Title: The challenge of building effective hybrid organizations in Brazil: the experience of the Center of Excellence in Engineering, Procurement and Construction.

Having mastered in developing oil fields in deep water, Petrobras- Petróleo Brasileiro S.A, the biggest oil company in Latin America, is now facing the challenge of operating the new reserves found in the pre-salt layer. According to the company, operating the pre-salt demands a new exploratory model, which means a huge call for research, development and innovation (RD&I) activities. To cope with this knowledge intensive enterprise, the oil company needs to count on a highly qualified and articulated network of suppliers and partners from different institutional spheres and knowledge fields. The company's traditional R&D approach of running collaborative projects with universities, research institutes, suppliers and/or other operators in the oil & gas industry sounds insufficient for such a challenge. The rapid development of the necessary expertise and favorable institutional environment claims for the engagement of Industry, University and Government (U-I-G) in proactive Triple Helix (ETZKOWITZ, 2009) partnerships which favor the information flow among the relevant players and help them generate ideas, optimize solutions and overcome technological and institutional barriers. But bringing these players together and having them collaborate efficiently require special capacities, skills and schemes which are not yet consolidated in Brazilian organizations. Investigating organizational and institutional solutions founded on U-I-G relations thus sounds relevant and urgent.

Since 1996, Petrobras has been supporting a program for the design, customization and implementation of tri-lateral collaborative arrangements - Centers and Networks of Excellence (CNE) – in areas which are critical to the company's competitiveness, such as geochemistry, oil well and pipeline technologies and engineering, and marine engineering, or areas which demand improvement within the company, such as relationship with subcontractors, transport and asphalt. The program called *Prática Centros e Redes de Excelência* - PCREX (PETROBRAS, 2008) is now coordinated by two Brazilian research groups: *Ecentex and Espaço Redes Bahia*, respectively from Coppe/UFRJ, the Coordination of Engineering Post-graduation Programs in the Federal University of Rio de Janeiro, and UFBA – Federal University of Bahia. By applying the PCREX methodology, the *Ecentex* team has oriented the structuring of over 15 CNE, which are either embedded in the company's structure or created as independent organizations.

The PCREX methodology presents guidelines, norms and architectural models, to help create permanent self-sustaining U-I-G networks or hybrid organizations which mission is to maintain or reach supremacy in a certain field, be it technological, scientific, social, cultural or educational. According to the PCREX methodology, a CNE is a combination of knowledge and physical, financial, technological and methodological resources, put together for the development of high quality products, processes and services for the benefit of the partners and/or the society. The PCREX methodology is aligned with the Open Innovation proposal (CHESBROUGH, 2006), since it intends to intensify the inflows and outflows of information and technology, from internal and external sources, in the RD&I activities of the participating organizations.

This article presents the case-study of the Center of Excellence in *Engineering, Procurement and Construction* – CE-EPC (www.ce-epc.org), a hybrid organization which brings together oil companies, EPC companies, universities and technical schools, government entities, professional associations and industry bodies, in an effort to make the Brazilian EPC sector related to the oil and gas industry sustainable and worldwide competitive. Proposed by Petrobras in the 4th Prominp (National Program for the Mobilization

of the Oil and Gas Industry) National Workshop in 2006, the CE-EPC was institutionalized in 2008 with the following vision statement: to be considered the main forum of the Brazilian EPC industry, being a national and international reference to technological and business management in its field. The core idea was to create a consensus space, both physical and virtual, where the CE-EPC members could interact, identify critical issues and bottlenecks, discuss and develop projects of common interest for the improvement of the national EPC and the Oil & Gas businesses. This case-study is part of a comprehensive research done by the *Espaço Redes Bahia* team in 2009/2010 on the performance of CNE in which Petrobras participated. Despite its two-and-a-half years of activities, the CE-EPC case was selected for its complexity and adherence to the PCREX conceptual model and also for it is the only CNE institutionalized as an independent networked organization.

The methodological procedures and instruments used in this qualitative research were a questionnaire and in-depth semi-structured interviews with six members of the CE-EPC board, including its president and executive managers. In order to assess the evolution of the organization, interviews were done in two different moments in time: November 2009 and June 2011. Documentary evidence was utilized as an additional source of information. Considering the collaborative nature of the CE-EPC, the research focuses on studying the collaboration dynamic within the organization. The research objectives are to identify collaborative practices inside the organization, and investigate the enterprise's governance elements and managerial mechanisms that support / hinder collaboration between parties. The research includes analysis of the strengths and weaknesses of the organization concerning collaboration dynamic.

Some of the CE-EPC strengths identified in the research were (1) supportive formal institutional mechanisms which include a statute, a membership contract and a strategic plan; (2) presence of representatives from all the institutional spheres and industries on the board of directors; (3) regularly scheduled meetings; (4) comprehensive use of digital medias; (5) focus on knowledge creation and sharing; and (6) high potential to align efforts and avoid redundancy and noise among partners.

The weaknesses include (1) weak network culture and consequent difficulty to realize the power of cooperation; (2) high technological asymmetry among partners; (3) difficulty to have the members' C (chief) level staff participate in the center's activities; (4) difficulty to obtain partner's commitment to the projects; (5) financial restriction and difficulties to have the parties provide qualified personnel to develop the projects; and (6) little systematization of management practices.

The results obtained by CE-EPC include an online training program on critical technological issues pointed out by the partners, the definition of a collaborative projects agenda, the intensification of university-industry interaction and the practice of networking. Learning to cooperate takes time and efforts but once the partners develop this ability the rhythm of innovation generation tends to grows significantly, therefore, the companies' gains in interacting and networking capabilities are of extreme relevance in this kind of enterprise.

The case-study highlighted the PCREX suitability in fostering Triple Helix partnerships in the form of centers of excellence and also pointed out some barriers for the accomplishment of its full potential. Although collaborative research centers are not exactly a new model of hybrid organization in developed countries (STAL, 1999), they are still not common in Brazil, despite the Government effort to spur U-I-G interaction through the Brazilian Innovation Law (Law no. 10.973/2004). Therefore, the authors of this paper are convinced of the relevance of studying such initiatives and helping improve and disseminate

the methodology so that soon the CNE movement becomes as prominent as the incubator movement in Brazil.

This article comprises of eight sections. After this introduction, there is an abridged literature review on (1) the Triple Helix principles; (2) learning networks; and (3) institutions organizations relations. The PCREX methodology is presented in section 4 and the CE-EPC in section 5. The methodology is briefly discussed in section 6, followed by the case-study in section 7. Finally, section 8 brings conclusion and implications.

TRIPLE HELIX

The Triple Helix approach (ETZKOWITZ, 2009) focuses on University-Industry-Government (U-I-G) collaborative initiatives to foster socioeconomic development through technology, science and innovation activities. The Triple Helix thesis defends that the university is increasingly central to discontinuous innovation in knowledge-based economies since it is the traditional locus of knowledge generation and diffusion.

Etzkowitz (2009) argues that U-I-G hold complementary resources and competencies which should be brought together in a concerted effort to improve the knowledge flow within society. According to him, traditionally rigid university, industry and government boundaries are changing into more porous lines, allowing for enhanced information, knowledge and people transfer. A vigorous interaction of these three institutional spheres favors the creation of Knowledge, Consensus and Innovation spaces. Knowledge spaces consist of a concentration of related R&D activities in a local area: universities, research centers, technology institutes, technical institutes. Consensus spaces are privileged forums where people from different perspectives (public and private sectors and academia) come together to generate, brainstorm new ideas. Innovation spaces are arenas where the goals articulated in the consensus space are realized. The existence of these three spaces outlines the triple-helix model of regional innovation (ETZKOWITZ, 2002).

The dynamic interconnection of U-I-G also favors the emergence of hybrid organizations such as technology transfer offices, business incubators, science parks, collaborative research centers and center of excellence, which facilitate communication, knowledge flow, innovation, and the identification of new business opportunities among the interacting parts. These organizations are hubs that connect university and industry and, sometimes, funding entities, in a collaborative effort to accelerate the rhythm of innovation. They work as consensus spaces where key stakeholders meet, get to know each other better, identify opportunities, build trust and plan joint actions for the future. The government's main role in this arena is to provide an appropriate institutional environment – laws, policies, funding mechanisms, etc. – that offers collaborative initiatives legal support and effective incentive to work. Considering the networked nature of postmodern economy and society, helping local players connect with foreign ones is another key role for the government in this agenda.

The emphasis on university-industry relations highlights the relevance of the debate about University Intellectual Property and Technology Transfer Policies, institutional mechanisms which are crucial for the success of U-I collaborative projects (VAN LOOY, CALLAERT AND DEBACKERE, 2006). Questions concerning patenting and licensing activities, appropriability, knowledge share, and the secrecy – publication dilemma are part of any U-I relation; the partners' ability to deal with these issues may either strengthen or weaken the links of these high potential knowledge and innovation networks.

Despite the apparent benefits of U-I-G interaction, hybrid organizations such as

collaborative research centers and centers of excellence are difficult to set up and manage: they require a whole new set of institutions, practices and values, which support and promote collaboration among independent players that frequently hold divergent interests and viewpoints, different cultures and languages, high technological, financial and knowledge-related asymmetries. The performance of this kind of enterprise depends heavily on the consistency between the type of organization, the institutions, the governance and the management practices, which will be referred to as the ORIGOM coherence from now on, key elements for the promotion of collaboration between players, the main resource and the distinguishing feature of collaborative arrangements.

GOVERNANCE OF HYBRID ORGANIZATIONS

Inter-organizational networks, which bring together key stakeholders and facilitate the flows of information, resources and trust necessary to secure and diffuse learning and innovation, have emerged as a key growth strategy in the knowledge-based economy. Keast and Hampson (2007) argue that the blending of organizations, resources and purposes creates new, hybrid institutional forms that can draw on a mix of contract, structure and interpersonal relationships as integration processes. The governance and management of the responsibilities, relationships and interactions within the arrangement are critical issues for its development.

According to Keast and Hampson (2007), through the interactions between people and organizations in inter-organizational networks, a relatively stable pattern of relationships is formed in which members come to know more about each other and their organizations, common goals are established and trust and reciprocity begins to develop. These interpersonal aspects of networks act as an integrating mechanism to bring together previously disparate and even competing players and their resources and enable members to not only secure resources, take advantage of economic efficiencies or tap into their partners' opportunities but also draw on and leverage off the synergies that are formed to create new and innovative solutions and ideas.

In order to bring different players into transactions, administrators can draw upon three main governance modes or mechanisms of social integration: the hierarchy, the market and the networks (KEAST AND HAMPSON, 2007). The table below sets out the key aspects of each of these governance modes and their idealized associated integration process and management foci.

Table 1: Governance, Management and Integrating Mechanism Schema

Relevant features	Governance mode		
	Hierarchy	Market	Networks
Integration orientation	Authority relationships	Exchange relationships	Social/communal relationships
Key integration mechanisms	Centralized and legitimate authority, rules, regulations, procedures and legislation	Formalized, legal contractual arrangements, arms-length transactions, bargaining	Interpersonal trust, mutuality and reciprocity

Institutional arrangements	Committees, working parties, interdepartmental committees	Business associations, Corporate Boards	Networked arrangements, collaborations, social charters and roundtables
Management focus	Administration	Contracts	Relationships

Source: Adapted from Keast and Hampson, 2007.

However, as markets are perceived as unable to adequately bundle the relevant resources and capacities between science and industry, and complete vertical integration of the hierarchy restricts flexibility and incentives, and the networks of relationships based on trust and reciprocity are often insufficient forces to secure necessary directed outcomes, often a mix of governance modes is employed. Such hybrid arrangements allow for the interaction, often simultaneously, of governance modes resulting in combinations and recombinations of contract, formal structure and interpersonal relations as the linking process for these new institutional arrangements (KEAST AND HAMPSON, 2007).

These authors argue that the ability to mix governance and management elements has engendered hybrid arrangements with some unique characteristics, such as simultaneous competition and cooperation, highly complex structural arrangements, and power and loyalty tensions, that challenge pre-existing management strategies and skills because they are not always synonymous with conventional management approaches. The ability to mould the mix of governance and management strategies for effective outcomes in hybrid organizations is a big challenge for managers who dare coordinate such initiatives.

Building an appropriate institutional environment is a key task for collaborating parties. According to Coriat and Weisntein (2002), institutions – laws, rules, contracts, norms of conduct, customs, taboos, etc. – play a central role in developing collaborative enterprises because they "regulate", both in tacit and explicit terms, the partners' behavior. Institutions impact people's evaluation of the risks and advantages of engaging in cooperative initiatives, an important element when defining the formal institutional mechanisms to rule the relations between the players.

In general terms, institutions can be distinguished between two types: institutions as constraints, "rules of the game", according to which agents operate and coordinate themselves; and institutions as resources to be used by agents. Even in given institutional constraints, a certain level of "discretion" is always observable and *some organizational choices are always still open,* particularly as regards the modes of coordination of information and knowledge inside the organization. Institutions as resources are typically linked to the productions and reproduction of collective goods such as knowledge, safety, competitiveness etc.

Far from being only a system of constraints posed on the agents, some institutions *give birth to entirely new fields of action or new environments* where individuals will be able to develop their abilities. We can take up Searle's distinction (1995) between "standardizing rules" (like the Highway Code) and "constituting rules" (like the game of chess). If we follow this definition, we can say that some institutions aim to set up rules for already existing activities, *whereas others seem to be cut out to create the conditions for new activities to emerge.* This is true for a good many economic institutions. Such is the case for many collaborative research centers which, as they get structured, offer new types of activities, new strategic environments and create new "patterns of behavior". Building an appropriate institutional environment is a sine qua non condition for the creation of new collaborative

patterns of behavior which is essential for a hybrid organization to achieve its goals.

Relationships, governance and management is essential for developing collaboration among parties in a hybrid organization. Only when people connect to each other, there is a possibility that trust is built, resources are brought together, information flows, new knowledge is created and new business opportunities are identified. Getting the parties to collaborate is big challenge in hybrid organizations. The next session focuses on studying the collaboration dynamic in organizational settings.

MANAGEMENT MECHANISMS PRO COLLABORATION

Collaboration happens when two or more people interact and work together towards the achievement of a common goal. The idea in this session is to investigate what interferes with people's disposition to collaborate in organizational settings. According to Barnard (1938), the persistence of cooperation depends on two conditions: effectiveness and efficiency. Effectiveness refers to the fulfillment of the collaboration social purpose. Efficiency refers to the satisfaction of individual motivations. The test of effectiveness is the fulfillment of a common purpose. The test of efficiency is getting enough individual will to continue cooperating. The survival of cooperation, therefore, depends on two interrelated and interdependent classes of processes: (a) those that refer to the system of cooperation as a whole towards the environment and (b) those that refer to the creation or distribution of satisfactions among individuals. According to the literature (DEUTSCH, 1960; SMITH, CARROL e ASHFORD, 1995), the two features which impact the most collaboration effectiveness and efficiency at work are coordination and trust. Coordination allows the strengthening of trust among parties, which is the *sine qua non* condition for intensifying collaboration in hybrid organizations.

COORDINATION

Since the old classic work of Fayol (1916), coordination is considered one of the management functions, along with planning, organizing and controlling. As noted by Thompson (1967), the activity of coordination arises from the need to manage the interdependencies generated by the division of labor. Also according to this author, when rationality prevails, the organizational structure is geared towards reducing the costs of coordination.

In his work on the structuring of organizations, Mintzberg (1995) agrees with Thompson on the relationship between the structure of the organization and the coordination of interdependencies caused by the division of labor. Mintzberg (1995) proposed five basic mechanisms of coordination:

- **Mutual Adjustment:** coordination is accomplished by the simple process of informal communication. It is used in both very simple processes - like coordinating the handwork done by two people - and in very complex situations - such as shared research projects.
- **Direct supervision:** coordination is performed by a person who has responsibility for the work of others, providing instructions and monitoring actions.
- **Standardization of work processes:** the activities that make up the task are specified in pre-programmed procedures.
- **Standardization of outputs:** the results of the process are specified and can be controlled, like the dimensions of a particular product.

- **Standardization of workers' skills (and knowledge):** the type of training required to perform the job is specified.

Based on this categorization of coordination mechanisms, Mintzberg (1995) proposes a dynamic approach for the changes in the coordination process. According to him, the more complex the work grows, the coordination mechanism changes to facilitate it in such a way that an initial mutual adjustment choice, changes into a direct supervision model, and then to standardization alternatives, finally reverting to the original mutual adjustment mode if work becomes very complex. Recent attempts to develop more intense forms of cooperation, including the use of Web 2.0 tools, highlight the high potential of making informal interactions easier and stronger. Spontaneous cooperation has become a key input to achieve high performance teams focused on change and innovation.

In the context of hybrid organization, three features of coordination are particularly relevant: conflict management, communication and leadership.

Conflict Management

Considering that in social settings cooperation coexists with competition (Deutsch, 1949), the existence of personal, intra-group and intergroup conflicts is kind of natural; in organizational settings, where power relations and dispute for positions, promotions and pay rises are part of everyday life, conflicts are part of the game.

According to Coleman (2006), power plays a central role in most conflicts. He distinguishes between two categories of power: (a) 'power over someone' is the possibility of compelling someone into doing something. This viewpoint highlights the competitive and coercive nature of power; (b) 'power with someone' emphasizes the effectiveness of cooperative action. It can arise from cooperative conflicts.

Researches show that people who hold high power tend to appreciate power, use it, justify it and do everything to keep it. They pay little attention to powerless people and have an innate tendency to dominate them. Groups with high power tend to alienate those with lower power thereby causing resistance. Groups with low power tend to develop limited vision and discontent. They can express that discontent by putting pressure on groups with less power than them, reducing the possibility of gaining power through cooperation and coalition with other groups.

Communication

Ostrom (1998) argues that no other variable has as strong and consistent effect on the level of cooperation as frank and direct communication between the potentially cooperating parties. With repeated opportunities to see and talk to others, a participant can assess whether he or she trusts the other enough to try to reach an agreement on the level of collective effort and its allocation.

The importance of communication for coordination comes from the fact that when individuals have an individualistic orientation, the exchange of clear information about the conditions of engagement in cooperative actions can overcome barriers to cooperation. To do so, communication must be reliable for both parties. If not, competitive behavior tends to predominate (DEUTSCH, 1960). The same can be said about communication emitted directly from those who exercise the function of coordination in cooperative initiatives, since decisions can only be implemented if individuals accept them and are willing to cooperate and take them on.

Careless communication can exacerbate conflict. Considering that communication is a highly cooperative process, Krauss and Morsella (2006) propose five principles to reduce conflict:

1. Avoid communication channels with high noise ratio. If it is not possible, be redundant and send the message through different channels.
2. Effective communication requires a common knowledge base. The existence of this common ground should be verified when communicating.
3. The communicator must take into account other people's perspectives when formulating his / her message. He / she must be an attentive listener.
4. In conflict situations, ensure that the conditions for effective communication are present.
5. Pay close attention to all forms of communication, since content may easily be changed or obscured.

According to Chatterjee (2009), communication is the main integrating element of a person in the organizational environment, followed by the attitude of the leadership, reward systems and training. The author's research revealed that communication is perceived by employees as the main factor impacting trust building in workplace.

Leadership

Granton (2011) points out that the conversion of a person's propensity for cooperation into effective collaborative action depends to a large extent on the signals that he / she receives from the organization. These signals are, to a significant extent, conveyed by managers through the exercise of leadership. The author observed a strong relationship between leadership styles and the negative effects of failures in collaborative processes. Schein (2010) believes that leadership is the fundamental process through which cultures are built and modified. An effort to intensify cooperation in an organizational environment requires reshaping traditional hierarchical power structures. The ability to lead in an environment of distributed power is an indispensable attribute of leadership in networked organizations. Autocratic, centralizing leaders, protected behind the command-control logic, inhibit both collaboration and the full use of individual skills (Schein, 2010), and are in frank misalignment with the current requirements of flexibility, integration and agility. To change behavior and get out of the comfort zone are major challenges for leaders who operate in complex environments, in situations of change and innovation.

In collaborative arrangements, power is not a feature, quantity or capacity that can be delegated or distributed according to the will of the leading parties: power emerges from a negotiation process through which individuals and organizations demonstrate their own ability to act, react and interact in the network. Power has a relational nature. The influence of a node in a network can only be understood in terms of its relational interdependence to the others. (Beirne, 2006) The knowledge-based economy, sharing is a source of power.

TRUST

Trust can be defined as the willingness of a person to be vulnerable to someone else's actions, based on the expectations that the other entity will play a specific action, which is important for the person who trusts, without having to monitor or control the trustee (MAYER *et. al.*, 1995). From this definition, one can infer that a trustful environment supports cooperation by reducing the uncertainties and risks in interpersonal cooperative relationships. Confidence in the trustee's reciprocation is a founding element of collaboration: if the interacting parties try to obtain maximum gains with minimal personal costs during a collaborative process, regardless of the costs and gains of the other parties, the process tends to be interrupted.

Jones and George (1998) propose that trust is a psychological construct, the experience of which is the outcome of the interaction of people's values, attitudes and moods and emotions.

- **Values** are general standards or principles that are considered intrinsically desirable ends, such as loyalty, helpfulness, fairness, predictability, reliability, honesty, responsibility, integrity, competence, consistency and openness. According to Rokeach (1973, *apud* JONES AND GEORGE, 1998), typically, people incorporate values into their value system and prioritize them in terms of their relative importance as guiding principles. A person's value system guides behavior and the interpretations of experience by furnishing criteria that the person uses to evaluate and make sense of events and actions in the surrounding world. That value system determines which types of behaviors events, situations or people are desirable or undesirable. Values contribute to the generalized experience of trust and can even create a propensity to trust (MAYER *et. al.*, 1995) that surpasses specific situations and relationships.
- **Attitudes** are the means through which people define and structure theirs interactions with others. Attitudes are composed of knowledge structures that contain the specific thoughts and feelings one has about other people, groups or organizations. The attitudes that people form toward each other in an organizational context are likely to contain information concerning the other party's trustworthiness.
- **Moods and emotions** capture how people feel as they go about their daily activities, including interacting with other people; they are affective states or feelings that provide people with information about their ongoing experiences and their general state of being. Moods and emotions affect ongoing processes either positively or negatively. Experiencing positive moods or emotions may cause one to have more positive perceptions of others, resulting in a heightened experience of trust in another person. Conversely, negative moods and emotions may add a negative tone to interactions and may result in an individual perceiving others as less trustworthy than they actually are.

These components are interactive, *i.e.* they reinforce each other. Values provide standards of trust that people strive to achieve in their relationships with others. Attitudes provide knowledge of another person's trustworthiness, and current moods and emotions are signals or indicators of the presence and quality of trust in a relationship. A trustful environment which favors high quality cooperative processes comprises of shared values, confidence in each other's trustworthiness, favorable attitudes and positive experience in the context which generate positive moods and emotions towards each other.

Modeling trust from a symbolic interactionist perspective, Jones and George (1997) assume that (1) people act in social situations based on the meanings that they have learned to associate with them, and (2) these meanings are acquired by interactions with other people so that a definition of the social situation is created over time. More specifically, in any particular encounter two (or more) parties mutually develop and negotiate a definition of the social situation. This joint creation of the definition of a social situation involves each party trying to understand the other party's expectations, needs, and goals. Each party brings its own set of interpretive schemes to the social situation. To the extent that they use or develop similar interpretive schemes to define the social situation, the parties will tend to agree on their perceptions of the level of trust present in the social situation, so adjustment to each other takes place.

Based on these assumptions, Jones and George's model of the evolution of trust admits three levels of trust:

- **Distrust**: since people use their own value system to decide if the stranger is fit to transact with, perceptions of value incongruence can quickly lead to distrust. Nevertheless, there may

be cooperation even in the presence of distrust. That might be the case of two political parties that, even in the absence of trust, decide to cooperate to compose a government. In the organizational environment, however, distrust negatively affects the quality of cooperation.

• **Conditional trust**: a state of trust in which both parties are willing to transact with each other, as long as each behaves appropriately, uses a similar interpretive scheme to define the situation, and can take the role of the other. In conditional trust attitudes of one party toward the other are favorable enough to support future interactions; sufficient positive affect and a relative lack of negative affect reinforce these attitudes. Conditional trust usually is sufficient to facilitate a wide range of social and economic exchanges; it is consistent with the idea that one of the bases for trust is knowledge or positive expectations of the other. Indeed, the most common form of trust existing in organizational settings is probably conditional trust.

• **Unconditional trust**: shared values now structure the social situation and become the primary vehicle through which individuals experience trust. With unconditional trust, each party's trustworthiness is now assured, based on confidence in the other's values that is backed up by empirical evidence derived from repeated behavioral interactions. Positive affect increases as positive moods and emotions strengthen the affective bonds between parties and bolster the experience of trust. When unconditional trust is present, relationships become significant and often involve a sense of mutual identification. In organizational settings, unconditional trust is associated with cooperation within high performance work groups.

It is important to understand that this model of trust is dynamic: in social situations, people can move from lower levels to higher levels of trust, and vice versa. In fact, trust can evolve positively if the parties meet their expectations about the each other's behavior throughout a cooperative process. Situations are understood and negotiated favorably, creating an environment where positive attitudes, and moods and emotions lead to significant recognition and respect to mutual values. Conversely, changes in attitude, motivated by negative moods and emotions, can alter people's perception of share values and understanding and push interaction from an unconditional trust environment to a conditional trust or even distrust context. Considering this dynamism, the three levels may be seen as references in a potentially useful scale to diagnose and manage the level of trust in work situations.

Once one accepts that cooperation intensity and quality depends upon the level of trust among participants, one can infer that unconditional trust is more appropriate when a company relies on highly cooperative teams for competitiveness gains. According to Jones and George (1998), the effects of unconditional trust on interpersonal cooperation and teamwork are the following:

• Broad role definitions: parties tend to go beyond their formal duties.
• Communal relationships: based on mutual help and individual responsibility for the group's well being.
• High confidence in others: necessary to develop synergy within the group.
• Help-seeking behavior: no fear of negative evaluation.
• Free exchange of knowledge and information: knowledge and information are not considered power instruments but endless resources of change and innovation: the more one shares them the greater they grow.
• Subjugation of personal need and ego for the greater common good: confidence on reciprocity.
• High involvement: feeling that everybody is working towards a common goal and that each one's contribution is strongly related to accomplishing that goal.

Coordination and trust mutually reinforce each other: while on the one hand coordination allows the strengthening of trust, on the other hand the effects of unconditional

trust on interpersonal cooperation and teamwork facilitate the coordination activity and reduce management costs. The goal of this study is to identify coordination practices which contribute for trust development.

MODEL OF ANALYSIS

The main objective of this qualitative research is to analyze the governance elements and management mechanisms which favor and hinder collaboration at the CE-EPC. To do so, a model of analysis was developed based on the literature review.

Figure 2: Model of Analysis
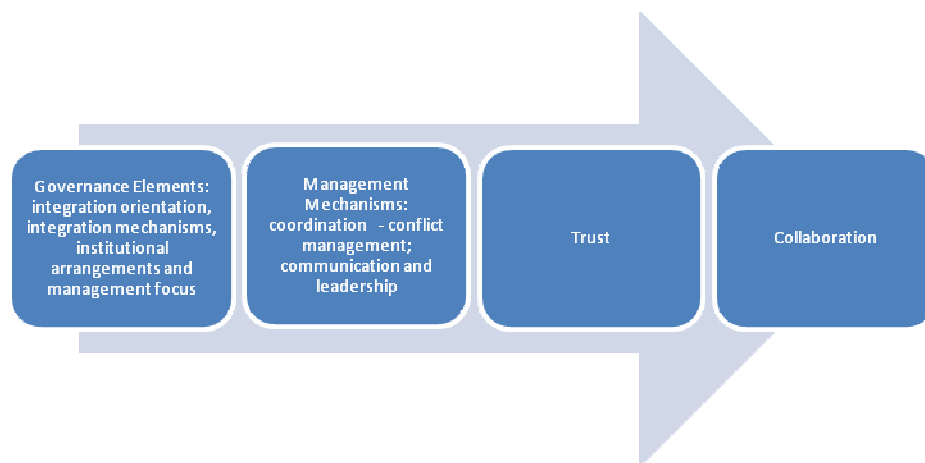
Source: Authors (2011)

THE PCREX METHODOLOGY

The first version of the *Prática Centros/Redes de Excelência* – PCREX Methodology, developed by Petrobras with academic support by Coppe/UFRJ, was issued in 1996 and the last review was done in 2011. The PCREX presents guidelines to create Centers / Networks of Excellence which compulsorily bring together university, industry and government institutions, both national and foreign, in an effort to reach and maintain supremacy in a chosen field, be it technological, scientific, social, cultural or educational. (Petrobras, 2008)

The PCREX recommends the creation of sustainable permanent trilateral networks primarily focused on R&D, education and training. A PCREX CE should carry out actions and projects to (i) solve existing problems, (ii) maintain or reach a leading position in local and/or global level and (iii) introduce scientific or technological breakthroughs in the market. The PCEX methodology defends that cooperative, interactive processes between collectives of key stakeholders generate better distributed results. At the firm level, a PCREX CE should search for the technological vanguard and for the expansion of company participation in the technology and innovation markets.

A PCREX CE is described as a combination of knowledge and physical, financial, technological and methodological resources, organized by leaders that may come from any of the three institutional spheres, aiming at the promotion of social and economic development. According to the methodology coordinators, it applies to a wide spectrum of themes from firm-related questions to national priorities and global challenges. By bringing together U-I-G, a PCREX CE intends to optimize and multiply tangible and intangible resources, stimulate

technical cooperation, access strategic information, diversify sources of information and knowledge, reduce project time and cost, access new markets, enter new businesses, create high-tech institutions and laboratories, invest in professional and academic education, participate in a greater number of technical-scientific events, trade fairs and forums and publish technical-scientific paper. Interaction with the Government is considered vital to the success of a PCREX CE for the participative development of efficient incentive programs and supportive regulatory environment, access to public and foreign funding, alignment with Public Industrial and Social Policies, etc.

In principle, a firm-led PCREX CE represents a hybrid organizational mechanism which facilitates the development of human potential, company innovation process, company-society integration, and current company business and new opportunities, leading to better corporate results. A PCREX CE must be aligned with the company's strategic plan and able to contribute to achieving corporate goals.

The start-up of a PCREX CE comprises of (1) the self-selection of Strategic Partners or "Anchors" and (2) the setting up of a Management Council and an Executive Committee whose members are chosen by the founders of the enterprise and may include professionals pointed by the Anchor Organization(s). Depending on the case complexity, the structuring of a Technical Support Group or a group of recognized experts is also suggested. The coordination of PCREX initiatives can be networked, centralized on the strategic partners, or attributed exclusively to the lead organization (the entity which proposed the creation of the initiative), depending on parties' agreement. A PCREX initiative may be a traditional physical organization or a virtual entity; one way or the other, it should define its mission, vision and unifying goals clearly. The operation of a PCREX CE is based on the development and realization of structural projects by a network of partners of recognizable competence in the theme.

THE CE-EPC

The Center of Excellence in *Engineering*, *Procurement and Construction* – CE-EPC, structured according to the PCREX methodology, is a public interest civil society organization (OSCIP) which comprises three oil companies – Petrobras, Shell and Statoil, 47 EPC companies, 19 universities and technical schools, and 19 government entities, professional associations and industry bodies, in a collective effort to make the Brazilian EPC sector related to the oil and gas industry sustainable and worldwide competitive. The project benchmarks were the American organizations Construction Industry Institute (CII), based at the University of Texas at Austin, and the Independent Project Analysis (IPA) Institute, and the Petrobras Center of Excellence in Pipelines (Cedut). By bringing together players that share common interests and complementary knowledge and resources, the CE-EPC intends to develop synergy in a collective effort to generate solutions for a wide variety of problems faced by the EPC supply chain in planning and executing facilities projects. It is expected that the interaction within the CE facilitates identifying bottlenecks, and developing innovative approaches to human resources qualification, and the application of new technologies and best management practices.

The CE-EPC founding assembly took place on June 23, 2008 at Petrobras headquarters in Rio de Janeiro, Brazil, after a one-and-a-half-year planning process led by Petrobras, the proponent of the initiative. At the assembly, the parties signed the CE-EPC statute. The CE was established under Prominp (www.prominp.com.br), a governmental program for the mobilization of the national oil and natural gas industry, coordinated by the Brazilian Ministry of Mines and Energy. The Prominp was institutionalized by the Federal

Government in 2003 aiming at maximizing the participation of the national goods and service industry in the implantation of oil and gas projects in Brazil and in other countries, on competitive and sustainable basis. Besides the significant support by Prominp, other entities whose support was of great relevance for the consolidation of the CE were IBP – the Brazilian Petroleum Institute, FIRJAN – the Rio de Janeiro Industries Federation and SENAI, the arm of the National Industries Confederation System dedicated to generating and diffusing knowledge for industrial development.

The CE is installed in a set of offices lent by FIRJAN, a member of the CE. The organizational structure is composed of the general assembly, an advisory council, a supervisory board, a board of directors, an executive director and a support team, a project management committee, and a committee of technology transfer and communication. The general assembly appoints the members of the board of directors, among whom the president and the vice-president are elected for a two-year period.

The CE-EPC strategic focuses are (1) to reach international standards of excellence in EPC; (2) to expand the participation of its members in the global market; and (3) to generate and preserve relevant knowledge. The strategic focuses guide the definition of the project themes and training activities. The CE management guidelines are (1) strong strategic alignment of the project portfolio; (2) participation and accountability; (3) intense communication; (4) integration of university, EPC and oil companies; and (5) knowledge application.

Regarding funding, the administrative costs are covered by the payment of annuities by members, and the sale of services, namely, lectures and online mini-courses on topics of interest for the EPC industry. As for the annuities, the oil companies sponsor 50% of the total annual budget and the other entities pay the other 50% (two different fees are established, according to the organization income). Universities and technical schools are free of charge. The projects have their own budgets: most of them are funded by the operators, but public funding is also accessed through projects presented by universities. Until June 2011, Petrobras offered additional support by having three of its employees and four of its interns work for the CE.

CASE STUDY **Governance elements**

The CE-EPC is hybrid in two senses: it molds players from **different institutional spheres** (industry, academia and government) into a dynamic **network** aimed at improving collective productivity. The organization is charged with a great integrative responsibility. The players brought together by the CE-EPC initiative used to interact in market-like relations but then realized that only a cooperative, integrative effort could generate the collective improvement necessary to meet the national challenges and to compete in the global market. Bringing such a diverse set of actors together into an environment that stimulates information flows and knowledge creation requires the development of a mixed hierarchy-market-network governance model and new management strategies and practices.

Regarding integration orientation in the CE-EPC case, integration is mainly motivated by shared belief and interest in self-improvement through collective development. The participation of the oil and gas companies (the main contractors) in the endeavor is a relevant source of motivation for EPC firms' membership. It is considered a unique opportunity to connect with key players in the oil and gas industry and its supply chain, multiply businesses, access relevant knowledge, broaden personal network and strengthen existing links. In this business-oriented network, membership is not oriented by social or communal relationships (KEAST AND HAMPSON, 2007), but by interested rational decisions.

The CE-EPC relies on formal rules and legal contractual arrangements as integration mechanisms. The rules and regulations which mold the parties' participation and interaction within the CE-EPC are institutionalized in written documents. The parties' rights and obligations, as well as the expected behavior, sanctions and penalties, are defined in the CE-EPC statute and internal bylaws. Membership requires the signature of a "membership term". Although formal instruments are used for member integration, the interviewees understand they are not enough to push the CE into dynamic operation: interpersonal trust, mutuality and reciprocity are essential elements to spur information flow and resources combination, to ignite synergy in the network and, therefore, augment its chances of realizing its full potential.

The CE-EPC institutional arrangement includes the General Assembly, composed of representatives from all member-organizations; the Board of Directors, which comprises four representatives from the EPC industry, three from the oil and gas industry, two from academia and one from IBP; the advisory council, composed of ten representatives from professional associations and industry bodies; and the supervisory board, which has four members: one from the oil industry, one from university and two from industry bodies. The two technical committees report to the executive manager, who reports to the Board of Director. The General Assembly (GA) is the supreme organ of the organization, the one that appoints and removes the Directors, the President and the Vice President. The GA also approves, disapproves, proposes and modifies critical issues such as the budget, the strategic plan, the project portfolio, the statute and the bylaw. Another relevant institutional aspect is the alternation of Oil & Gas – EPC players in the presidency every two years. The competencies of all the administrative bodies are defined in formal instruments. The CE institutional arrangement reinforces the networked nature of the initiative, which clearly prioritizes participation and decentralization, despite the big technological, financial and managerial asymmetries among members.

Considering the CE complexity, a lot of attention is given to its administration and legal contractual arrangements, however, the interviewees understand the most relevant management focus is the relationships among members within the CE. The success of collaborative arrangements depends greatly on the quality of the relationships within the organization. When parties engage in direct relationships with one another the chances of identifying commonalities and complementarity grows higher as well as the possibility of assessing how trustworthy the others are. Effective cooperation, which involves sharing resources, co-deciding and co-creating, only happens in trustful environments and good quality relationships, based on truth and ethics, favor the evolution of trust among collaborating parties in such a way that initial distrust may evolve to conditional trust and even to unconditional trust, the ideal situation in collaborative endeavors. The CE-EPC institutional environment seems to favor the development of cooperative relationships. Not only does it enable and encourage the direct and indirect participation of all members in the CE activities, but it also emphasizes that participation and cooperation are duties of all members. Rather than constraining cooperation, the CE-EPC institutional environment supports collaboration and therefore may be considered a relevant resource. Opportunities for face-to-face interaction include the annual meeting of the General Assembly, technical lectures by invited experts and the participation in project development. The Board of Directors meets twice a month. Virtual interaction is also stimulated: in the CE-EPC website there are discussion forums where members can exchange experience and learn with each other. The online mini-courses are another opportunity for people to connect and interact using the web.

Management mechanisms

As highlighted in the model of analysis, three aspects of coordination were investigated by the researchers: conflict management, communication and leadership.

Despites the asymmetry, the heterogeneity and the different demands among members, no conflict was reported by the interviewees, which may indicate a shared belief in the relevance of the organization and the value of participating, and a tacit approval of its management.

The interviewees understand the central role of free direct communication among members for the intensification of collaboration within the CE. The most used means of communication are the telephone, e-mail, video conference and website.

Regarding leadership, the role played by the executive manager is of extreme importance for the success of the initiative. The interviews reveal the executive manager is aware of his role as a facilitator, an articulator and an interaction booster. He realizes his greatest challenge is to have people participate more dynamically in the CE activities. Although the members seem to support the initiative, it has been difficult to have them engage in project development, which has been done mainly by the associated universities; nevertheless, members have been cooperating with information and allowing access to their facilities. The executive manager believes there should be more opportunities for face-to-face interaction among members and, in June 2011, he was negotiating with the Board of Director the possibility of having two General Assembly meetings a year. He also proposed a monthly meeting where two to three members with complementary competences would get together to discuss and identify collaboration opportunities. The proposals were being analyzed by the Board by the time of the research.

CONCLUSION

The case-study highlighted the PCREX potential to foster hybrid collaborative initiatives and also pointed out some barriers for the full accomplishment of their goals. A weak culture of collaboration was the greatest difficulty identified by the researchers. Collaboration competes with ordinary demands. The lack of positive previous experiences with cooperation together with a lifelong practice of market competition makes it hard to get members to dedicate attention to a new working logic. But collaboration has high transformative potential and since its practice is learned and exercised, a virtual feedback loop is activated and collaboration competencies are developed and consolidated. Trust is essential for collaborative initiates and, therefore, communication and relationship management are the core competencies for network managers.

Some of the CE-EPC strengths identifies in the research were (1) the diversity of members in the CE-EPC directory and the alternation of players in the presidency; (2) the participative process used for building the project agenda; (3) its connection to Prominp; (4) the development of its strategic planning; (5) the availability of a website and virtual forums; and (6) its potential to align efforts and avoid redundancy and noise among partners.

The weaknesses include (1) financial restriction and lack of available personnel to develop the; (2) high technological asymmetry among partners; (3) weak culture of networking and difficulties to realize the power of cooperation; (4) difficulty to obtain partner's commitment to the projects; (5) difficulty to have the members' C (chief) level workers participate in the center's activities; and (6) little systematization of management practices and knowledge management systems.

The results include an online training program on critical technological issues pointed out by the partners, the definition of an agenda of collaborative projects, the conclusion of two of these projects, the intensification of university-industry interaction and the practice of networking. Learning to co-operate takes time but once the partners develop this capability the rhythm of innovation generation tends to grows significantly, therefore, the gains in interacting and networking are of extreme relevance in this kind of enterprise.

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