A systematic framework for analysing the critical success factors of communities of practice

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Abstract

Purpose – *The purpose of this paper is to briefly illustrate the test of an explanatory framework of the factors affecting the success of internal communities of practice (CoPs).*

Design/methodology/approach – *The analysis is based on a qualitative case study of the formation and management of intentionally created CoPs inside a large division of a multinational oil company.*

Findings – *The results of the study appear to confirm the utility of the framework as a tool for a sound and systematic investigation of the functioning of a CoP, and for understanding the reasons of its success or failure*

Research limitations/implications – *Since it if the first attempt to test the framework, further empirical investigation is needed. In particular, it would be particularly useful to apply the scheme to cases of failure.*

Practical implications – *The suggested framework can be of use for the design and management of intentionally created CoPs. In particular, it can provide insights into ''good practices'' or ''mistakes to be avoided''.*

Originality/value – *The main contribution of the paper is the application of a comprehensive and coherent model, which can represent the initial step toward the definition of a ''check-list'' for the creation and management of CoPs.*

Keywords *Communities, Knowledge management, Critical success factors, Oil industry, Case studies*

Paper type *Research paper*

1. Introduction

As is widely acknowledged, the ability to capitalize on the available knowledge is a major source of sustainable competitive advantage. Unfortunately, the largest amount of knowledge possessed by firms is embedded into the minds of employees, or disseminated in hundreds of documents, artefacts, procedures, etc. This is particularly true in the case of large dispersed companies, where geographical, cultural, and organisational barriers may hinder the effective retrieval, sharing and reuse of the existing knowledge. In particular, the experience shows that knowledge barriers tend to grow among the distinct parts of the organisation, that become knowledge islands (Franz *et al.*, 2002) with specific (and, sometimes, idiosyncratic) backgrounds, values, languages, behaviours, etc. In order to bridge such islands – and, by this way, promote knowledge sharing, organisational learning, and rapid innovation – several global corporations have promoted the deliberate creation of internal Communities of Practice (CoPs) (Archer, 2006; Dubé *et al.*, 2006; Garavan *et al.*, 2007).

Internal CoPs raise new questions that challenge the traditional organisational approaches. There is thus an urgent need to achieve better understanding of the real potential of such structures, the mechanisms of their functioning, and the relevant problems (Verburg and Andriessen, 2006).

> **"The KM system was implemented with the special goal to reduce the project cycle time and improve the company performance."**

Since the work of Wenger *et al.* (2002), there has been a flourishing literature about CoPs and their management. However, as frequently happens in innovative fields, most publications have focused on anecdotes, or on case studies that investigate specific situations. Some studies have attempted to focalise ''general'' aspects that characterise and influence the performance of a CoP, such as: the need for appropriate leadership (Bourhis *et al.*, 2005; Cargill, 2006; von Wartburg and Teichert, 2006); the importance of incentives to promote active participation (Fahey *et al.*, 2007); the controversial role of enabling technologies (Huysman and Wulf, 2005; Wenger *et al.*, 2005; Dotsika, 2006); the implications of cultural differences (Ardichvili *et al.*, 2006); and the pivotal role of trust (Usoro *et al.*, 2007). However, a comprehensive, systematic, and integrated view of all those intertwined factors is still missing.

In a previous study (Scarso and Bolisani, 2008), the authors developed a framework aiming to integrate the main aspects shaping the life and success of a CoP into a coherent picture. This framework has been designed as both a tool for analysing existing CoPs, and a guide for the planning and management of new ones.

Here, the authors apply that framework to the knowledge management (KM) programme of the Exploration & Production Division (E&P) of Eni, major Italian Oil Company. This case is very interesting for various reasons. E&P is a large division with units operating all over the world, and plays a leading strategic role in the corporation. In addition, a significant number of internal CoPs have been implemented in this division, whose KM project is regarded as the ''pioneering'' programme of the whole company.

The purpose of this paper is twofold. First, the explanatory power of the framework is evaluated, and in particular its capability for identifying and highlighting the critical success factors of a CoP, their mutual interactions, the relationships with the global knowledge strategy, and the influences (in terms of opportunities and constraints) exerted by the broader organisational and strategic context. Second, based on these findings, the paper illustrates how the framework can serve to formulate guidelines for the design of new CoP-based projects.

2. Internal CoPs as main components of a deliberate knowledge strategy

The most popular definition of CoP is that of Wenger *et al.* (2002): a ''group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis''. CoPs are not a new phenomenon, because their origins can be traced back to the corporations of craftsmen in Ancient Greece or the guilds in the Middle Age. However, what is considerably new is their intentional formation as a way to consciously manage knowledge in companies. A particular attention deserves CoPs created within companies (and mainly in large multinationals), named internal CoPs. Actually, an increasing number of global corporations have started to develop and manage such communities, including, e.g.: Shell, BP, ChevronTexaco (Oil Industry); Allianz (Insurance); DaimlerChrysler, Ford, Caterpillar (Automotive); Ernst&Young, Accenture, PriceWaterhouseCoopers (Consulting); IBM, HP, Siemens (Computers and Electronics); SAP (Software Vendors); IKEA (Retailing). As the reader can see, the examples refer to some of the most prestigious companies of the international arena. In all these cases, the purpose is to build structures that might facilitate

the sharing and diffusion of knowledge and, by this way, improve the innovative potential and problem-solving capability of the company.

While CoPs were initially conceptualised as a spontaneous phenomenon, marked by informal nature and lack of regulation, shortly afterwards it has become clear that they should be cultivated and managed (Wenger and Snyder, 2000; Brown and Duguid, 2001). Nowadays, they are considered as key components of systematic and deliberate KM strategies (Smith and McKeen, 2003; Wenger, 2004).

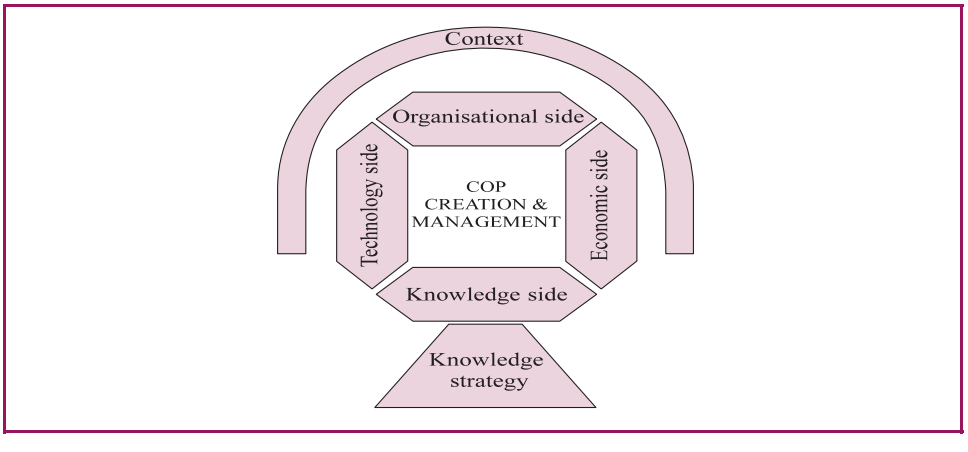
In particular, CoPs can be regarded as a manifestation of a human-oriented approach to KM (Huysman and Wulf, 2005; Newell *et al.*, 2006) that sees knowledge as constructed through the joint experience in social networks and, thus, as characterised by a prevalently tacit dimension. In this view, the potential of ICT applications is not neglected (indeed, without ICT, it would not be possible to connect professionals working globally, nor to store and share large amounts of information), but their role is somewhat seen as ''ancillary'': what is deemed vital is the implementation of appropriate organisational structures, processes, and mechanisms that facilitate the sharing of experience, ideas, and suggestions among individuals.

The design and management of internal CoPs appears a difficult task. Together with interesting cases of success, there are also many failures. As Coakes and Clarke (2006b) affirm, communities are often easier to destroy than construct, and there is no ''one-best-way'' to CoP formation and management; on the contrary, poorly reflected solutions may produce valueless outcomes (Pemberton *et al.*, 2007).

3. Analytical framework

The interpretative framework used here derives from a review of current studies of CoPs-based KM programmes (Scarso and Bolisani, 2008), which involved more than 200 papers selected from various sources. This survey provided a comprehensive picture of the current state of knowledge about the topic. As mentioned, most contributions report anecdotes and case studies, and give insights into particular features of the specific community under investigation but provide just partial views of the question. Nevertheless, there is a number of works (Wenger *et al.*, 2002; Coakes and Clarke, 2006a; Dub́ *et al.,* 2006; Roberts, 2006; Verburg and Andriessen, 2006; Zboralski and Gemünden, 2006; Pemberton *et al.* 2007) that attempt to categorise the critical success factors of CoPs. These studies were taken as the starting point for the analysis. The authors' effort consisted of accurately examining and organising this vast but heterogeneous material into a systematic and comprehensive framework, in order to develop a unifying view of the main issues influencing the life and development of a CoP. The resulting ''general framework'' comprises six elements (Figure 1), four of which are called internal (constituting) characteristics, and two are called external influences.

Figure 1 Framework for analysing the functioning of a CoP



The internal elements are the four pillars of a CoP, i.e. the structural factors on which its creation grounds. They can be regarded as the design options that can be chosen, whose features thus derive from the decisions taken by the designers, managers, or sponsors of the CoP. They are:

1. the organisational dimension, that concerns roles and relationships within the CoP and between it and the rest of the organisation;
2. the cognitive dimension, that regards the specific knowledge domain, the kind of practices the CoP deals with, and the KM processes undertaken;
3. the economic dimension, that involves benefits, costs, and relevant performances;
4. the technological dimension, that relates to the role of enabling technologies.

Each pillar includes several components, the most important of which are reported in Table I.

Since CoPs do not operate in a vacuum, their success depends both on the particular combination of the illustrated factors and its appropriateness to the specific circumstances of implementation (Paik and Choi, 2005; Kohlbacher and Mukai, 2007). Hence, the proper design of a CoP and its ''good functioning'' also rely on two external elements, which represent the ''background environment'' that entails the set of opportunities and constraints to the CoP project. These two external elements are:

1. the business context where the CoP project takes form; and
2. the knowledge strategy pursued by the organisation.

The business context consists of all the aspects connected with ''the way the organisation runs the business'', such as: the business environment (industry, product/service, markets, typical trading procedures, etc.), the corporate culture of the organisation (beliefs, basic assumptions, shared values, norms, practices, etc.), the level of ICT literacy of prospective CoP members, and the amount of resources available for the KM projects.

The knowledge strategy represents the deliberate plans of the organisation for making the best use of knowledge for competitive advantage (Zack, 1999; Holsapple and Jones, 2006). It stems from – or should be strictly associated with – the firm's competitive strategy. Generally speaking, the knowledge strategy defines the general aims of any KM

Table I Main components of the four pillars of a CoP

Pillar	*Main components*
Organisational	Size (number of members)
	Degree of transverseness across the organisation
	Relationship with the existing structure
	Formal acknowledgement
	Governance
	Local versus centralised management
	Roles of members and supporting functions
	Kind of leadership
Cognitive	Nature of shared knowledge
	Cultural proximity of members
	Knowledge gaps between members
	Knowledge domain
	KM processes and knowledge flows
	Mechanisms for establishing trust
Economic	Mechanisms for evaluating costs and benefits
	Budgeting, resources allocation, accounting
	Systems to promote and reward participation
Technological	Kind of technological platform
	User-friendliness
	KM processes underpinned by technologies
	Relations with the social/organisational context
	Intensity of use across the CoP

programme. As pointed out by some recent studies (Akhavan *et al.*, 2006; du Plessis, 2007), having a clear and well-planned knowledge strategy is an essential condition for a successful CoP.

The framework is used to identify the internal consistency of the different pillars with one another, as well as their alignment with the contextual constraints that limit the space and effectiveness of the possible solutions. It is assumed that the risk of failure rises when such consistency conditions are not satisfied, that is:

- a lack of internal consistency among the four pillars can cause malfunctioning, i.e. CoPs that are not organisationally balanced, conflictual, etc.;
- a lack of alignment of the four pillars with the business context constraints can lead to ineffectiveness, i.e. CoPs are not able perform the desired KM processes;
- a lack of alignment of the four pillars with the knowledge strategy can lead to useless CoPs, i.e. CoPs whose outcomes are not in line with the strategic requirements.

Based on these assumptions, the rest of the paper illustrates the analysis of the CoP-based KM programme of Eni that was carried out with the purpose to identify and discuss the results of this project, to explain their causes, and to pinpoint the problematic aspects.

4. Case study

The research strategy, qualitative and explorative in nature, centres on the process of formation and management of CoPs in Eni. The case study was conducted with the direct involvement of the staff, and particularly the programme leader. Since the case aims to test the framework described above, the empirical findings are gathered, presented and highlighted following its structure. In the next sections, the framework is thus applied to describe the main features of Eni's CoPs programme, and to highlight how it can help explaining success factors and critical points. First, the two ''external elements'', that represent the set of constraints and opportunities within which the programme was designed, developed, and implemented (the business context, and the knowledge strategy of the company), are illustrated. Then, the four pillars characterising the ''internal'' features of the CoP system are analysed.

4.1 Business context and implications for KM

Eni is a big multinational with a long tradition that can be traced back to the foundation of AGIP (which is today the fuel brand of the company) in 1926. The corporation has business units and operational locations scattered all around the world, with more than 70,000 employees of various nationalities working in 70 different countries. It is the most rapidly growing oil company of the last decade: the current production is 1.8 million barrels of oil equivalent per day; in 2007 net earnings was over 10 billion euros.

Eni is an ''integrated company'', which means both vertical and horizontal integration: on the one hand, activities range from exploration of new reserves to refinery and distribution; on the other hand, products and services include oil, gas, chemical goods, power production, engineering, oil services.

All this highlights a first important issue relevant to KM: the oil business is very complex and implies a large variety of activities and professional skills. Technical competencies include several specializations (geology, chemistry, construction, electronics, mechanics, etc). Economic-managerial skills are also vital, not to mention the legal and political competencies implied by the international negotiations and contracting.

A second important element is that an oil company combines routine processes (day-by-day production of oil from a well) that require efficiency and standardization, with project-based activities (the discovery of a new reserve, or the implementation of a new production site), where the research for specific solutions to new problems is required.

Eni has a typical functional structure, with units specialized in particular activities, tasks, or products: today, it is organised in three divisions (exploration and production, gas and

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power, and refinery and marketing) with two additional areas (chemical activities grouped under the company Syndial, and a construction and oil service company – Saipem). This functional structure is combined with a project-based structure, with managers responsible for specific projects, contracts, or sites.

The E&P Division – which is the one where the KM programme started – deals with the search for new reserves and the production of oil and gas. These activities are, by nature, risky and capital intensive, characterised by long cycle time and leading-edge technological content. Since the decisions taken by this Division are, often, very influential for the company in the long term, it is very important not to make mistakes and, overall, not to repeat previous mistakes.

At E&P, the management of a new project requires that the different competences involved co-operate along with the various steps of the project – from reserves research to site implementation, production, refinery and finally distribution. A consequent challenge is to connect the various ''islands'' of knowledge specialization all around the division, and to ensure the balance between the efficiency required by routine activities and the innovativeness needed in the new projects.

In addition, even if a new project can be very different from the old ones, it calls for the competencies already achieved in the company. Old competencies need thus to be ''stored'', reused when necessary, and re-formulated or combined with new ones.

Another problem derives from the international extension. About 22,000 people work for the E&P Division in more than 30 countries, and they are of many different nationalities. On the one hand, this cultural richness is a value for a company, which operates and interacts at a global level; on the other hand, an effective management of knowledge is critical and complex in a context marked by strong cultural and linguistic differences.

Despite the increasing use of computer-based technologies, the value of people's experience is crucial. An example is given by the capability to evaluate the potential of a new oil reserve: the decisions to invest in a new well can largely affect the economic outcomes of the company. Unfortunately, the results of geological and chemical analyses are never self-explanatory, and require the interpretation of large amounts of data by specialists. Hence, the quality of this analysis strictly depends on the expertise of the professionals involved. Furthermore, estimating their economic effects requires practice and capability that go well beyond the strictly technical field. It can thus be affirmed that the knowledge embedded in people is a major resource for E&P activities.

The project life cycle is an additional critical issue. The management of a new well – from the early search to the closure – can extend over several decades. In this long term, the problem of ''aging workforce'' implies great efforts to ''capture'' and record the people's experience before they retire. The declining interest in oil business by the younger generations is an additional reason for a further push to manage the knowledge capital of the older employees, with the purpose to avoid the gradual impoverishment of the company's knowledge assets.

4.2. The knowledge strategy

According to what illustrated, the knowledge strategy followed by E&P was aimed primarily to create an environment that facilitates knowledge exchanges between the operating lines and the more experienced people, and can thus help the young to learn faster by eliminating

the spatial constraints due to the worldwide dispersion of employees. The other two important objectives of KM programme were: to capture individual experience and transform it in established company assets, and to increase interactions among the different professional groups.

Professionals were considered the crucial success factor of this strategy, and the KM system was built around those people and their behaviours. It was, however, clear that the implementation of such strategy should have required some kind of supporting structure to facilitate the development of the KM system, assist the professionals, do the practical activities, and keep a connection with the top management. In addition, the KM programme should have involved the line operators, but without asking them unjustified efforts. In other words, the professionals should have not asked to ''change their job'', nor been charged of additional unwarranted duties. Instead, they should have been provided for a useful support that could improve the quality of their jobs, thus benefiting the company and them together.

To pursue the mentioned goals, CoPs were identified as a suitable tool. A process of rationalisation and formalisation of information/knowledge flows was also started, along with the design and the implementation of a new organizational structure called ''Enabling team'' (see below).

5. The four internal pillars of the Eni's CoP programme

5.1 Background and basic features

The KM system was implemented with the special goal to reduce the project cycle time and improve the company performance. Owing to the nature of the business, a better use of experience and tacit knowledge embedded in operating people was regarded as essential. Hence, the KM system was designed to leverage on such experience, to avoid error repetitions or the ''wheel reinvention'' and, particularly, to allow the exploitation of the full potential of each employee. It was, thus, centred on the communication and collaboration among people.

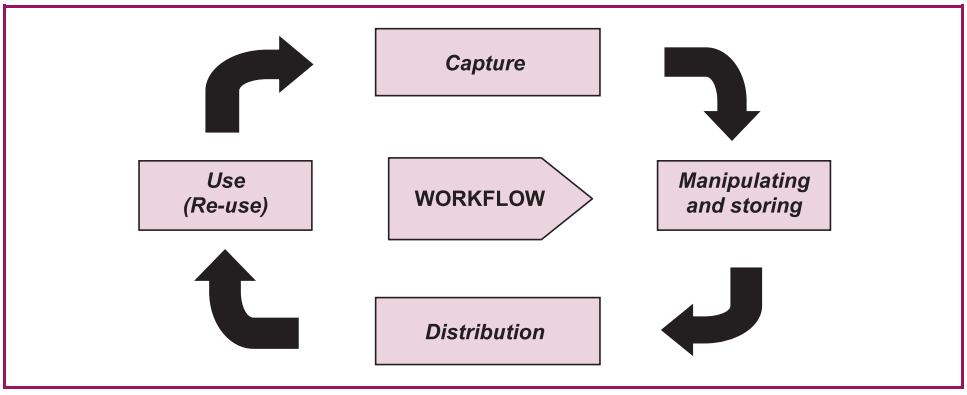
The pilot project started in 2004, after a design phase that had lasted six months and involved about 150 Eni people, supported by an external consultant. In order to keep a strict control over the change process, an in-house design was decided. In February 2005, the rollout phase begun and covered 90 percent of the subsidiaries by the end of that year. Investments amounted to 5 million euros

Before the start of the project, a big training effort was made, which involved about 1,900 managers and professionals from the various units for a total of 450 meeting hours. During the meetings, a particular stress was put on the potential benefits of the system for both the company and the single employee. Also, the prospective participants were explained that the top management was entirely committed to the project, and considered it of strategic value.

The project started with five CoPs, each focusing on a core activity at the Division (Geology, Geophysics, Drilling, Exploration, and Reservoir). Other nine communities have been created next: GIS (Geographical Identification System), Health, Safety & Environment, Flow Assurance, Materials & Corrosion, Business Support, Rotating Machinery, Subsea Completion and Social Investment. A further Production Optimisation CoP is going to be alive shortly.

The KM system was designed to support and facilitate the company's ''knowledge cycle'' (Figure 2). The main concept here is that the knowledge generated during the operation activities can be captured, manipulated, and stored for reuse, distributed when and where needed, and applied to solve practical problems. It is a recursive cycle, since the fresh knowledge produced ''by applying the old one'' is, in turn, captured, manipulated, stored, distributed and used again. The development of internal CoPs was seen as the best approach to support this cycle. CoPs have also the role of ''evangelising'' the line people, or in other words of supporting a ''cultural'' shift towards knowledge sharing and pro-active

Figure 2 The knowledge cycle in Eni



behaviours. The resulting cultural change was seen as a side effect of the introduction of KM, even though this could represent the main value of the project in the long run.

5.2 The organizational pillar

Eni CoPs consist of ''experts'', who are the main source of the professional knowledge and whose duty is to offer solutions to the problems encountered by line operators. The qualification of expert is assigned ''on request'' (i.e. a professional may ask to join a CoP as an expert), and is based on the ''peer assessment'' made by the other professionals to which the CoP is targeted (more precisely: colleagues working in the same technical or functional area). Currently, the number of members of a CoP ranges between 10 and 40. On average, they have 30 years service, are geographically dispersed (only about 50 percent of the members belong to the central service units), and are trained specifically for KM functions.

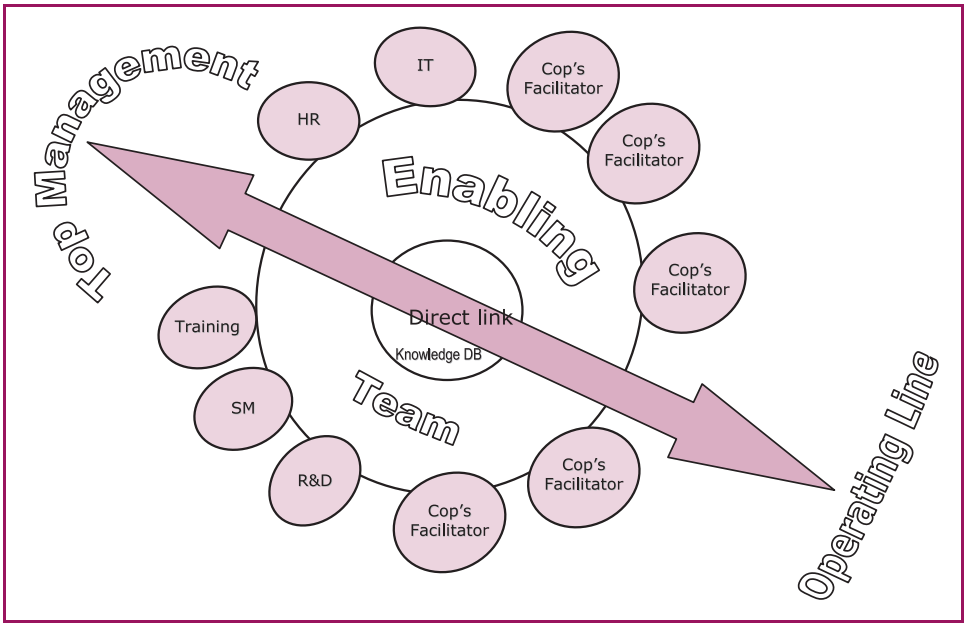
There is no rigid hierarchy in a CoP, and everybody can contribute with a ''good idea''. However, to speed up operations and avoid ''anarchy'', a ''*primus inter pares*'', named Facilitator, has been chosen, whose main task is to improve the functioning of a CoP by facilitating the relationships among the members as well as the connections with other CoPs. Facilitators also monitor the respect of the participation rules that each community can autonomously set, and the response time to a request of advice. Facilitators are selected based on both technical competence and communicative or social attitudes.

The work of CoPs is assisted by a special group, called the Enabling Team, which comprises the facilitators of the various communities, who share their experience for the benefit of the whole KM programme, and representatives of other functions (R&D, IT, HR, Training and Strategic Management – Figure 3). The main goal of the Enabling Team is to promote the dissemination of a ''culture of KM'' and of good practices among the different communities. Thanks to its position in the middle between the top management and the operating lines, the Enabling Team also serves as ''ear'' that captures information from the operating lines about the day-by-day technical or business issues, and carries it to the top management.

A chief knowledge officer (CKO), specifically assigned for this role, directs the Enabling Team. The CKO, the Enabling Team and the single communities are assisted by a KM Team that comprises a few specialists in communication and ICT: they run a web portal (see below), manage the contents of document repositories, organise meetings and training sessions, and so on.

From an organizational perspective, Eni's project raises a number of interesting points. An essential element of the programme is the resort to a structure that overlaps the existing organisational levels. Due to the transverseness of CoPs and the intrinsically ''intangible'' and ambiguous nature of their knowledge processes, flexible membership and voluntary participation have been allowed. Also, to facilitate the acceptance by the formal organisation, a non-invasive structure has been chosen.

Figure 3 Enabling team: composition and role of interface



Accordingly, all the KM structures (CoPs, Enabling Team, etc.) have been defined formally, but are not included in the organizational chart. The CKO and his collaborators compound the only staff completely dedicated to KM. The CoP's members continue to carry out their ''business as usual'' – with roles, responsibilities and hierarchical dependency as already fixed in the conventional chart – while, for KM activities, they refer to a different and flatter self-governed structure. CoP experts can devote to KM activities up to 10 percent of their working time, during which they respond to the Enabling Team Coordinator; for the rest, they do their customary job. The facilitator continues to perform his usual activities as well, although he can devote to KM up to 90 percent of his time.

Despite the flexibility and openness of the system, a structured and systematic support is needed to give efficiency to the working of the communities. The point is how to find a proper balance between informality and structuredness. Although each community is left free to set specific internal arrangements, a common set of practices and rules needs to be established, this is particularly important considering the growing number of communities. Similarly, the necessity of central co-ordination was clear to the promoters of the KM programme since the early beginning. For this reason, the Enabling Team was initially conceived as a rigidly hierarchical structure imposed by the top management, but this had little success. The current light and ''bottom-up'' version of the Enabling Team can be seen as an attempt to reach the difficult trade-off between efficiency and flexibility of the CoP system, with the purpose to ensure participation on the one hand, and to avoid conflicts with the formal structure and the ''day-by-day'' routines on the other hand.

5.3 The cognitive pillar

CoPs have the twofold function of helping the line in their usual activities by acting as ''answer providers'', and preserving the company knowledge base. Accordingly, the knowledge treated by the KM system strictly concerns to the everyday business operations. This is why the knowledge domain of each CoP focuses on a particular core activity: specialisation and ''professional proximity'' of members are privileged, which facilitate the creation and dissemination of a common pool of knowledge inside the CoP.

Each CoP acts as a collector, supervisor, storekeeper, and provider of specialised knowledge for the entire Division. A line operator can resort to a particular Community when

he has an issue to deal with, a problem to solve, an interesting solution to share with others, or an instructive experience to tell.

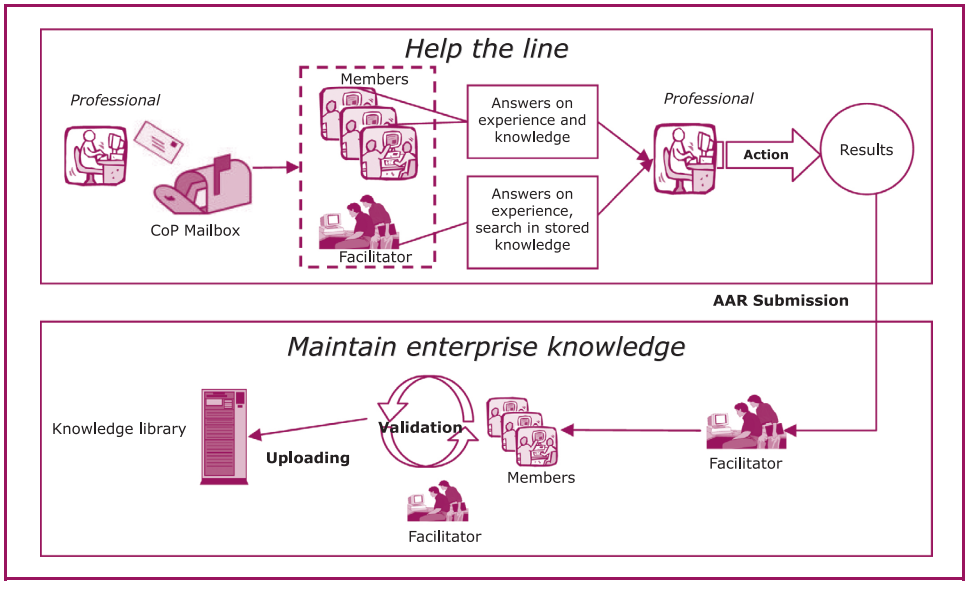
Figure 4 describes how CoPs work. A professional having a particular question e-mails an issue to the Community to get some help. The issue is submitted to all CoP members who, based on their knowledge and experience, can suggest a solution. The Facilitator coordinates and synthesises the community response, and can send the issue to other CoPs if he thinks that the answer calls for other competences.

Once the answer has been received, the line operator autonomously decides if and how to employ it: the final decision entirely remains his responsibility. Whatever it is, he has to keep a record of the effects of his decision: an ''after action report'' is drafted and sent back to the CoP. The CoP members analyse the report, validate it, and upload it to the public knowledge library. The resulting knowledge object is structured following a rigid template including: the problem description, the action implemented, and the results obtained, irrespective of the fact that such action has solved the problem or not. The outcomes are recorded in any case: if they are positive, then there is a possible solution available to others that may be interested; if negative, there is a mistake that has not to be repeated. Knowledge objects also include the results of the validation process, the possible interactions with other activities, and the scope (punctual, local or general) of applicability. They can be linked to one another, or to materials (reports, manuals, etc.) published in the internal company library or retrieved from outside. Finally, each knowledge object is provided with a header that refers to a three-level classification scheme, which facilitates the retrieval from the database. Since internal professional skills and expertise are described using the same classification scheme, this allows linking the matter to a specific area of competence within the organization.

Once a knowledge object has been uploaded, the ''knowledge cycle'' is complete: the fresh knowledge (produced by applying ''old'' knowledge to new problems) is now captured and made available for subsequent applications.

The analysis of this solution provides some interesting hints. First, since the crucial question is to use CoPs for facilitating the sharing of knowledge ''in its entirety'', both explicit (documents, formulas, technical data) and tacit (experience, feelings, perceptions) forms should be included and combined. On the other hand, the mechanism to produce Knowledge Objects is long and complex, but necessary for allowing the storage and worldwide retrieval of knowledge through computer networks. This practice may neglect or

Figure 4 Eni CoPs: knowledge aims and processes



skip tacit aspects, which can result in a loss of important experiential elements. For this reason, the CoP process has been designed to allow direct interactions between people in addition to computer-mediated knowledge exchanges.

Another critical point is the focalisation of each CoP on a specific domain to improve their efficient functioning. Too widely focused communities can lead to inefficient knowledge sharing, and can also cause the difficult codification and storage of knowledge objects: each discipline has its own languages, expressions, terms, etc. However, the E&P projects require the interaction among professionals specializing in different areas: that is why the interconnection between distinct communities is allowed, which, however, requires that their structures and functioning replicate a common model. In addition, the enabling team represents a bridge between the different communities, and sets common ''standard'' rules of their structuring.

5.4 The economic pillar

The implementation of KM in business cannot be separated from adequate mechanisms of performance measurement. At E&P, there is a dedicated team that monitors quantitative indicators and assesses the level of use of the entire system: number of processed issues; number of answers given to a specific issue; communities involved; level of participation and so on. Other more specific indicators check the utilisation of the knowledge portal: number and duration of accesses to the different sections; number of contributions to the discussions; number of people accessing the knowledge library and other sources made available through the portal. All the indicators are analysed and discussed by the ET, and constitute the basis for possible interventions of CoP management.

Costs have to be measured as well. At the moment, they are evaluated based on working time of employees, for instance: the time spent in KM training, or the time that the experts devote to the management of knowledge cycle. The evaluation of costs is essential for budgeting resources and setting goals. During the two first years of design and implementation, a special budget was allocated to the KM project but, after that, KM became ''a business practice'' with a specific budget annually allocated within the organisational units where the CoP members carry out their main job. This budget is calculated in terms of man hours spent by CoP members for knowledge activities. Other costs relate to the central supporting team and the ET coordinator: for these, a special budget is allocated at the divisional level. At present, operational costs can be assessed as about 4 Million euros per year in total, including both accountable expenses and the monetary value of working hours.

Another economic element that typically characterises the functioning of communities is how to induce people to share knowledge. At Eni, no economic or career incentives are provided. For the experts, the reward for CoP participation consists essentially in the recognition of their prominent role by the peers and by the company. For the users, the payback just comes from the benefits they can obtain to their work by getting useful advice. This decision can seem risky, but is integral to the ''Eni's way of seeing KM'': rather than getting direct economic rewards, employees are required to shift their attitude from an individualistic behaviour towards a collaborative perspective. Accordingly, the value of each employee is measured based on ''what he shares'' rather than ''what he knows''. According to the fact that this increases the economic outcomes of the company ''as a whole'', the most active people are compensated through the company's standard reward systems in relation to their overall contribution to the achievements of the company's goals.

What described above raises some important points about the ''economy of communities''. The step taken toward a systematic budgeting process (where goals, responsibilities, and resources are clear) is essential to achieve results on the medium-long term. As a matter of fact, KM programmes are perceived as extending well beyond the short run, and thus they require a multi-annual planning. In addition, the existence of a formal budget makes CoPs' activities more visible to the rest of the organisation as well. Still, some aspects require adjustments. For instance, the budgeting procedure is somewhat too simple – and, at least

in part, contradictory: today, the general objectives are established with a time horizon of four years, but the next-year budget is fixed simply based on the previous year.

Also, an effective budgeting requires the verification of the results in economic terms. As is well known, measurement is a special problem for KM, and the experience at Eni is not an exception. Beyond the practical obstacles that can make it difficult to do a specific measure, it is even hard to identify what parameters are best to assess the ''actual outcomes'' of a community. As an example, the number of accesses to the communities – and, especially, the requests processed – has been extensively used as a ''proxy'' measure of the CoP efficacy. However, the direct connection between the intensity of use of a community and its economic outcomes is just a speculation that has not been proven yet.

5.5 The technological pillar

The company has chosen to keep the technological supports as simple as possible. The basic idea is that ICT tools should make the collaboration among people easy and immediate. Therefore, it was decided to use e-mails as the base of any communication and knowledge exchange, supported by commercial screen-sharing and file-sharing software. For flexibility purposes, the use of more traditional communication channel (i.e. phone calls) is also allowed; professionals are, in any case, requested to follow the ICT-based procedure.

As mentioned before, a knowledge portal has also been implemented. This is a simple web site managed by the enabling team, where information about the KM system and CoP's activities can be found quickly, and from which other internal and external knowledge sources can be reached. The portal is very user-friendly, and it is conceived to enable the quick retrieval (in ''a maximum of three clicks'') of the desired resource. Also, the system is very light and can be accessed from mobile locations with limited band.

The portal has both a public and a private area, where the latter is restricted to the single communities. The public area contains: the knowledge library (the repository of useful people experience, where the knowledge objects are classified and stored); internal explicit knowledge resources (company general data and information); and external explicit knowledge materials (documents, reports, and the like coming from external sources).

More than two thousand employees are regularly delivered a newsletter, in which knowledge objects of general interest are illustrated after being translated in ''a language that can be understood by everybody''. Single professional groups may also produce their own newsletters. The responsibility of the content management is vested in the enabling team, which, through the KM team, is continuously exploring new tools and criteria to improve the quality, consistency, and accessibility to knowledge.

Eni's experience highlights some key issues about the potential of ICTs for supporting CoPs. On the one hand (as may seem quite obvious), there is no chance to create and develop so complex organizational structures without technologies. On the other hand, the choice to develop a light technology tool appears consistent with the other organizational and cognitive elements of the system. Actually, the current ICT structure is quite flexible, allows the exchange of many types of knowledge contents, and is also user-friendly and non-invasive for the ''day-by-day business''. Simplicity has, however, some drawbacks that

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can hinder the further development of CoPs. In particular, there are concerns that the system may become inadequate to manage the complex flows of a growing bundle of communities.

Another issue refers to the way members currently use the technology. For example, when new questions are posted, these are expected to be answered by an established time. However, in this way, the experts' attention can be diverted from their ''usual'' business, which can cause tensions with their line duties.

The development of ICT support is also affected by the ''legacy'' applications existing in the company. Today, the KM system is based on a Lotus Notes mailing system, which has been used in the company for some years but is not tailored to the specific KM needs. New solutions are being studied, but their selection is difficult. Conversely, there is the issue of replication: although the KM system has been designed for the E&P Division, it may be of use to extend the CoP model to a broader corporate level. Indeed, there are some fields where working procedures and knowledge contents are common throughout the company, while each division has specific structures, ways of working, and supporting systems. Thus, the problem is to find a proper balance between specific applications on the one hand, and general shared models on the other.

6. Discussion

Since the study aims to test the proposed interpretative framework as a sort of ''checklist'' for understanding the reasons of success or failure of CoPs, a basic question needs an answer first: how and when is it possible to affirm that a CoP programme is a success, or a failure? Generally speaking, the ''objective measurement'' of the value produced by this organisational structure is difficult, and sometimes even impossible. Thus, the following discussion will be based on the assessments provided by Eni's top management itself.

In particular, two important elements can be mentioned. During the first year of implementation, the company tried to estimate the value produced by the CoPs in terms of cost savings or other economic indicators. About 10 percent of the issues discussed in the communities was analysed, and the economic effects of the decisions taken on the base of the CoP experts' ''advice'' were estimated. Even though it is hard to affirm that there is a direct connection between the advice of an expert and the economic results of a decision, Eni managers estimated that these results were sufficient to cover some 25 times the entire cost of the KM project at that time.

A second important element is the level of access to the communities over time, which can also testify the shift of the attitude and behaviour of employees towards a collaborative approach (one of the central strategic purposes of the company). All the indicators monitored by Eni appear encouraging. The interaction between the operating line and the CoPs continues to grow, and today there is an average of 16.2 interactions (e-mail exchanged) per working day over 14 communities, with the production of a new knowledge object everyday. To each inquiry proposed to the community, there are 5.5 answers on average. First answer comes within seven hours in 61 percent of cases, and within 24 hours for 73 percent of them. The number of visits to the knowledge library is about 60 per working day. All this testifies that the communities are actually used, which means that the employees find their service useful.

To sum up, it can be affirmed that Eni evaluates the CoP programme positively. Thus, the analysis of the critical success factors, conducted by means of the framework, can help to understand the reasons of these good results, and to identify elements that can still be considered points of weakness.

First, it is clear that the E&P Division has a well-defined knowledge strategy strictly aligned with the business strategy. In particular, it was realised that the strategic goal of reducing the cycle time could be only achieved through a more effective and efficient use of knowledge and competences owned by the more skilled and experienced people. Thus, an explicit KM programme was needed to pursue these goals, and the choice to

implement CoPs met this need exactly. Second, the decision to create communities of experts for providing operational advice allowed defining and focusing their goals very precisely. This made the CoP creation easier, and avoided to waste efforts and resource in a multiplicity of small but less useful initiatives. Third, the KM programme was intended to keep the operating line involved. In terms of ICT design, the system was kept simple: from Eni's viewpoint, KM deals with people communicating, not with computational power. The knowledge cycle procedure (see above) complies with the usual way of working of professionals, who maintain their decision-making autonomy. All these solutions ensure a high degree of internal consistency of the CoP's dimensions, as is indicated by our framework.

Another decisive element is that the organisational change produced by the use of CoPs is pushed from the bottom, i.e. it is mostly in the hands of the line people. CoPs are perceived by professionals as a tool to help them, not as something invented elsewhere and imposed on them. Fundamental for achieving such perception was the communication plan implemented. The meeting hours with managers and key technicians all around the world allowed communicating the purpose of the project, and collecting and implementing very useful feedbacks. To sum up, the systems is compatible with the key organisational roles of professionals in the company; they now find the CoP a useful, user-friendly, and flexible tool, and not a further bureaucratic procedure imposed by the top management as a sort of ''burden'' that weighs on their every day work or limits their creativity. The CoP system does not provide binding directives: is just designed to facilitate the sharing of experience between skilled people and less expert employees. This means that the communities do not affect competencies, roles and established responsibilities in the organisation. At the same time, the system allows the company to collect and store part of its knowledge, thus avoiding the risk of losing it when people retire. In such a way, it is possible to say that there is a strict alignment with the existing organisational structure.

All things considered, the reasons of the results obtained by Eni can be found and understood in the light of the proposed framework, and summarised through the following factors:

- a well defined and focused knowledge strategy;
- a strict coherence between the knowledge strategy and the CoP-based KM programme;
- a balanced attention to all the different dimensions of the CoPs; and
- a careful consideration of the relevant business and organizational context.

Furthermore, this experience highlights the importance of targeting the KM programme to solve specific working problems and involve the future users in the development and maintenance of the structure directly. These facts seem to be an effective way to avoid the misalignments and inconsistencies earlier recalled.

The framework also allows singling out specific points of weakness as well, on which the company may find it useful to work. For instance, the issue of the economic measurement of KM activities is a controversial and problematic point that still requires a solution. This is particularly important for the long-term sustainability of the KM project and for introducing budgeting procedures, which is also essential for a full recognition of the role of KM inside the company. The technological aspects are critical as well. As mentioned, the simplicity, user-friendliness and ''generality'' of the systems is an element that can favour the boosting of the KM programme across the whole company. However, it is likely that more specific and complex technologies become essential for increasingly sophisticated uses brought about with the growth of the communities.

7. Conclusion

The results obtained from the test of the proposed interpretative framework gives encouraging prospects about its usefulness as a tool for analysing the critical factors of a CoP-based KM programme. The framework appears appropriate for a sound and systematic investigation of the functioning of existing CoPs, and for identifying and

understanding the reasons of their success or failure. Accordingly, it can be of use also for the designing and implementation of new CoPs, because it can provide insights into the ''good practices'' or the ''mistakes to be avoided''. In practice, the framework can be used in two ways:

1. As a sort of ''check list'' for an existing or a new project: the four pillars described in section 3, and the more detailed elements such as those indicated in Table I, can be used to single out specific points of strength and weakness of a CoP programme, or to formulate the design of a new one in a more reflected way.
2. As a tool for analysing the consistency of the various internal elements of a CoP programme and with the external or environmental conditions. As mentioned, the alignment of the various aspects of a CoP project is an essential ingredient for its success. This consistency can be assessed for an existing programme, or checked during the design of a new one.

Clearly, further empirical investigations are needed to better validate or to adjust the framework. It would be especially useful to apply it to other situations in the same sector (for making comparisons and cross analysis) or in other industries (that can highlight completely different elements). In addition, it might be useful to test the framework to cases of failure. However, the availability of a systematic approach, as the one proposed here, appears to be an important contribution to the development of this field.

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