

# Communities of Practice Supporting Research and Technological Development

## *A Practical Case at Electrical Sector in Mexico*

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**Abstract:** The IIE is devoted to innovation, technological development and applied scientific research. In order to increase productivity and to anticipate the needs of electrical sector, IIE is promoting collaboration and sharing of knowledge, ideas and experience among researchers through communities of practice. Communities of practice enable creating and sharing of knowledge and its application in the development of research projects, realize and anticipate problems, and devised new research lines to be undertaken. To impulse communities of practice, several efforts have been conducted, such as funding, talks by experts, defining success indexes and regulations and the development of an information system based on Web technologies. The Web system supports distance collaboration and sharing of documents. This paper presents an approach to implement communities of practice.

## 1 INTRODUCTION

In the global context, companies require endlessly for new knowledge in order to be innovative and competitive. Usually, this new knowledge comes from academic education and training of personnel; however, companies need to learn from their own experience. They also need means to manage their own knowledge, this includes means to generate, share and transfer it. The Electrical Research Institute (IIE, for the Spanish *Instituto de Investigaciones Eléctricas*) is a public company devoted to innovation, technological development and applied scientific research, in order to develop technologies for the electrical and oil industries. Its mission is to promote and support innovation through value-added applied research and technological development (IIE, 2013).

IIE's researchers are specialized in several fields of sciences and technology. They develop high quality projects. Most of these projects are multi-disciplinary and include researchers from different departments. IIE identified that workgroups work isolated often without noticing what other workgroups are doing; sometimes trying to solve similar problems. To promote knowledge sharing a

knowledge management model is being implemented. Through several strategies, this model enables to generate, identify and share resources of knowledge across departments and divisions. Communities of practice are an important knowledge management strategy which contributes to organization's strategic direction; they enable expertise to be transferred across organization and encourage the discussion of effective solutions to a range of problems (Wenger and Snyder, 2000).

At IIE, communities of practice are groups of researchers who meet regularly to share specialized knowledge and learn together. They apply this knowledge in the development of innovative projects, products and services to be delivered to customers.

Formerly, informal groups of researchers met up to talk about an interesting paper or final outcomes of a project for instance. However, researchers did not collaborate, and it was difficult to know if researchers applied this knowledge in their projects. These groups have received recognition and resources to create formal groups with the aim to produce knowledge and results aligned with strategic vision. Provided resources includes a Web system to support collaboration.

Communities of practice has been identified as a key to improving performance, therefore a growing number of people and organizations in various sectors are now focusing on them (Wenger, McDermott and Snyder, 2002).

This paper presents the efforts in promoting communities of practices in the IIE. The rest of this section presents a brief description of the context of communities of practice. Sections 2 and 3 describe how communities of practice are integrated and how they work. In section 4, a Web system for communities of practice is described. Section 5 outlines how we are planning to measure communities of practice's success. Finally, conclusions and future work are presented in Section 6.

## 1.2 Knowledge Management

The knowledge management model is based on a broadly accepted definition, it points out that knowledge management is the process of managing the corporation's knowledge through a systematically and organizationally specified process for acquiring, organizing, sustaining, applying, sharing and renewing both the tacit and explicit knowledge of employees to enhance organizational performance and create value (Davenport and Prusak, 2000).

The model is intended to increase productivity and competitiveness through collaboration, and turns around seven supports: communities of practice, technological repository, relational capital, innovation management, intellectual property, competence management and human capital (IIE, 2013). Figure 1 shows the knowledge management model.



Figure 1: Knowledge management model.

The main domains of the system of knowledge are

lined up with the technological development areas of the IIE, which in turn are aligned with the strategic planning of electrical and energy sectors in México. The principal customer of IIE is the Federal Electricity Commission (CFE) which is a company created and owned by the Mexican government. It generates and distributes electric power for almost 35.3 million customers what represents almost 100 million people (CFE, 2013). Thus, the domains of knowledge support electricity generation processes, such as: energy efficiency and energy savings, use of renewable energy sources, use reduction of fossil fuels and climate change mitigation.

## 2 COMMUNITIES OF PRACTICE

Communities of practice are a fundamental component of knowledge management because they join people to share knowledge and learn together about common topics of interest; they manifest the importance of social interaction in learning. The term “communities of practice” was coined by Etienne Wenger and Jean Lave (Lave & Wenger, 1991) and it is defined as groups 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 on-going basis (Wenger, McDermott and Snyder, 2002).

A community of practice (CoP) has three essential components: domain, community and practice (Wenger, McDermott and Snyder, 2002). *Domain* is the definition of the technological or research area of shared interest. In the IIE, *domain* corresponds or is lined up with the technological development lines of the IIE. The *community* is the group of researchers with a sense of belonging to it. CoPs are shaped across the organizational structure; therefore, CoPs are multidisciplinary and interdepartmental groups. The *practice* is given in terms of projects development which in turn originates a body of knowledge, methods, stories, cases, tools, documents, etc. The body of knowledge is produced and applied in the development of projects, which mainly consist in applied research and technological development. Figure 2 shows these components.

We have adopted a bounded definition: a CoP is a group of researchers constituted to develop specialized knowledge on a strategic theme based on shared learning and joint reflection about practical experiences (Hernández, Arroyo-Figueroa and González-Castro, 2013).

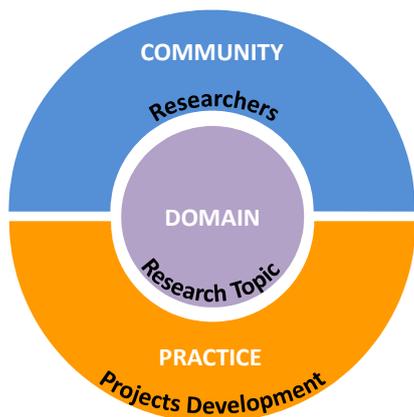


Figure 2: CoP components.

In some way, CoPs are not new in the IIE, since along its 35 years of live, several homogenous groups of researches have regular meeting to talk about several problems or to share knowledge and experience. These informal meetings were plenty of knowledge but most times, the knowledge was only in the verbal channel, but there was no history on how a problem was solved or how the knowledge was applied. On the other hand, researchers worked isolated in their projects and the knowledge and experience was no shared, even there were other projects facing similar problems. Moreover, sometimes research projects were no line up with strategic topics. Consequently, it was noticed the need to capture or retain that knowledge and to focus on topics around strategic lines with the aim to innovate.

As a result of these needs and the strategic planning, it was launched the innovation development programme (PDI, for the Spanish *Programas de Desarrollo de Innovación*). PDI aimed at the development of lines of research to support the competitiveness. A PDI involved a set of elements, such as projects, funding, laboratories, researchers, students, potential customers, and so on which are intended to support the development of a research line.

PDI made evident the need for mechanisms to establish guidelines and responsibilities for knowledge management and innovation. As a result, communities of practice were initiated, as groups of researchers to develop specialized knowledge on strategic topics.

Communities of practice are formed with the purpose of working on strategic topics associated with lines of technological development. CoPs Members share experiences and explore new technologies to detect opportunities, where IIE, its

customers and potential customers, may have a competitive advantage. In this way, CoPs support institution and its customers' competitiveness; at the same time CoPs supports professional development of members of CoPs. To achieve the objectives, communities of practice share knowledge, experiences and learning based on joint reflection.

The process to implement and shape CoP started with strategic goals statements and required core competencies, business processes, and key activities. These requirements were analyzed in terms of critical knowledge domains. Then potential CoPs members were identified. A requirement is people's interest and need for this knowledge for their work. Also the passion and attitude is important for the success of CoP. Finally, it was analyzed how to connect them into communities of practice in such a way they can share and generate knowledge. A CoP creation is strongly supported in energy sector and IIE strategic planning. Figure 3 shows the process to shape a CoP.



Figure 3: CoP process.

As we mentioned, a frequent problem was researchers worked alone and regularly the knowledge was not shared or reused; and, most times when a project finished, projects team split. Therefore there was necessity for CoPs composed by researchers from several departments and divisions participating in different projects, but with a permanent relationship in the CoP. Figure 4 explains this organization, in a schematic way.

In this way, a community of practice is a group of researchers constituted to develop specialized knowledge on a strategic topic. Currently, in the Enabling Technologies Division there are about 12 communities of practice and more than 100 researchers participating. Table 1 presents a list of CoPs.

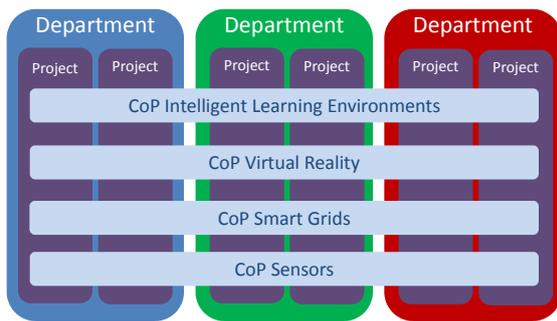


Figure 4: Horizontal organizational structure of CoP.

Table 1: List of communities of practice.

Communities of practice	
1	Systems for detection, diagnosis, prediction and remediation faults
2	Development of real and virtual sensors
3	Network and communication devices for process and elements monitoring
4	Smart grids
5	Virtual reality
6	Intelligent learning environments
7	Technologies for training simulators
8	Generation substation automation
9	Graphical interfaces
10	Business intelligence
11	Mechatronics
12	Power electronics

### 3 CoP OPERATION

To foster communities of practice, we have followed the guidelines proposed by Wenger (Wenger, McDermott and Snyder, 2002) but we have put some formal mechanism to monitoring CoP. We have a process document and a regulations document.

The process document establishes guidelines to create, update and cancel communities of practice. The regulations document establishes a minimum of guidelines for operation and monitoring of communities of practice.

CoPs can be set up with researchers who are interested in the domain of CoP. Preferably the members of a CoP must be knowledgeable in the subject matter and be experienced to support the work of the CoP, or to have the potential to get professionally developed in the subject domain. Communities of practices are constituted by a coordinator, a secretary and members. All of them must have the above characteristics.

To achieve goals, CoPs have some functions to be conducted; these functions start with the

definition of short and medium term objectives of the CoP, establishing the strategies required to achieve them. The CoP members have to elaborate some documents such as a technical background document, the state of the art and practice document of the CoP domain and a calendar of activities. These documents have to be updated annually. The knowledge, experiences and results of the CoP are intended to be shared; therefore CoP members have to document them through regular reports. An important CoPs function is the analysis of relevant issues and problems of the CoP domain and to propose innovative methods of solution. Also CoPs have to identify and propose the development of innovative products and services by conducting preliminary technical and economic feasibility studies. To promote standardization across projects and departments, CoPs have to identify appropriate development platforms. As specialists, CoP members recommend actions in accordance with the direction of technology and the results obtained.

CoPs has a close interaction with the development of research projects, since the results, products and learning of a CoP are applied in their development and in turn, the knowledge generated in the project is shared in the CoP. Figure 5 depicts the functions and operation of a CoP.



Figure 5: CoP operation and functions.

We think that for a CoP to be successful, it has to have a formal status in the organization, but members have to feel independent to work and to meet and to be creative. Therefore, we try to formalize the results they already produce before belonging to a CoP and they have autonomy to organize the work inside the CoP.

Another important point in the implantation of CoPs is resources allocated to achieve objectives.

CoPs need financial and material resources but also they need support, coaching and logistic assistance.

To support CoPs, we have implemented talks with researchers with potential to belong to a specific CoP. In these talks we try to explain the benefits of a CoP base on knowledgeable literature and successful cases. We try to fit all these theories on own experience and history, since, as we already mentioned, CoP are not new in IIE.

Thus far we have depicted the regulations and procedure for CoP, in which we tried to sensitize research staff about the impact of CoP in the projects development and in personal development. We have supported the beginning of CoPs, by helping in selection of coordinators and secretaries. Annually, we have met with each CoP to discuss about its results and resources. We have tried to monitor the functioning of the CoP.

#### 4 WEB INFORMATION SYSTEM

In order to achieve goals, CoPs requires some means to support CoPs members collaboration, therefore an information system was developed based on Web technologies.

This system supports CoP members in basic activities, such as to register objectives, active members, technical documents and an activities calendar. Figure 6 shows a screenshot of the information system. Information about Virtual Reality CoP is shown.

The system has facilities to load current technical documents, activity reports and memorandums of meetings agreements and to keep track their lifetime. Moreover, the members can keep their own activity record and a vita which includes their production.

The system has public and private sections. In the public section non-members can ask questions to CoP members, to access open documents and to know current topics being discussed. In the private section, members can initiate blogs, monitoring activity and documents elaboration.

The activities of the projects frequently requires research work field, therefore we provide with the electronic resources for virtual meetings to use when researchers are away from office.

The principal users are: CoP coordinator, CoP secretary, CoP members and manager for the CoP process. A detailed description of the system can be found in (Argotte, 2014).



Figure 6: Communities of practice information system (In Spanish).

## 5 ACTIVITY INDICATORS

Since it is difficult to see whether or not a community of practice is working or it is successful just in terms of learning, we establish a list of indicators of activity and success for each particular CoP. These indicators are not supposed to be completely accomplished, but these indicators are mainly important to know if the CoP requires support or if it has to be reconfigured. Indicators allow knowing whether a CoP is working, how we have to support it and what resources are needed. Some of these indicators are:

1. CoP is composed by coordinator and secretary and at least four additional members.
2. Members understand the CoP mission and aims.
3. Members have elaborated an annual work schedule.
4. Members have elaborated a state and practice of art document and it is annually updated.
5. Members enthusiastically collaborate in the tasks assigned.
6. CoP meets twice a year at least.
7. CoP has generated ideas which have resulted in projects or projects proposals.
8. CoP members have identified and defined an innovative product.
9. CoP has a network of contacts which includes customers, suppliers, specialists, research centers.
10. CoP members have organized events where external experts are invited to share experiences.
11. CoP members have generated ideas, initiatives or proposals, which have led to the development of projects whose products, are liable to be protected by patents or copyrights, or suitable for technology transfer.

## 6 CONCLUSIONS AND FUTURE WORK

The IIE is conscious of the importance of having a knowledge management system and it is concerned about competitiveness and providing innovative products and services. Therefore it has implemented several mechanisms to motivate the generation and sharing of knowledge.

The communities of practice respond to these needs, motivating the knowledge sharing between colleagues. CoPs help to keep the knowledge on the cutting edge, deploy it, leverage it in operations, and spread it across the organization.

We have initiated the process of fostering CoP in the research personnel of the Enabling Technologies Division of the IIE which comprises four departments. Also, we are planning and working on expanding the model to reach the whole IIE to include all business processes.

A Web information system has been used to support CoP work, this system is being updated to include some researcher comments in order to be more supportive and user-friendly. This new functionalities includes emails alarms, chats.

In this paper, we presented the work and results at Enabling Technologies Division.

Communities of practice at IIE are the result of IIE efforts to develop and deliver innovative products and services to its customers; and it is expected CoP are consolidated in a medium term.

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