degree depends on the network dimension. It is possible to standardize this measure dividing it by the number of nodes in the network. This mean degree of centrality is useful to compare different networks. The centrality degree is a local measure, considering an actor in its surroundings. Anyway we can consider two global measures of centrality:

- Betweenness (Freeman, 1979): centrality based on the frequency with which a node falls between pairs of other points on the shortest or geodesic paths connecting them. The higher is the value of betweenness for an actor, the more this actor is an intermediary in the system analyzed.
- Closeness (Sabinussi, 1966): centrality based on the sum of the geodesic distances from that node to all other nodes.

The higher is the value of closeness for an actor, the more this actor is globally central in the system analyzed that is near to the other nodes.

The betweenness highlights the strategic position of an actor within the communications flows. People with high betweenness could influence a group keeping or distorting information. People with high closeness have a strategic position because they are the “closest” to the others.

The centralization shows a global network characteristic:

- Network centralization: measured as the degree to which a network is centralized around one or few actors.

Network centralization measure highlights how the graph is organized around its central node. Networks with high centralization values are systems where information flows tends to concentrate to a single person. On the contrary, if the centralization value is low, the relationships are distributed more homogeneously. In Figure 3 it is shown a star. It has 100 % of network centralization by definition.

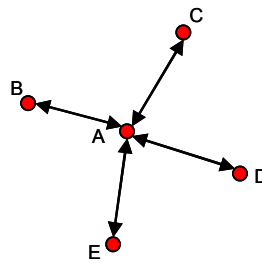


Figure 3 – Star network.

Finally, in network analysis it is important to find clusters:

- Clusters: actors grouped by structural equivalence, high density or closeness criteria.

Generally, clusters could be defined as homogeneous groups within the network owning particular properties and identifiable through cluster analysis techniques.

#### 4. INFORMAL NETWORK ANALYSIS: THE EURIS GROUP CASE STUDY

In the research we focused on an in depth analysis of the informal structure of a real company. We used the SNA methodology for studying the five social relationships proposed by Cross *et al.* (2002a) and the five corresponding informal networks. These five networks have been chosen because they represent the most in-depth model for the analysis of informal organization we found in the literature. Nevertheless, we were interested in finding a new key (informal) role. This key role concerns people considered by their colleagues as problem solvers, experienced and accessible. In order to identify this new key role we studied the intersection of the problem-solving network, the know network and the access network.

The company studied has been selected due to its belonging to the knowledge intensive industry. As a matter of fact, in these contexts, informal structures and informal relationships play a fundamental role in achieving strategic and operative goals (Burt, 1992; Cross *et al.*, 2002b; Wang and Pervaiz, 2003).

##### 4.1 The Euris Group case study

The Euris Group operates in the information technology market, offering software services and solutions to its customers. Euris' customers are medium and large manufacturing enterprises, banks, local public authority and multi-utilities companies. A proper human resource management, in terms of accessing and sharing of the knowledge flows, is fundamental for companies operating in such contexts. This aspect is important both for the operative management and both to achieve competitive advantages.

The Euris Group, founded in 1989, has 6 business units, which are companies focused on different market areas. The biggest one, Euris Solutions, is focused on large clients, while Gesta Consulting offers solutions to industrial markets. Eidos has its headquarter in Rijeka (Croatia) and its mission is to build a software development center specialized in innovative platforms. Besides these business units, the Euris Group includes Progetti, located in Trieste, Milan, and Padua, and Cores, which is the administrative unit. The last business unit is Euris, leader of the Group, represented only by the CEO. At the



time August, 31 – 2005 the number of employees were 102 in Euris Solutions, 26 in Gesta Consulting, 20 in Progetti, 18 in Eidos, and 25 in Cores.

#### 4.2 Steps of the Euris Group case analysis

The literature analysis conducted on SNA allowed us to identify some commonalities among different social network analysis processes. The differences among the steps only concerns two aspects: the data gathering and the analysis' objective. The social network analysis conducted was organized in 6 core steps and a preparatory step. Figure 4 shows the sequence of the methodological steps.

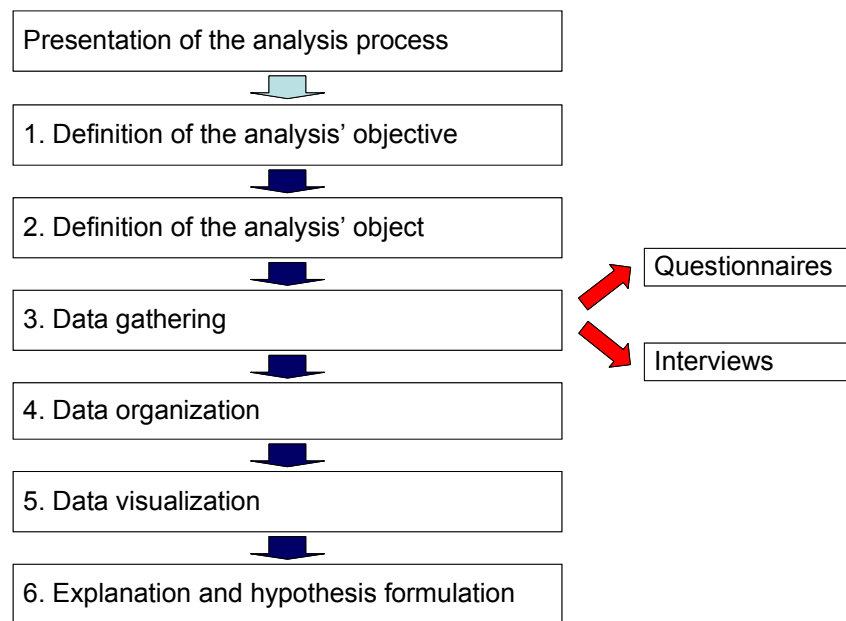


Figure 4 - Steps of the SNA methodology in the Euris Group.

##### Preliminary step: presentation of the analysis process

First of all, we presented to the top management of the Euris Group the process of the analysis, the achievable objectives and the efforts required. The goal of this pre-step was to involve the top management both directly (in defining the research objectives and in gathering structured data) and indirectly (in sponsoring the research to the other actors involved).

##### Step 1. Definition of the analysis' objectives.

In this first step, we defined the objectives of the research, that are: (a) to understand the real informal organizational structure, (b) to identify the informal key roles, (c) to identify the new informal key role from the joint analysis of the intersection of the problem-solving, know network and access network, and (d) to hypothesise interventions to enhance the diffusion to knowledge within and among strategic groups.

On one hand the analysis process requires a time investment both for the company and the research team. On the other hand, social network analysis provides numerous measures to evaluate the roles within an organization. Therefore, it is important to correctly design and plan every aspect of the process in order to correctly select the

measures and the tools to be used. For instance it is necessary to define the critical process to be analyzed together with the management of the company. This process can be critical because the management considers that it doesn't properly work or due to its strategic importance.

### Step 2. Definition of the analysis' object.

Once defined the research objectives, we selected the objects of the analysis and the suitable measures to use. As above mentioned, it is important to define the general and specific objectives of the analysis for each one of the 5 informal organizational networks. It is also important to define which actors and relations we would study. Accordingly to these remarks, we propose in Table 1 a matrix where we summarized the analysis objectives, the objects, the networks involved and the measures for the analysis.

### Step 3. Data gathering

There are 3 techniques of data gathering generally used in social network analysis: participant observations, interviews, and questionnaires. In this research we used questionnaires to collect data in order to measure the relations among actors and semi-structured interviews to collect data on the case study.

We developed an electronic questionnaire in Microsoft Excel<sup>®</sup>. This choice was driven by the number and the characteristics of actors in the Euris Group. In fact, each Euris employee uses a personal computer. Nevertheless the electronic data gathering simplified the data management. We administered to each employee 10 questions subdivided in 5 groups, representing the 5 networks. These are examples of such questions:

1. Communication Network: *"Specify who you speak with about every topics, both personally and by telephone"*;
2. Information Network: *"Specify who you speak with about work topics, both personally and by telephone"*;
3. Problem-solving Network: *"Specify who you speak with in order to receive information about new issues concerning your work activities"*;
4. Know Network: *"Specify who you consider those most qualified about your work issues"*;
5. Access Network: *"Specify who you speak with in order to solve a problem, knowing he/she will give you enough time"*.

In developing the questionnaire structure, we placed particular attention to the easiness and quickness in answering. In particular, we grouped the workers by the business units and by alphabetical order. Nevertheless, the electronic interface allowed to prefix the range of the answers and to automatically check them. We measured the direction and the strength of relationships. The weight of the relationship means both the level of preparation (e.g. problem solving network, know network) and the frequency of the relationship. With reference to this second meaning, we assumed that the relationship between actors exchanging information daily is stronger than the relationship between actors interacting weekly or monthly. Finally, we administered the questionnaire to each employee and successively we received all the questionnaires filled in. Therefore it has not been necessary to sample the population.

OBJECTIVES OF THE ANALYSIS											
OBJECT OF ANALYSIS INFORMAL NETWORKS	ANALYSIS OF THE RELATIONSHIPS WITHIN GROUS/DEPARTMENTS			ANALYSIS OF THE RELATIONSHIPS AMONG GROUS/DEPARTMENTS				IDENTIFYING KEY ROLES			
	Distribution of non-working relationships	Distribution of working relationships	Distribution of knowledge	Distribution of non-working relationships	Distribution of working relationships	Collaboration among Departments/ Business Units	Identifying homogeneous informal groups	Boundary spanner	Central connector	Information broker	Peripheral specialist
Communication Network	Mean centrality degree + Network Centralization			Mean centrality degree + Network Centralization			Cluster Analysis		Betweenness (OPINION LEADER)		
Information Network		Mean centrality degree + Network Centralization and density			Mean centrality degree + Network Centralization and density	Mean centrality degree	Cluster Analysis	Centrality degree (CUT POINT)	Centrality degree "In e Out Degree" (BOTTLENECK)	Betweenness	Closeness
Know Network			Mean centrality degree + Network Centralization						Centrality degree "In Degree" (EXPERT)		
Problem-solving Network			Mean centrality degree + Network Centralization				Cluster Analysis		Centrality degree "In Degree" (CONSULTANT)		
Access Network							Cluster Analysis		Centrality degree "In Degree" (AVAILABLE)		
Problem-solving X Access X Know Network							Cluster Analysis		Centrality degree (PILUS PRIOR)		

Table 1 – Objectives, objects, networks and measures.

#### Step 4. Data Organization

Data gathered through the questionnaire were organized in adjacency matrixes, where rows and columns reported the names of each employee. We saved the matrixes in Microsoft Excel®, compatible with the software used for the data visualization.

#### Step 5. Data Visualization

The social network data analysis process is based on the graphs theory and the indexes described in paragraph 2. Starting from the adjacency matrixes related to the 5 informal networks, we elaborated the measures abovementioned according to the objectives stated (par. 4). In particular, we used one of the most used software for network analysis: UCINET 6® (Borgatti et al., 2002).

In the analysis process one fundamental aspect concerns the graphical representation. As a matter of fact, one of the objectives of the informal network analysis is to visualize the informal structures influencing organizational performances. We used NetDraw® (provided with UCINET 6®) to visualize the networks.

#### Step 6. Explanation and hypothesis formulation

The objectives of a social network analysis (SNA) can be theory building, theory testing, and improving of informal structures, in terms of enhancing the accessibility and the sharing of information in order to improve network performances.

In theory building, the objective of the SNA is gathering and analyzing information in order to find general models which can be applied to other networks with the same characteristics. This models concerns relationships and interactions among entities.

In theory testing, SNA is used to describe the structure of one or more observed networks. The proposed description can be tested as hypothesis. (Burt, 1982).

Finally SNA can be used to improve informal structures, eliminating weaknesses emerging from the network analysis. SNA is used as a diagnostic analysis to identify and to eliminate (Krackhardt and Hanson, 1993):

- Implosive relationships: exclusive relationships among departments;
- Irregular communication schemas: lack of cohesion among departments;
- Fragile structures: communication only among two departments;
- Network holes: places with no relationships but where we expect them;
- Bow ties: networks characterized by a strong interaction with a single individual and a weak interaction among others individuals.

The objective of this research concerned both the identification of new key (informal) roles (theory building) and to hypothesize interventions to enhance the sharing of knowledge within and among strategic groups.

## **5. RESEARCH RESULTS AND DISCUSSION**

In this work we interpreted informal networks in the light of Euris Group characteristics. Moreover, we analyzed the relationships among different networks, providing a complete framework of the informal structure.

### 5.1 Communication network

Individuals with central positions in the communication network are the opinion leaders. This characterization is referred particularly to trust and friendship ties. These individuals have a great ability to interact with the others.

The identification of homogeneous groups can be very important, especially when the company is facing changes. As a matter of fact, we can find a common attitude within networks in facing the changes. In Figure 5 the communication network of Progetti and Eidos is shown.

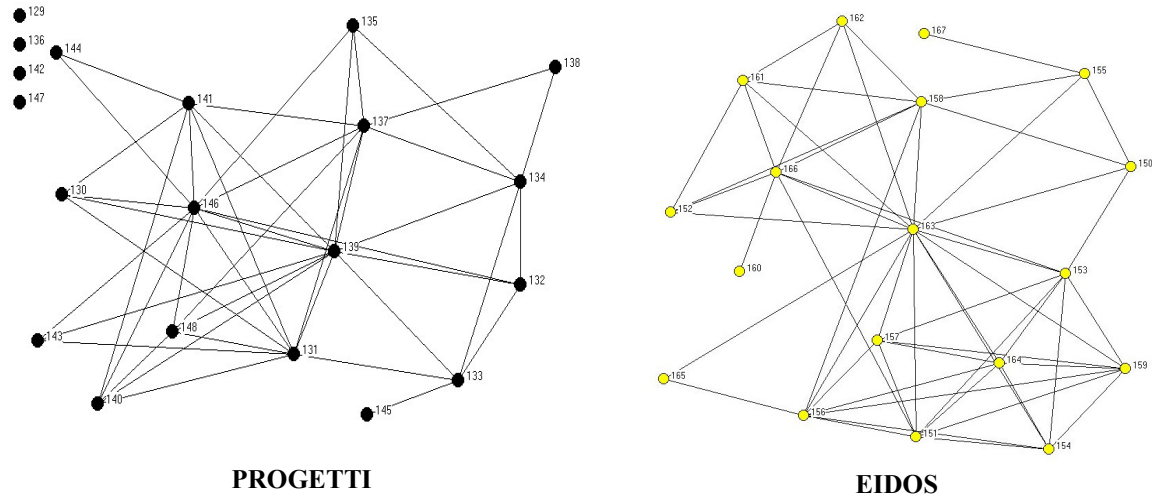


Figure 5 - Communication network (Progetti and Eidos).

The comparative analysis of the two networks (Figure 5) allows to make some interesting remarks. Comparing the network centralization it emerges that the structures are very different, as shown in Figure 5. As mentioned below, network centralization indicates the distance from a star configuration. The higher the network centralization is, the more the network is organized around one point. The network centralization for Progetti is equal to 44.44% while for Eidos it is 60.29%. This means that within Eidos exists an opinion leader, Berislav, while in Progetti it is not possible to identify an opinion leader. Table 2 shows the number of ties among the most 7 central people. In Progetti the centrality degree for the first individual (Luigi) is not very different from the second individual (Marzia). On the contrary, in Eidos, Berislav has centrality degree much more high than Adriana.

Table 2 – Centrality degrees in the Communication network (Progetti and Eidos).

PROGETTI		
Name	N°	Centrality degree
Luigi	139	12
Marzia	146	11
Giovanni	131	9
Luca	137	8
Paolo	141	7
Vincenzo	134	6
Stefano	133	5
Marco	140	5

EIDOS		
Name	N°	Centrality degree
Berislav	163	15
Adriana	151	8
Damir	153	8
Alen	156	8
Marko	158	8
Daniele	166	8
Ksenija	159	7
Tatjana	164	7

## 5.2 Information network

Individuals with central positions in the information network own a great importance in the working domain, as they are the central connectors of the working flows. But they could also act as a bottleneck slowing down and reducing the efficiency both in the operative and decision-making process. Table 3 summarizes the analysis of the information flows with reference to the information network of the Euris Group. The table resumes the data about the network centralization and the mean centrality degree.

Table 3 - Network centralizations and mean centrality degrees in the Information network.

Company	Network Centralization	Mean centrality degree
<b>CORES</b>	36,29%	13,640
<b>SOLUTIONS</b>	36,49%	6,510
<b>EIDOS</b>	66,44%	6,333
<b>PROGETTI</b>	66,48%	6,000
<b>GESTA</b>	80,00%	5,679

The most efficient information flow is the one in Cores: as a matter of fact, the average number of ties is high, the network centralization is rather low, and therefore the information is homogeneous spread among actors. On the contrary, in Gesta the network centralization is higher whilst the mean centrality degree is lower than in Cores. Figure 6 shows the Gesta information network with a monthly frequency.

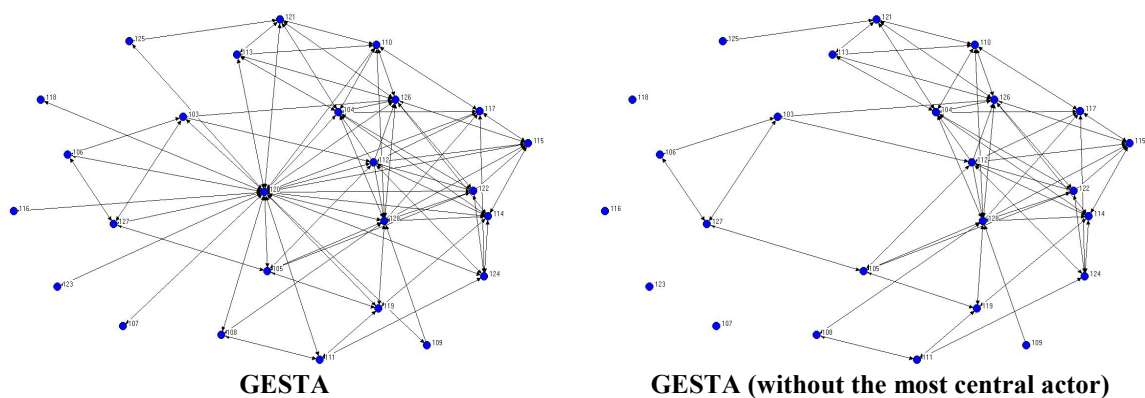


Figure 6 – Information network (Gesta).

In the figure it is possible to note that Andrea (actor N° 120), the only senior executive in Gesta, is very central in the network, if compared to other actors. In fact, the network centralization is 80%. Such a case has two important implications:

1. Andrea is a bottleneck in the working information flows and he slows down the entire network;
2. The high dependence of the network from one person is dangerous: if he is absent the information flow would be considerably reduced. As a matter of fact, if we remove the central actor, the density would be reduced by 27.77 % and 4 people would be isolated.

According to these observations, in the Gesta case it would be appropriate to enhance the efficiency of the information flows through some organizational intervention discussed below.

### 5.3 Know network

The know network highlights how knowledge is distributed and used, in order to identify the actors who are considered the most competent and experienced by their colleagues, the experts. In such a way, the analysis allows to identify individuals potentially qualified to hold important positions in the company and the so-called peripheral specialists. In both cases, they are expert individuals, but a peripheral specialist is characterized by a low closeness in the information network. In figure 8 it is shown the know network of the Euris Group. The ties direction means that an actor is considered competent by colleagues.

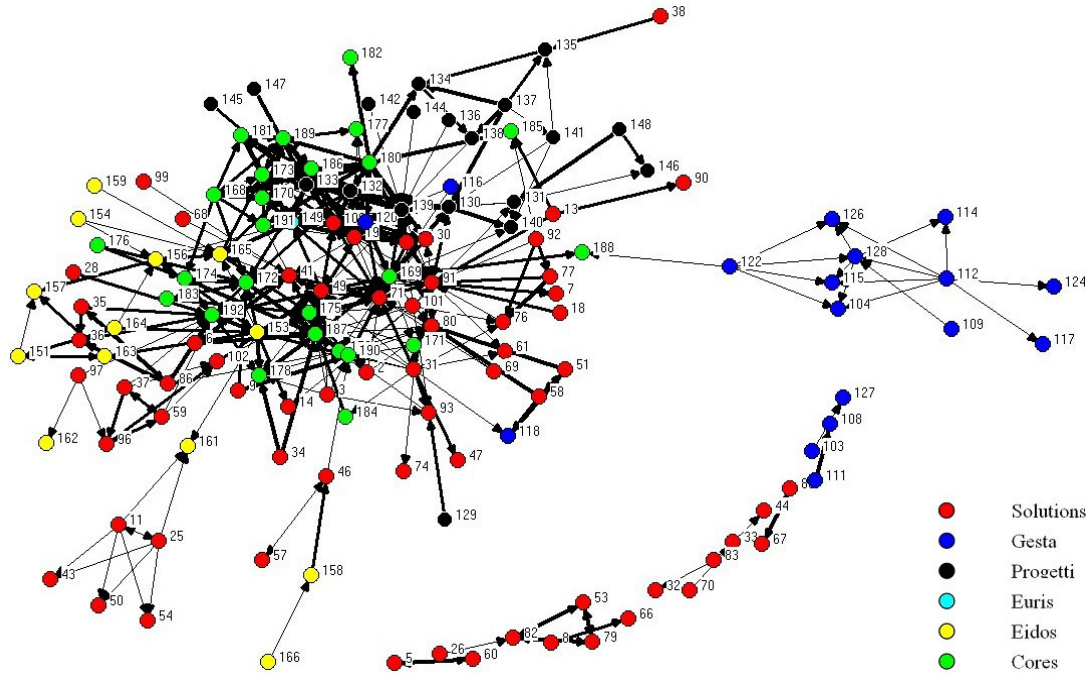


Figure 7 - Know network (Euris Group).

As shown in Table 4, people considered the most competent and experienced by their colleagues are Egisto (N° 149), Luigi (N° 139), and Antonina (N° 71). It is interesting to note that all of them are managers of three different business units.

Table 4 – Centrality degrees in the Know network (Euris Group).

EURIS GROUP		
Name	N°	Centrality degree
Egisto	149	33
Luigi	139	31
Antonina	71	27
Fabio	175	24
Alessandro	187	24
Luca	91	22
Stefano	100	22
Sergio	192	22
Luisa	169	21
Massimo	172	20

In analyzing the know network, people with low “in degree” are not necessarily the least qualified. In fact, it is possible that their colleagues ignore their competencies, considering them as no skilled.

#### 5.4 Problem-solving network and access network

Individuals, who are central in the problem solving network, are recognized to be the most able to solve work-related problems by their colleagues, the consultants. These individuals act as informal consultant and they are legitimated by the opinion of their colleagues. In fact, consulting ties are knowledge exchanges which are based on trust.

The analysis of problem solving network allowed to identify individuals considered the most qualified to solve work-related problems but who are not always accessible. Therefore, it is important to analyze the access network, representing the accessibility to different actors. Individuals placed in peripheries are less accessible than their colleagues. In fact, people not always have enough resources (e.g. time) to create ties with others. As a matter of fact, an individual recognized as very qualified by his/her colleagues can be inaccessible. This situation is a symptom of inefficiency for the network because competences owned by these individuals aren't exploitable in case of necessity.

Generally, people less accessible are the highest in the hierarchy, the managers from whom often important decisions depend. In the case study analyzed, Egisto, the general manager, is in the top position in the know network, therefore he is recognized as the most experienced in the Euris Group, but he is in the fifth position in the access network.

#### 5.5 Inter-company relationships

The analysis of distribution of relationships among the business units allows to understand the external level of collaboration. Table 5 shows the mean number of relationships of people working in each company with reference to the entire Group. Furthermore the distribution percentage of these relationships in terms of how many internals or externals has been calculated.

Table 5 – Mean centrality degrees for the intra- and inter- companies relationships

	N° of relationships in the Euris Group	Mean centrality degree in the Euris Group	% of internal relationship	% of external relationship
<b>Cores</b>	900	7,29	42,5%	57,5%
<b>Solutions</b>	772	6,90	62,5%	37,5%
<b>Gesta</b>	234	2,34	54,1%	45,9%
<b>Progetti</b>	194	1,85	59,2%	40,8%
<b>Eidos</b>	128	1,68	63,7%	36,3%
<b>Euris</b>	48	0,25	0,0%	100,0%

Table 6 reports how the external relationships of a single business unit are distributed towards the other divisions.

Table 6 – Distribution percentages of relationships among the companies

	Solution	Gesta	Progetti	Euris	Eidos	Cores
Solution	-	4,7%	12,2%	2,1%	8,3%	72,8%
Gesta	15,4%	-	2,6%	0,9%	4,3%	76,9%
Progetti	48,6%	3,1%	-	3,1%	0,0%	45,3%
Euris	33,3%	4,2%	12,5%	-	8,4%	41,7%
Eidos	50,0%	7,8%	0,0%	3,1%	-	39,1%
Cores	62,4%	20,0%	9,8%	2,2%	5,6%	-



The high value of mean centrality degree for Cores is satisfactory considering that it is the administrative unit of the company. The high value for Euris Solutions is justified by the high number of workers in comparison with the other companies. The distribution of inter-company relationships is perfectly aligned with the company strategy. As a matter of fact the CEO of Euris Group affirmed that all the companies should have an active external collaboration above all with Euris Solutions.

### 5.6 Intersection of informal networks

Besides the analysis of single networks, it may be significant to study jointly different social networks, in order to better understand the dynamics regulating informal relationships within organizations. Interesting remarks can be derived by the join analysis of the problem-solving network, the know network and the access network. This should allow to identify key roles representing individuals who are both problem solvers, experienced, and accessible.

If an expert and problem solver is inaccessible, obviously he/she is not able to influence network performances. Similarly, individuals accessible and experienced, but not problem solvers, are not able to help their colleagues. As a matter of fact, there is a significant difference between the ability to solve problems and the experience. A very skilled individual on one topic might not be able to profitably interact to his/her colleagues in order to solve a problem. On the contrary, a qualified individual might fulfil a task thanks to his/her relational qualities which allow him/her to collect the necessary information. We multiplied the three networks in order to study their intersection. In this way, if a relationship between two actors is null in one network – which means that it doesn't exist – the relationship between these actors is null also in the final network. In Figure 8 it is shown the final graph obtained as the intersection of the three networks considered. The lines showing different ties are represented with different thicknesses according to their strength.

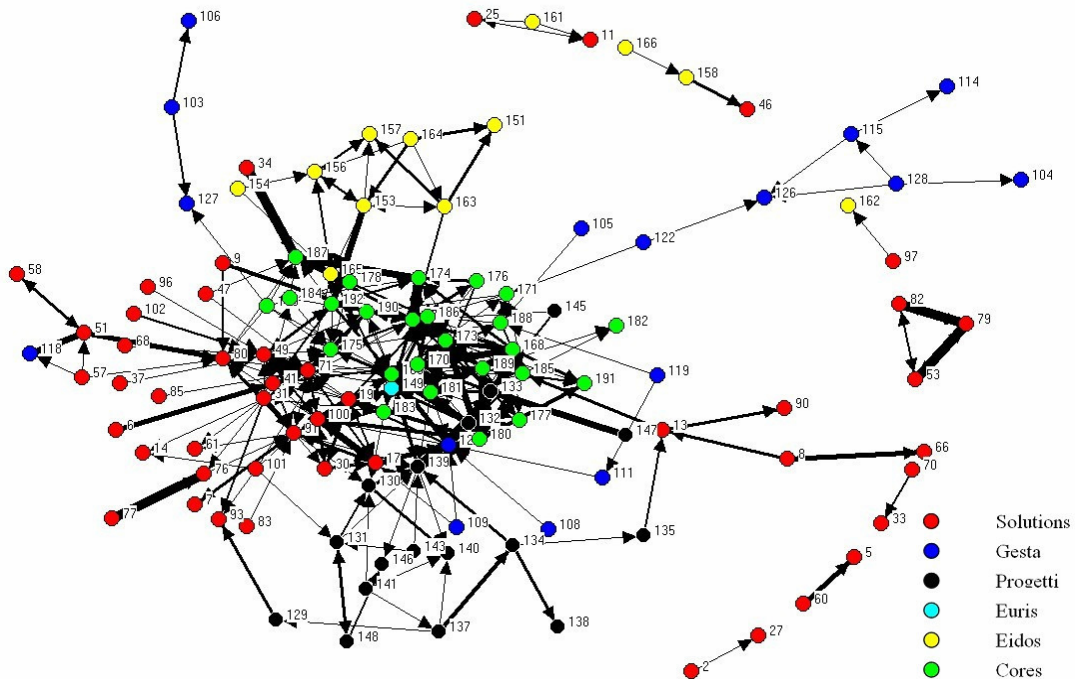


Figure 8 – Intersection among Problem-solving, Know and Access networks.

In the graph shown in figure 9 we can identify some groups which are not connected with the remaining part of the network (right sector). If we focus on single actors, we can identify the ones most qualified, accessible and able to solve problems.

Table 7 – Centrality degrees in the intersection among Problem-solving, Know and Access networks.

EURIS GROUP				
Name	N°	Centrality degree	Company	Role
Elena	173	86	CORES	Administrative manager
Luigi	139	81	PROGETTI	Senior business executive
Alessandro	187	76	CORES	Senior programmer
Massimo	172	67	CORES	Senior systems analyst
Stefano	100	63	SOLUTIONS	Senior business executive
Antonina	71	55	SOLUTIONS	Senior technical executive
Alessandra	170	55	CORES	Human resources manager
Egisto	149	54	EURIS	Chief Executive Officer
Stefano	133	51	PROGETTI	Senior business executive
Luisa	169	51	CORES	Project manager

The intersection among the three networks has allowed us to identify a new leading key role in the company hierarchy. In the graph shown in Figure 8 we can identify some groups which are not connected with the remaining part of the network (right sector). If we focus on single actors, we can identify the ones most qualified, accessible and able to solve problems.

Table 7 shows the nine actors with the maximum centrality degree, the company and the role. Five of them (Luigi, Stefano Z., Antonina, Egisto and Stefano C.) are senior executives. This is a positive fact, because they are properly recognized as experts and still accessible, despite they are in a high hierarchic position. It is not a surprise that Alessandra and Elena are in central positions (Elena is at the top position) because they belong to Cores and they work in the administrative department. Anyway, their colleagues recognize them as competent and problem solvers. Surprisingly, Massimo and Alessandro, who are actors without a leading role in the company, are in a central position in the network because their colleagues rely on them. They are workers owning jointly three qualities which make them the emerging individuals inside the company. Their informal role is a synthesis of problem-solving, experience and accessibility. We named this role *pilus prior* (first lancer). The pilus prior was a roman legionary recognized by his companions-in-arms as leader on the field. He commanded a roman cohort, coordinating his companions during the battles, making himself accessible to them and offering rapid solutions to unexpected criticalities. This role can be compared with the playmaker in the basket. The pilus prior assumes the important role of “informal” manager and leader inside an organization. A fundamental aspect is that this leading role emerges from the working domain and it is informally recognized by other colleagues.

### 5.7 Actions for improving collaboration and knowledge flows' efficiency

The analysis allowed us to propose some suggestions in order to improve the efficiency of the informal structure derived from the specific case, but valid more in general for any company. These corrective actions should help Euris Group to enhance knowledge sharing and to align the formal structure to the informal one.

Corrective interventions aim to enhance informal networks' performance and must be planned according to the objectives initially defined from the requirements of the organization and to the real situation photographed by the analysis. As a matter of fact, there are actions suitable to the informal structure of every company while others must be studied *ad hoc*. The same network configuration could be positive or negative. In fact, for instance, a low collaboration between two business units can be negative, if it requires high interaction; on the contrary, if the company strategy doesn't require high collaboration between such business units, the situation identified is the best in terms of efficiency, due to the correct use of resources used in keeping relationships.

The intervention can be made at a single actor level or at the whole network level, even if intervention at one level would have a considerable impact on the other.

At the single actor level, here we propose corrective actions concerning opinion leaders, bottlenecks and isolated actors:

- *Bottlenecks*. We can consider the case of Andrea, the bottlenecks of the information network in Gesta. He is recognized as very competent but he is not accessible (in fact his position is low in the intersection of the three networks); individuals considered experienced by their colleagues, are often overloaded of work and therefore they are "overused". It is necessary to identify when these individuals are indispensable due to the competence required and when it is possible to delegate their activities to others. In the particular case of Andrea, it is advisable to verify if the requests to him are consistent to his competences and to his availability. If some requests are not consistent, they should be delegated to other individuals. This allows Andrea, the bottleneck, to concentrate on the relationships which require higher levels of competences. If there is no possibility to delegate, it is necessary to support him with a collaborator of the same hierarchic level. This should allow to speed up the problem solving and to enhance the efficiency of the information flows in the company.
- *Opinion Leader*. They are individuals with particular personal qualities which make them as a point of reference to others (e.g. Berislav). When there are organizational changes the opinions and attitudes of these individuals are particular important; in fact, they can influence, also unintentionally, the judgments of their colleagues. Top management should know how to deal with him, according to their impact on the whole network.
- *Isolated actors*. The reasons for which an individual is in an isolated position in the network can be various. The actions must identify the causes in order to remove them. If an individual is isolated because he/she is not able to integrate himself/herself into the workplace, it should be advisable to involve him/her in different projects, in order to support the creation of ties towards other actors of the work team. The isolation could be caused also by a lack of cognition of others' competences. In this case it is advisable to create a database of skill-profiling. In these systems it is possible to track different projects on which every individual has worked. This allows to generate a profile of the competences belonging to each worker. Otherwise, it is possible to set periodical meetings where each worker describes his/her activities they work on.

At the network level, we distinguished two categories of corrective actions:

- Actions aimed to enhance the collaboration among strategic groups/business units;
- Actions aimed to integrate isolated groups.

In order to identify the correct actions to enhance the collaboration, the first step is the identification of the areas in which the effect would have a positive impact on organizational performances. This should optimize the use of limited resources, *in primis* the time. Following this analysis, it is possible to set periodical meetings in order to share information about the projects developed by each group. The groups can be created using resources coming from different work-situations and formulating common management objectives (for instance in Euris Group this procedure is usual).

Finally, in order to integrate isolated groups of actors, companies can involve them in important projects for the whole network or set some periodical meetings.

Some months after the accomplishment of these corrective actions, the SNA should be repeated, in order to assess the efficacy of the actions and to identify the dynamics of the informal structures. In fact, informal networks can rapidly change their structures. For this reason it is useful to repeat the analysis with a planned schedule. This allows to monitor the relationships within groups accurately and with up-to-date information.

## 6. CONCLUSIONS AND PRACTICAL IMPLICATIONS

The paper proposes a methodology which allows both an analysis of the informal organizational structure (informal networks) and the identification of the key informal roles within companies, like experts, problem-solvers, central connectors or information brokers. The SNA has been applied in the case study of a company operating in the information systems industry, in order to represent and to better understand its informal organizational structure. The research objective was to identify a new key informal role, we called *pilus prior*, synthesis of problem-solving, knowledge and accessibility characteristics. The pilus prior is not necessarily a manager of the “formal” organization but he/she assumes the leading role of “informal” manager recognized by his colleagues.

The mapping and analysis of the informal networks has certainly practical implications for a company. The management’s objective must be to better comprehend the invisible relationships in order to improve (or make worse) the collaboration and the sharing of knowledge which enable a more efficient and effective management of operative and decision-making processes. As a matter of fact some suggestions have been finally proposed according to the criticalities of the case study, but valid more in general for any company. These corrective actions will help the case company to enhance knowledge sharing flows and to align the formal structure to the informal one following strategic and operative requirements.

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