

## COLLABORATIVE INNOVATION NETWORKS, VIRTUAL COMMUNITIES AND GEOGRAPHICAL CLUSTERING

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### Abstract

This paper describes the emergence of Collaborative Knowledge Networks (CKNs), distributed communities taking advantage of the wide connectivity and the support of communication technologies, spanning beyond the organizational perimeter of companies on a global scale.

CKNs are made up of groups of self-motivated individuals, linked by the idea of something new and exciting, and by the common goal of improving existing business practices, new products or services for which they see a real need. Their strength is related to their ability to activate creative collaboration, knowledge sharing and social networking mechanisms, affecting positively individual capabilities and organizations' performance.

We describe the case of a Global Consulting Community to highlight the cultural and structural aspects of this phenomenon. Our case study also illustrates the composition of the CKN ecosystem, which are made up by a combination of Collaborative Innovation, Learning and Interest Networks. Empirical evidence suggests physical proximity as a supporting success factor of such communities, depending on the capital and knowledge intensity of the target industry.

**Keywords:** *collaborative knowledge networks, virtual communities, collaborative technologies, knowledge sharing, social networking, innovation*

### 1. Introduction

Globalization, advances in information technology, demassification of society and hypercompetition were pointed to in the 90s as the main factors responsible for the reshaping of the global competitive landscape (Ilinitch et al, 1996). The pressure on organizations exerted by the complex nature of the political, regulatory and technological changes forces them to continuously adapt to the environmental shifts (Greenwood and Hinings, 1996), and to create organizational forms able to provide faster and innovative response to market threats and opportunities (Coleman, 1999). According to Miles, for organizations the ability to adapt in turbulent environments can be enhanced applying the operating logic of new organizational forms, the so-called "cellular form",

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consisting of teams engaged in accomplishing entrepreneurial opportunities, sharing knowledge and experience, that together found an organizational body more powerful than each cell working alone. They are able to face different challenges, and benefit from their natural flexibility and reconfigurability, since at each point in time new cells can be constituted as old ones become less competitive due to changes in the environment (Miles et al, 1997).

The conceptualization of “cellular forms” is consistent with that of “patches” (Kauffman, 1995) and that of “communities of practice” (Lave and Wenger, 1991; Brown and Duguid, 1991). They are composed of knowledge workers, are designed to avoid the rigidities of bureaucratic hierarchy, to enhance the learning process and the development of dynamic capabilities that make them able to fit a sudden shift in the market or the emergence of new knowledge.

In recent years the further development of ICT and the diffusion of the Internet had a disruptive impact on organizations, altering also their time and space dimension (Castells, 2000), allowing the creation of communities that benefit from networking information advantage, delocalization and fast-paced processes.

To exploit these benefits, more and more organizations have created and supported virtual communities to maximize their capability to absorb new knowledge, share and apply it.

## **2. Virtual Communities**

In this paper we focus on “virtual” or “online” communities, that is groups whose members use ICT as the main means of communication (Cothrel and Williams, 1999). They don't exclude using other interaction modes, in particular face-to-face or video conferencing, which are essential to support the building of group cohesion and trust (Storck and Hill, 2000).

The main distinction between real and virtual communities is technology based interaction for the later. This reliance on technology makes it harder for virtual communities to be developed and nurtured in the most effective way, but it also enables them to more flexibly adapt to the challenges of increasing complexity of the new business environment (Hildreth et al. 1998).

The main differences between the two community categories can be analyzed in terms of *purpose, size, physical proximity, membership, leadership, diversity, lifecycle, sponsorship and institutionalization*.

*1. Purpose.* Just like real communities, virtual ones can arise for several reasons, ranging from support to Customer Relationship Management, to

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New Product Development. These communities display different characteristics according to the rate of environmental uncertainty, strategy or operation management aims (Denning, 1998). Virtuality appears to become an advantage when an unexpected shift in the organization or a change in the business environment happens, or when an immediate intervention is required to allow the organization to react and adapt quickly to new external conditions.

2. *Size*. Community size is widely variable, in real as well as in a virtual setting. Generally, as the number of people involved grows, the distinction between the *core* and the *periphery* of the community becomes more and more visible. The core is composed of few members who lead the community under both the intellectual and organizational point of view (Wenger and Snyder, 2000). The periphery is often made up of a very large number of members whose contribution is to link the virtual group to the real world (McDermott, 2000). Virtual communities tend to grow more easily and faster, thanks to Web connection and the rapid diffusion of aggregative movements in the web-sphere. They are able to reach large size and dispersion, introducing the risk to neglect common goals and interest for the sake of individual ones (Von Krogh, 2002). This risk is counterbalanced by the opportunity to involve diverse people and information and to act in a continuous process of renewal. This is why virtual communities can easily split up in subgroups and subcommunities, requiring specific managerial attention and skills.

3. *Physical Proximity*. In virtual communities, the employment of ICT to communicate and to exchange contents allows people to interact in an ubiquitous way (Wenger et al. 2002). Physical proximity that generally reinforces the collaboration within real communities also becomes important in virtual ones not just for the creation of the community, but for the motivation and sustainability of the group. Although participation is voluntary by definition, and they defy managerial intrusion, virtual communities need strong management commitment. Leaders need to encourage interaction, coordinate actions devoted to the achievement of the common goals, and to support the ICT application in various ways to facilitate the creation of physiological closeness. The low rate of non-ICT interactions affords the opportunity to track community information exchange in a more simple, reliable and objective way (DeMaggio, Grippa, 2007).

4. *Membership*. Members in virtual communities experience occasional problems because they have a natural inclination to openness. Also there is a low level of control within the community and its growth. The involvement of new members from time to time provides a continuously renewed source of novel information, but requires sound selection

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principles to guarantee to members the maintenance of a trustful environment.

This principle varies in the ways in which the community grows. When the growth process is free, and completely voluntary, some sort of natural selection operates: potential entrants aware of the features, vision and common goal of the community self-select based on their skills and motivation; then the collaborative work and the interaction process of the community activate a self-isolation mechanism for those that discover their unsuitability to the community, and bring them out of the group. Membership can be also strongly encouraged by the organization, but voluntary members are much more motivated (Mitchell, 2002).

Another difference between real and virtual communities is the rate of members' turnover: virtual communities are more fluid than real ones, membership therefore can vary quickly (Stork, Hill, 2000), vibrant virtual communities are therefore continuously recruiting new members.

5. *Leadership*. For virtual communities it is common to have a flexible managerial structure, without any top-down assignment of roles (Lesser and Storck, 2001). For the sake of sustainability and effectiveness of the community firmly appointed leaders are advantageous. Fixed leaders can better manage the potentially large size of a growing community and guarantee to all members the needed recognition of their contribution and also provide a landmark for the community identity (Fontaine, 2001). The importance of focused and recognizable leadership in virtual communities emerges in particular in the need of consolidating a strong vision, providing guidance and encouragement; building a result orientation, ensuring suitable reward for the work accomplishment; providing and supporting the necessary infrastructure, both cultural and technological, for a continuous learning environment able to foster personal development for all members and community development in goal achieving (Gretchko et al., 2002).

6. *Diversity*. The rate of diversity among community members can be the primary source of novelty and diversity of information that are aggregated and operationalized within the community, and finally one of the main sources of competitive advantage created for the organization (Aral and Van Alstyn, 2007).

Community diversity may be attributed to several differences that community members present (Wenger et al., 2002).

Different geographical origins could shape cultural differences in the concept of community, collaboration and relationships (Hofstede, 1993; Pan, Leidner, 2003).

Different organizational behaviors come from the cultures of the organizations, community members belong to. In virtual communities, the *Boundary Spanning* principle, that is the attitude to connect people across

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organizational boundaries is made easier by the delocalization process of the community development. Organizational boundaries might be those of business units, of work teams as well as of whole organizations and companies (Wenger and Snyder, 2002). The connection process is further supported by the availability of friendly access.

Different individual professional backgrounds of the members, particularly evident in the virtual communities, enhance both individual and group creativity by comparing different perspectives.

*7. Lifecycle.* Virtual communities more than real ones have no definite boundaries, in time and space; properly a virtual community never ends (Gloor, 2006), but can change in time composition and goals, that is to say shifting in shape by time. Though they are generally considered permanent settings of information exchange, knowledge sharing and collaborative work, sometimes they are planned to have a duration (Wenger et al, 2002). This allows to concentrate energy and efforts to a stated goal in a short time. While several models have been developed to describe the hypothesis of lifecycle of a community (Wenger and Snyder, 2000), presenting a wide range of timelines around an agreed sequence of stages, as explained before, virtual communities show a high rate of variability in timing and phase of development, depending on their structural dimension as well as on the options regarded in terms of vision, size, cohesiveness and goals (Gongla and Rizzuto, 2001). For virtual communities, more than for real ones, the lifecycle idea represents a hypothesis, and commonly is shaped on the proper characteristics of each single case.

*8. Sponsorship and Institutionalization.* The last feature of virtual communities considers the relationship with the organization, one of the most critical issues related to the creation and evolution of a virtual community (Brown and Duguid, 1991).

The free and open nature, especially in virtual communities, makes the involvement of management, the dependence on the organization structure, the respect of organizational culture and practices too strong a constraint to creativity and innovativeness. They injure not only the results of the community work, but also the community survival (McDermott, 1999).

This relationship can assume different forms (Wenger et al, 2002): it can vary from the total independence, to some degree of support provided by the organization, to the total institutionalization of the community as an operative program generated by the organization.

This issue represents an important challenge for the management, called to provide the best relationship order according to purpose, composition and goals of the community.

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### 3. Virtual Communities and Collaborative Networks: a systematic Taxonomy

In an attempt to provide a systematic taxonomy of virtual communities interacting on a global scale, Peter Gloor (2006) identified three kinds of networks described as follows:

a. *Collaborative Innovation Networks (COINs)*: made up of self motivated people who share a common vision, meeting on the web to exchange ideas, knowledge, experiences and to work in a collaborative way to achieve a common goal.

b. *Collaborative Interest Networks (CINs)*: composed of people who have the same interests but don't perform a common work in a virtual team; this kind of community is very frequent on the web, has a lot of silent members, who keep information from web sites, portals, forum, and a few active members who are inclined to share their knowledge and experiences within the community.

c. *Collaborative Learning Networks (CLNs)*: a community made of people inclined to share knowledge and practice to benefit reciprocally from personal mastery and the collective knowledge accumulation of a group of attitudinally similar people.

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| Community Type | Category                           | Focus                      | Mode of Participation   | Example  |
|----------------|------------------------------------|----------------------------|---|--|
| COIN           | Innovation                         | Fundamentally new insights | Peer group of Innovators  | Linux kernel developers, creators of Web       |
| CLN            | Best-practice knowledge stewarding | Shared Knowledge           | Active sharers of knowledge as experts; active seekers of knowledge as students | Xerox repair technicians, oneFish, Web masters |
| CIN            | Helping                            | Shared Interest            | Few sharers of knowledge as experts, many silent seekers of knowledge, lurkers  | The Motley Fool, Internet Users                |

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*Figure 1: A Taxonomy of Virtual Communities: the Components of Collaborative Knowledge Networks (source: adapted from Gloor, 2006).*

These three types of virtual communities are intended to form what is called a Collaborative Knowledge Network (CKN), a “high-speed feedback loop in which the innovative results of COINs are immediately taken up and tested, refined or rejected by Learning and Interest Networks, and fed back to the originating COINs” (Gloor, 2006, p.128).

The COIN is the creative foundation of the CKN, the enabling factor for the creation of fluid organizations, characterized by relevant creativity, productivity and efficiency thanks to its fundamental principles of “creative collaboration, knowledge sharing and social networking”. A COIN is generally born around a new interesting idea absorbed outside organizations, brought inside and discussed in a “swarming” collaborative and creative way to improve individual knowledge and capabilities and organizations’ performance.

Compared to other forms of community, Collaborative Knowledge Networks present some peculiarities: they link big organizations - not only people; and are less expensive thanks to the cost reduction obtained through communication technologies, that enable information exchange and collaboration spanning among people located in different places.

Collaborative Knowledge Networks are essentially “groups of self-motivated individuals driven by the idea of something new and exciting, a way to greatly improve an existing business practice, or a new product or service for which they see a real need” (Gloor et al, 2003).

Accordingly, they often happen instead of being planned; they dislike managerial intrusion, and don’t follow traditional organizational paradigm; self-directed in the organizational behavior, they generally are:

*Voluntary*: self-motivation is the driver of an effective collaboration and learning;

*Non hierarchical*: to support innovation and creative thinking, flat organization are the best setting for an active and open contribution;

*Heterogeneous*: diversity and novelty are both sources of new knowledge and information; they guarantee the adoption of different perspectives for the continuous adaptation to fit the external environment and for the growth of the community value;

*Cohesive*: cohesiveness represents the rate of interaction among community members; CKNs are strongly interactive and each member has the connection available to each one of the others;

*Focused*: people interacting in the community consider the CKN as a real organization, understand unequivocally its value proposition and its strategic goals.

Innovation Team is but a new concept, and talking about innovation in communities is like talking about one of the most diffused innovation

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practices in the world and in the history. The relevant differences emerging in the new generation of innovation communities are: the “virtuality” and the “connectivity” dimensions Enabled by the Internet, this changes the rules of both innovation generation and dissemination; and the process of spreading of new ideas, becomes global and fast.

Collaborative Knowledge Networks are effective settings for the development of new products, services, practices and methodologies. Two different mechanisms operate in the CKN ecosystems, namely

*a. Innovation Dissemination:* considered as the container of three levels of concentric collaborative networks, the CKN basically disseminates new ideas arising in the COIN, following a “ripple effect” (Gloor, 2006) by which each dimension is made aware of an innovation from its internal level and sensitive to the external ones. For each CKN we expect to find a core group, that generates ideas and proposes new goals, a middle level community of people who absorb the innovation, discuss, integrate and transmit it to the peripheral group. Finally all the group members become aware of a novel objective, and work to achieve it. The results, in terms of strategy, methodology and outcome generally jump from the virtual dimension to the real organization.

*b. Innovation Incubator:* the dissemination spiral activated by the CKN is potentially never ending. While COINs are born to create innovative ideas, the CLN is aggregated to discuss the new idea, to learn by exchanging information and experiences about the purpose or the application of the new idea, and to work in a collaborative way on its development. The CIN is the diaphragm that separates and links the innovation to the external environment and to the real world. An innovation brought from a COIN into a CLN will spread into the CIN, by which the levers for proposing a new innovative idea could arise. As a consequence new COINs are formed leading to a potentially “perpetual source of new innovations” (Gloor, 2006).

The new pace of communication within virtual communities, apart from being fast and global as never before, activates new ethical rules that operate spontaneously. They represent both the pillars of the CKN Culture and the conditions for its sustainability and effectiveness. Every community is a society, with roles and codes; virtual societies rising on the web activate a sort of natural selection of their members, basing on the principle of social rewards for positive behaviours and sanctions for bad ones (Gillmor, 2003).

The CKN social culture is well summarized by the following principles:

*Meritocracy:* sustainable and effective virtual communities should count on fair treatment for each member, guaranteeing the reciprocity of the benefit of the knowledge sharing and the collaborative work; free and

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voluntary contribution to the community growth must be rewarded by the availability of access to community knowledge and results for everyone.

*Transparency:* internet and communication technologies allow a wide and instantaneous interconnection, but pretend to provide to each one a clear picture of the community trend and behaviors. Belonging to the CKN requires and must ensure the awareness of the community composition, in terms of people and competencies, roles, rules and responsibility for each one.

*Consistency:* each community member has to behave consistently with the perspective of sharing a common vision and focusing on common goals. From this principle it derives the strength of the effort each member voluntarily chooses to employ to achieve the stated objective.

#### **4. Exploring a Collaborative Knowledge Network: the case of a global consulting community**

Studying the case of a global consulting community has been chosen to highlight cultural and structural aspects of Collaborative Knowledge Networks.

The Case Study strategy has been applied following the Yin approach (1994). The analysis has been conducted on the basis of two main sources of information. On the one hand the availability of a “key informant”, one of the leading coordinators of the community, was helpful for collecting information about the community evolution and history, and for testing the findings of the research. On the other hand the availability of the large email database containing the information exchanges within the community, represented the raw material for the application of a blended methodology of textual Content Analysis (Krippendorff, 2004) and Social Network Analysis (Wassermann and Faust, 1994). This method permitted identifying the composition of the virtual community, as the result of the combination of Collaborative Innovation, Learning and Interest Networks.

##### ***4.1 The Leading Company: features and culture***

The culture of the company that hosted the CKN we are going to analyze played a fundamental role in the creation of the community.

The host company operates on a global scale, and is composed of national member firms providing professional services in several areas of expertise, like accounting, consulting and other professional services. Today it is one of the Big Four auditor firms, and a very important advisory company.

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It is composed of 70 firms distributed in 140 countries all over the world, whose services are divided into 5 categories: Strategy and Operations, Human Capital, Technology Integration, Enterprise Applications and Outsourcing.

It is characterized by a strong culture of cooperation. Today it employs about 95,000 people, has customers in about 150 countries, and a large number of partners with whom it develops consulting services, IT solutions, methodologies and products to maximize shareholder value.

Integrated, multifunctional teams, representing all the fields of the company service offering, develop personalized solutions for the clients, in several Industries, spanning from Energy, to Financial Services, Healthcare, manufacturing, Public Sector, Real Estate, Retail/Consumer/Products, Technology, Media and Telecommunications, Transportation.

The company has a proprietary Research Branch, from which clients benefit directly, through their services, or indirectly, through sharing of scientific results in seminars and publications.

Company cultural factors, made explicit in its vision and mission are:

- Care to the needs of the customers,
- Focus on people,
- Support of cultural diversity.

These factors, together with the principles of trust and commitment to each other and the sense of integrity, represent the common vision and the set of beliefs of the group.

The year 2002 was marked by important international awards for the company, like

- *SAP America Services*, leader in business software solutions, awarded the Company the “*Partner Award of Excellence*”;

- *Workforce Magazine*, leading US human resource publication, awarded the Company the “*Workforce Optimas Award for the Global Outlook Category*”, that recognizes HR programs and strategies that help organizations succeed; in this case for the Company Global Development Program;

- *Fortune*'s ranking included the company in the prestigious list of “*100 Best Companies to Work For*”, basing on an in depth analysis of its culture, human resource practices and the reputation for its employees.

This rewarded performance was the result of the company culture and its attention to the social and human dimension of the organization that led during the period 2000 – 2002 to the creation of a virtual community.

In those years, since the company was aware of the importance of “social capital” to face the new competitive global environment in which it was positioned, it started and supported a cross-boundary community.

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This community was very close in culture and vision to the company's global nature and the attention to the human factors.

Chevron, Royal Dutch/Shell, Oracle had shown during these years relevant results by sponsoring and supporting informal groups, communities of practices and of interest and benefiting from the impact that could be gained through their improved knowledge transfer processes, response times and innovation.

The company distinguished itself by looking at this opportunity with the aim to create a novel way of interacting and innovating, choosing the interface that its community had to present.

The Collaborative Knowledge Network structure was the right dimension to give to the community to support: a very large group spanning geographical and organizational boundaries to embrace several communities of practice linked electronically in the same circuit.

One team in the Company was particularly conscious of the potential benefits that could have come from supporting informal communities of practices, but also of the risks related to an excessive community independence from the organization. Based on in-depth CKN research, this team concluded that even if communities of practice were not generally created but happened spontaneously, they could become blended organizational shapes when supported by *appropriate technologies, management sponsorship and vision, necessary organizational and cultural foundation*. They did combine expertise and access, providing huge benefits in terms of knowledge production, sharing and application: an actually strategic asset for the organization.

The idea to create and support a CKN was shared among two promoters working on the development of a new service.

The CKN constituent features resulted in:

- *Vision*: the evolution from service offering to consulting, setting the company apart from the competitive advantage, benefiting instead by the application of collaborative technologies
- *Mission*: the creation of new integrated products and services.

The creation process consisted of one face to face meeting of the promoters with other ten people, coming from different organizations, mainly involved in research activities, with whom the idea, its strategic goals, its value proposition and the basics of the CKN culture were shared.

For the interactions inside the CKN, mainly emails, and sometimes virtual meetings were employed. The language was primarily English, sometimes German.

CKN could count on a Knowledge Management Portal and a Knowledge Repository, that constituted the basic infrastructure to make it possible to store data, to share digital manufactures, and to provide an "organizational memory" for all the production of the community,

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supporting a complete cycle of organizational learning inside the network (Pawlowsky, 2001).

Some relevant positions and roles emerged naturally during the CKN life cycle: for each service, product or practice developed there, at least one coordinator emerged, as well as one group of consulting managers and a variable group of volunteers. None was ever appointed to any role.

#### **4.2 The CKN analysis: discovering the COIN, CLN and CIN dimensions**

Applying both social network analysis and content analysis to the email database of the CKN indicated the existence of 9 subcommunities, differentiated on the basis of the project/practice they developed.

The combination of centrality metrics and contribution index (Gloor, 2006) with the segmentation of the CKN in 9 project sub-communities permitted discovery of characteristics and common patterns in the organizational behavior of the community, and the identification of the COIN, CLN and CIN that made up the CKN.

The 9 project-related subcommunities varied from 16 to 605 members in size, showing a clear trend decreasing in size for the last two projects, that appeared to be less important, developed probably as dependent or deriving from the others. The size of project 3 of 605 actors makes it the most active, involving more than half of the overall community. This is by far the most complex and important one.

Figure 2 shows the size evolution of the Community: it is a helpful means to identify the involvement in different phases of each project development of the three dimensions of the Collaborative Network.

| Months | Project 1 | Project 2 | Project 3 | Project 4 | Project 5 | Project 6 | Project 7 | Project 8 | Project 9 |
|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1      | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         |
| 2      | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         |
| 3      | 5         | 8         | 4         | 5         | 0         | 0         | 0         | 0         | 0         |
| 4      | 2         | 4         | 8         | 6         | 0         | 0         | 0         | 0         | 0         |
| 5      | 26        | 2         | 50        | 24        | 12        | 0         | 0         | 0         | 0         |
| 6      | 8         | 4         | 36        | 16        | 9         | 0         | 0         | 0         | 0         |
| 7      | 23        | 10        | 116       | 31        | 7         | 28        | 21        | 0         | 0         |
| 8      | 11        | 13        | 95        | 83        | 41        | 32        | 25        | 6         | 0         |
| 9      | 19        | 11        | 91        | 99        | 24        | 34        | 24        | 18        | 0         |
| 10     | 151       | 25        | 86        | 97        | 33        | 171       | 194       | 12        | 3         |
| 11     | 13        | 9         | 102       | 78        | 21        | 57        | 50        | 15        | 2         |
| 12     | 14        | 17        | 85        | 189       | 28        | 77        | 34        | 5         | 12        |
| 13     | 4         | 13        | 218       | 111       | 184       | 96        | 26        | 9         | 9         |
| 14     | 3         | 36        | 135       | 119       | 58        | 116       | 20        | 18        | 2         |
| 15     | 0         | 3         | 146       | 127       | 55        | 102       | 13        | 19        | 0         |
| 16     | 0         | 0         | 52        | 23        | 31        | 20        | 0         | 24        | 0         |
| 17     | 0         | 0         | 0         | 8         | 4         | 0         | 0         | 0         | 0         |
| 18     | 0         | 0         | 3         | 0         | 4         | 0         | 0         | 0         | 0         |
| 19     | 0         | 0         | 19        | 19        | 0         | 0         | 0         | 0         | 0         |

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*Figure 2: Monthly distribution of Actors per Project (Actor-Projects Table)*

**a. COIN.** The CKN started with a very small group that was the core of the community until the end of the activities. This core group was made up by the same 10 central characters whom we identified as present in each project related sub-community. They spontaneously differentiated in roles, respecting the evidence coming from the CI Plot and the evaluation of the trend in Individual Betweenness Centrality average value. Even if they used different labels to identify their roles and responsibilities, their position was the following: 2 Coordinators, 3 Practice Leaders, and 5 Practitioners were involved in each project in the same position. The other actors, changing by time and project were identified as Task Administrators, the “middle agents category”, and Knowledge Experts, among which different attitudes emerged naturally, making some of them crucial and sometimes central in some task performance and for the involvement of subcommunities.

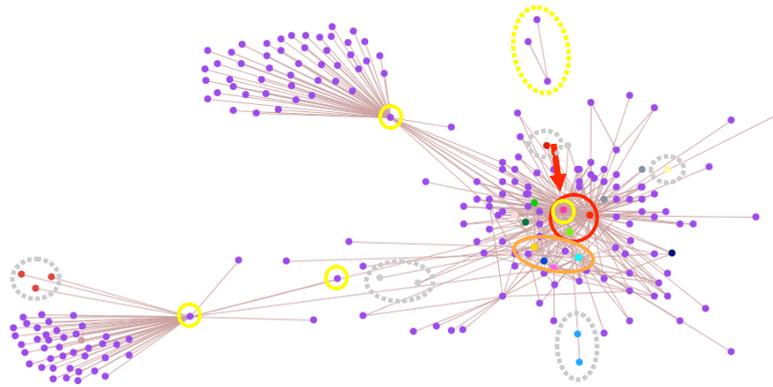
Blending the two analytic approaches Social Network and Content Analysis, we were able to clarify “when” and “by whom” the project initiatives were hatched, and how they were performed. The first 5 projects were the most important ones, and also the most successful. They were developed under the proposal of the 2 leading coordinators, probably because of their relevance for the hosting organization, and the temporal distribution of the proposals. The first four were started in the same month, August 2001, the fifth one to October, two months later. The others originated through the contribution of other actors but always among the 10 most central ones. Therefore these 10 most central actors were identified as the COIN, the creative core of the community, promoters of each project-idea, present and central in each project sub-community.

**b. CLN.** The community displayed a clear trend to maintain the fixed core group of these 10 actors, who coordinated and administrated the CKN, extended by a wide variety of consultants, engineers, researchers, marketing experts, etc. who contributed in different ways to the development of different projects, demonstrating a high *rate of turnover* of the different groups.

When the goal proposed by the COIN members was clear and the project activities started, the involvement of new actors mostly happened in the initial few months. This dynamic was easily detectable through *size* and *density* values of the project related sub-community, that we analyzed in depth focusing for each project on the months in which its density decreased below the value of 0.1 (Burt, 2000).

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During these periods the COIN evolved systematically in a Collaborative Learning Network. Indeed, the low *density level* always corresponded to the creation of task oriented subgroups: the growing sub-community worked as a real organization with differentiated tasks, and the emergence of people responsible for single tasks, connecting sub-communities and central actors of the overall network, as shown in Figure 3. These points turned out to be the key factors of a community's effectiveness.



*Figure 3: Project 2 Community Sociogram (Month 13). An example of organizational dynamics in a low density month (the COIN members are highlighted in central circles in the network).*

*c. CIN.* The analysis of the different project-related sub-communities displayed also another common pattern of the network organizational behavior. In the middle of each project development process, corresponding sub-communities passed through a phase of sudden extraordinary growth in a very short period, at most 1 month for each project. The growth rate in those periods is presented for each project in Figure 4, comparing the average size of the each sub-community to the maximum size value of the month.

| SIZE        | P. 1  | P. 2 | P. 3 | P. 4 | P. 5 | P. 6 | P. 7 | P. 8 | P. 9 |
|-------------|-------|------|------|------|------|------|------|------|------|
| Average     | 11    | 10   | 45   | 48   | 25   | 44   | 26   | 14   | 2    |
| Max         | 151   | 36   | 218  | 189  | 184  | 171  | 194  | 24   | 12   |
| Growth rate | 1372% | 360% | 484% | 393% | 736% | 388% | 746% | 171% | 600% |

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*Figure 4: Average, Maximum Size and Growth Rate for each Project related sub-community*

The temporal concentration of the phenomenon and the massive growth in one single month for each project related sub-community corresponds to the emergence of a Collaborative Interest Network, composed of actors not directly involved in the project development process, but interested in the topic; sometimes these people were mere receivers of information about the ongoing project, for marketing and promotional activities.

#### **5. Collaborative Knowledge Networks and Geographical Clustering: evidence from three case studies**

The case of the distributed Global Consulting community provided evidence about the “ripple effect” activated by the dissemination mechanism of ideas developed by the COIN, the creative core of the CKN, through the CLN and CIN concentric community dimensions, and its ability to create a virtuous system of continuous innovation. The natural evolution and reconfiguration of virtual communities, and their segmentation into “cellular forms” allows them to continuously broaden the process of dissemination of the innovation, leading to further incubation of new innovations.

The application of Social Network Analysis to other communities developed around different kind of organizations, was able to show that often physical proximity and geographical clustering play a critical role in the rise and success of such communities, and in the exploitation of their capability to act as incubators for knowledge creation and sharing, and finally for innovation.

The Swiss House for Advanced Research and Education (SHARE) is an organization aiming to create and enhance collaboration networks between the scientific and entrepreneurial communities of Switzerland and New England, fostering help in forming valuable and sustainable business links among academics, large research centers from pharmaceutical companies like Pfizer, Novartis, Wyeth, and GlaxoSmithKline, and venture capitalists.

It represents the World’s first digital Consulate; it is a Swiss institution, located in Massachusetts, and holds a community that is both virtual and physical. In the period 2004 – 2006 a study conducted using Social Network Analysis allowed us to observe how it contributes to the development of the “second leading technology region in US, the greater Boston area” (Gloor et al., 2007).

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The analysis of communication pattern within the SHARE community, and in particular the study about an event jointly organized in 2006 by SHARE and another business networking hub in San Francisco, provided an empirical testbed to compare the different networking behavior in the greater Boston Area and in the Silicon Valley. The event linking together academic and industrial actors showed different networking attitudes related to the different location of the participants' communities. Participants from the Boston Area communicate more than those from the Bay; furthermore the density of communication between the Academy and Industry groups was greater in the Boston Area community than in the San Francisco one.

The analysis of academic-industry communication in Boston, showed the prominent role of academics, acting as connectors within academia and between academia and the entrepreneurial community. Both areas, Boston and Silicon Valley, exhibit high density of universities around two leaders, Harvard and MIT in the East, and Stanford and Berkeley in the West. The Boston area, however, shows an unprecedented student density on a relatively smaller place. The communication patterns enabled by physical proximity (Allen, 1984) in a dense area where it is easy to connect face-to-face is higher in Boston than in the Silicon Valley, where the universities and networking opportunities are spread out over a wider geographic region (Gloor et al., 2007).

During the period 1997 - 2004 a study performed by Raz and Gloor (2007) on the weight of informal networks for the survival of companies, analyzed longitudinal data on the social embedding of company executives to correlate their networking behavior with the survival rate of the company. The study was focused on software start-ups in Israel, investigating their rise in 1998 before the e-business bubble burst, and measuring their survival in 2004, after the e-business implosion (Raz and Gloor, 2007). The e-business bubble acted as an external shock, especially for those countries like Israel that exhibited the highest density of software startups in the world during the period of the analysis relative to population.

The application of the Social Network Analysis to the data obtained by surveying the executives of 100 software start ups in Israel, allowed us to confirm that collocated companies in the high-tech cluster of Israel were better connected. The strong correlation between physical proximity and high intensity communication (Allen, 1984) in this study was also confirmed by the finding that the most geographically clustered firms showed the highest Betweenness Centrality value.

However, the hypothesis expecting significant correlation between physical proximity, i.e. the closeness to the high-tech business center, and the rate of companies' survival had to be rejected.

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The case provided the evidence that the chance to survive for such companies was independent of their location in Israel (Raz and Gloor, 2007).

Another study conducted by Allen and Raz found the opposite, though. It investigated the interorganizational dynamics responsible for the creation of successful industrial communities among firms, universities and other institutions in the Area of Boston/Cambridge (2006). The aim of the study was to highlight the path of creation of successful industrial communities by scientists and engineers among the Biotech firms. Prior work had studied the formal ties linking the universities, firms and hospitals, based on patent and publication databases; this study went beyond, however, focusing on personal and informal communication patterns.

The map of this communication showed that the Biotech startups in Cambridge, co-located within a 5 mile radius around the MIT-Harvard axis, communicated significantly more, and also had higher patent output than their peers further out (Allen and Raz, 2006).

The conclusion from these three studies is that location matters, and that effective high-tech clusters act as CKNs. On the other hand, co-located CKNs within clusters in capital-intensive industries, such as the Boston Biotech cluster, are more effective than physically separated CKNs.

### **Conclusions – Culture and Leadership in CKNs**

The application of the Social Network Analysis to the Global Consulting community allowed us to highlight the main features of Collaborative Knowledge Networks. The *cultural aspects*, the *technology dimension*, the *role of the leading organization*, together with the “*virtuality*” of such community, emerge as the primary factors affecting the community’s ability to activate creative collaboration, knowledge sharing and social networking mechanisms.

These factors represent the determinants of the successful absorption of the community members. They are the necessary premise for the exploitation of the community potential in terms of individual capabilities development, as well as for the achievement of the organization’s objectives.

At the individual level, belonging to such organizational forms helps people build a wider personal network that guarantees direct access to business critical information; to create relationships with experts in specific problem domains; to learn more rapidly, acquiring new skills for their personal promotion.

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At the organizational level, the creation and support of a virtual community with the cultural and structural characteristics of a CKN make organizations more innovative, collaborative, agile; let them benefit from external new knowledge, discover new business opportunities, and reduce costs and time to market.

Applying Social Network Analysis to other communities developed around different kind of organizations was able to show that physical proximity and geographical clustering can also play a critical role in the rise and success of such communities. Prior studies of a Digital Consulate, software startups in Israel, and the biotech startups in Cambridge showed that, even if proximity is not proven to be determinant for the survival of organizations, it correlated with improved communication.

In particular for *capital-intensive* industries such as biotech, geographical clustering brings a clear advantage by leading to increased communication. For *knowledge-intense* industries like software, whose activities can be performed everywhere, the more company executives communicate, the higher the probability of their business success. Geographical co-location does not seem to be mandatory in this case, and can be substituted by virtual means of communication.

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