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Innovation in Clusters: Proposal for an Analysis Framework

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***Abstract*— Recently, several countries have based their development strategies on "Clusters". These new forms of organization aims to develop and strengthen the innovation capacity of firms , and beyond, their competitiveness and even the attractiveness of their territories, based on cooperative actions between the various partners.**

This article aims to analyze the process where the actors, involved in an inter-organizational network, and in particular a cluster, implements ways and cooperation resources, and share the knowledge.

We propose an analysis framework to contribute to the understanding of the dynamics of innovation within a cluster. It is thus a matter of determining the elements and trajectories which compose this process of collaborative Innovation in an operational vision.

***Keywords*— Clusters, Innovation, Collaboration, Coopetition, Knowledge, Resources, Skills, Capacities.**

I. INTRODUCTION

In an increasingly competitive global environment marked by the complexity of innovations, the cooperation of innovation between companies has multiplied and became a privileged way to carry out their development and growth strategies.

It seems difficult today for a company to innovate outside inter-organizational networks (Poles of competitiveness, clusters, district, etc.). In fact, innovation and cooperation are considered as "an inseparable couple" [1].

In this context, the concept of "Cluster" was popularized in 1990's, by Michael Porter, professor at Harvard Business School, by defining it as " a Geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also cooperate" [2].

Indeed, clusters are centered on the main notion of networks between companies, research centers and training institutions. The objective is the collaboration of all the partners around high value-added collaborative projects to develop their competitiveness, visibility and attractiveness.

Thenceforth, Clusters should be able to innovate through cooperation between the actors. Collaboration and cooperation within clusters is based on a balance between cooperation and competition, which is called "coopetition"[3].

It is therefore important to understand how various and autonomous organizations can develop collaborative projects and set up innovations.

II. CONCEPT OF CLUSTERS

The concept of cluster emanates from research in industrial and space economics.

In 1890, the English economist Alfred Marshal had emphasized the advantages of the concentration of economic activities within the "industrial districts". The notion of "industrial districts" was adopted and applied in 1979 by G.Becattini in Italy, defining it as:

"A socio-territorial entity, characterized by the active presence of a community of people, and a population of companies in a geographical and historical given space" [4].

But it was in 1990 that the cluster concept was popularized by Michael Porter, a professor at the Harvard Business School, defining it as " a Geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also cooperate" [2].

Porter's model is based on the search for competitive advantages that are obtained through the interactions between four complementary factors that constitute the regional competitive advantage, summarized by Porter's "diamond": Resources, political, legislative and economic environment, a local market of quality, a local rich fabric of suppliers and related industries. This model is based on proximity and works best when the actors are grouped geographically.

Moreover, clusters are only one term among others, used to describe the phenomena of agglomerations and concentrations observed in the countries. Thus [5], distinguishes four types of territorialized forms, taking into account, on one hand, the composition of the members of the structures and, on the other hand, the more or less emergent

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character of the collaboration or, on the contrary, imposed by these organizations. Reference [5] proposes the following comparative table:

TABLE I
FORMS OF TERRITORIAL ORGANIZATIONS

Collaboration is recognized and strengthened by public authority	Collaboration is desired by the actors themselves	Collaboration is recognized and strengthened by public authority	
The partners are all companies	Industrial districts	Local Productive System	
The partners are diverse organizations (companies, teaching and research organizations, support organizations, etc.)	Clusters	Poles of competitiveness	

However, in the literature, there is no uniform definition of the cluster concept. The term is sometimes used with different meanings [6].

Given the diversity of cluster definitions, in this article we refer to the Moroccan clusters that are close to the French competitiveness poles. Nevertheless, we remain aware of the differences that may exist between the different terms used in the literature (district, cluster,..) and therefore we can apprehend the concept of "Cluster" as:

"The combination, over a given geographical area, of companies, training centers and public or private research units, engaged in a partnership approach aimed at creating synergies around innovative projects commonly carried out in direction of a given market (s) "[6].

The emphasis on organizing collaborations through structuring and federating innovation projects is precisely what distinguishes the poles of competitiveness from the industrial districts and even clusters popularized by Porter. Compared to the latter, where it is the actors themselves who implement specific organizational patterns, the poles of competitiveness have an obligation to set up a governance body that is responsible, for steering these partnerships [7].

III. COLLABORATION WITHIN CLUSTERS : TOWARDS COOPETITION

The main task of the clusters is to detect and serve as a catalyst for the development of collaborative projects with high added value. In these spaces, the notions of partnership and collaboration are particularly important.

The Relational View focuses on partnerships as a superior source of value creation and inter-organizational competitive advantage. This perspective argues that a firm's critical resources exceed its boundaries and may reside in its relationship with its partners [8]–[9]. This relationship allows organizations to receive an annuity, which can only be exploited jointly by firms. Cited by [10].

Generally, collaboration within clusters is based on a balance between cooperation and competition, which is called "coopetition".

The concept of coopetition has been introduced in the field of strategic management by Brandenburger and Nalebuff [3].

As a matter of fact, Porter hypothesizes that the co-location of firms gives rise to behaviors combining cooperation and competition (designated by coopetition). These firms can cooperate mainly during the upstream phases of research and development, while competing during the downstream marketing phases [11].

Subsequently, several authors affirm that companies have an interest in seeking both the advantages of competition and those of cooperation [12]. The advantages of competition are the stimulation of the search for new productive combinations, generating of annuity, and those of cooperation are access to rare and complementary resources [13].

In short, coopetition implies simultaneity of competition and collaboration [14]. The figure 1 provides a simplified representation of the concept.

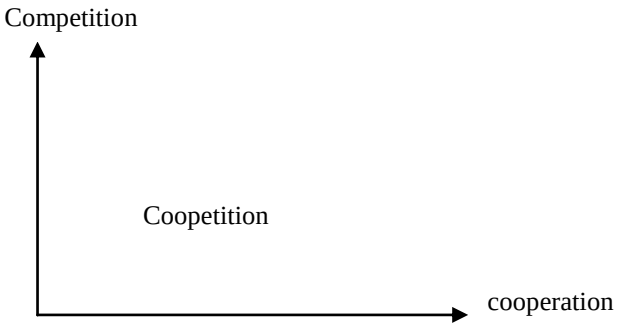

Fig. 1 Simplified representation of coopetition

IV. CLUSTERS: COLLABORATIVE SPACES FOR INNOVATION BASED ON KNOWLEDGE SHARING, RESOURCES AND SKILLS

According to [15]: "Innovation, knowledge creation and learning are all best understood if seen as the result of interactive processes where actors possessing different types of knowledge and competences come together and exchange information with the aim to solve some technical, organizational, commercial or intellectual problems".

To the extent that innovation is increasingly the result of a combination of multiple knowledge and know-how, its conception today is essentially based on the existence of various cooperations. The dynamic of innovation can only take shape if there is a pooling of resources mobilized [16].

Clusters ultimately present themselves as a system that starts from exchanges between actors towards increasingly efficient forms of joint management of resources, knowledge and skills.

Innovation in clusters or poles in general can be perceived from different angles, so we focus on knowledge, resources and skills.

A. Approach by resources and skills

In an inspired logic of resources theory, if we consider innovation as the product of the original combination of resources and multiple skills, location within the same geographical cluster allows firms to have access to complementary assets to their core business [16] – [17], cited by [18].

Indeed, the role of the clusters is the networking of the resources and skills necessary for the implementation of the innovation process. The aim is to pool skills in different organizations and make them coherent in the context of collective projects [19].

Reference [19] emphasizes the existence of so-called "synergistic" strategic capacities, ie resources and skills owned by companies, but only revealed by contact with other firms. The role of the cluster would then be to make these capacities emerge. The ability of the cluster to develop members' resources and skills would then constitute its "core competence" [20].

The concept of strategic capacity is used to understand how resources and skills are combined between companies that are members of the poles of competitiveness. This combination is materialized in collective R & D projects [19].

Reference [19] distinguishes two specific processes of combining resources and skills. The first can be described as a bottom-up process. In this case, the companies themselves, through their own knowledge of resources and skills available within a cluster, will even organize their combination in the framework of special arrangements. In this case, the dynamics of R&D projects are based on the nature of the interactions between the stakeholders and on forms of relational, cognitive and geographical proximity [21] – [22].

In the second process, the actors in charge of pole animation (operational governance), will propose to make partnerships between members on the basis of resources and skills identified and immediately available. This process can be described as "top down". Indeed, in this perspective, the role of the cluster is the implementation of incentive mechanisms to improve the interactions between the actors of a territory in order to make emerge R&D projects. These R&D projects therefore constitute a collective learning process that can help build specific local competences. These R&D projects therefore constitute a collective learning process able to promote the establishment of specific local competences [21].

In the approach by resources, the strategic capacities possessed by the enterprise are by nature "idiosyncratic", that's mean, they are inherently specific to the firm (they are a function of knowledge and of the experience accumuled). Their heterogeneity and their immobility is the condition of obtaining a lasting competitive advantage [23].

Thus, the challenge for the cluster will be to succeed in combining resources and skills that are by nature anchored in organizations and protected from competition [19].

B. approach by knowledge

The importance given to knowledge and its role in the dynamics of innovation is far from recent. Indeed, knowledge is considered to be the main strategic resource of the cluster [7].

The knowledge-based approach draws its foundation from work on national innovation systems, regional systems, Learning Regions and has been extended by the Knowledge Based View of Cluster. The latter emphasizes the role of tacit and explicit knowledge in the emergence and growth of clusters [24].

Indeed, belonging to a network can allow both the dissemination of existing knowledge and the access to new knowledge.

Concerning the circulation and dissemination of existing knowledge, the clusters thus materialize the idea that the relating of innovation actors can stimulate the diffusion of knowledge [25].

In the Knowledge Based View of Cluster approach, personal and organizational contacts are seen as a necessary element for the transfer and dissemination of knowledge.

Similarly, multiple exchanges, formal and informal, sharing of experience between cluster members, but also within inter-organizational networks that are created [26]–[27] represents a greater potential for access and transfer of knowledge, thus promoting innovation [7].

However, [28] argues that the dissemination of knowledge is a necessary but not sufficient condition for innovation. Networks can also be spaces for the creation of new knowledge.

In this perspective, the role of clusters is to stimulate the accelerated creation of new knowledge, which is a source of innovation for co-located firms [29]. And the focus is not on how knowledge flows but how it is transformed to lead to innovation.

Most often this transformation and production of knowledge is thought in terms of combination of knowledge [28] – [30].

This process of producing knowledge shared by the actors of innovation constitutes the interactive learning [31]. The latter is based on the existence of intra- and inter-organizational institutions (routines, norms, Conventions) regulating collective action as well as a tacit mechanisms facilitating the absorption of codified knowledge [32]. This learning process is important for innovation.

In the end, however, the potential of cooperation should not be thought of as the simple addition of the knowledge constituting the knowledge vector of each actor involved. The role of clusters will also be to combine this knowledge in order to create new ones.

V. COLLABORATIVE INNOVATION: TOWARDS AN ANALYTICAL FRAMEWORK

The analysis framework proposed to contribute to the understanding of innovation dynamics within a pole or cluster considers the interaction of the process with the context in which emerging and developing innovative projects. This analytical framework makes it possible to better understand in which context an innovation appears and develops within a cluster. Thus, we highlight the necessary conditions, the mechanisms implemented, the combination of resources, skills and the transfer of knowledge, etc and this in an operational vision.

The proposed framework is divided into four organizational schemes: prerequisites, mechanisms, process and results.

A. The Prerequisites

Prerequisites are the conditions necessary for the success of collaborative innovation.

The literature emphasizes trust as a necessary condition for innovation within clusters.

Indeed, [33] consider that the territorial anchoring of the companies in the cluster favors the development of relations of trust between the members. While encouraging learning, trust allows and reinforces cooperative behavior.

Thus, trust between individuals sharing a common set of references (culture, language, norms, values) is reflected at the level of organizations, facilitating open communication conducive to the exchange of specific and quality knowledge and information [34]- [35].

On the other hand, because of the often tacit nature of the knowledge exchanged, the production of new knowledge requires a high level of trust, reliability and cooperative interaction [36]. However, once implemented, it enables learning capacities to be increased within the cluster [31].

Reference [37] consider that, in addition to mutual trust, the particular relationships and the pooling of know-how have a positive influence on innovations and on the whole of industrial organization.

On the other hand, [38]–[39], go further and consider that an environment is conducive to innovation when it includes, cited by [40]:

-collective of actors (companies, research and training centers, universities, financing institutes, professional associations, public administration, etc.), characterized by its coherence and economic cohesion;

- material, human, financial, technological and information resources as numerous as various;

- know-how guaranteeing control of the productive process in the broad sense, whether technical, commercial or organizational;

- relational capital that promotes the creation of networks as knowledge vectors;

- norms, rules and values governing the behavior of economic actors and their relations.

B. The mechanisms

By mechanisms, we mean the practices implemented by the clusters to foster collaborative dynamics around innovative projects.

Through a literature review [40], [41]–[42], we can find a non-exhaustive list of innovation practices and services that clusters can develop and propose to their members, including:

- Technological survey / market
- Thematic meetings
- Business visit
- Intellectual property: Raising awareness or helping to manage it
- Transfer of technologies and skills
- Animation of creative groups
- Formations or job offers of elaborate methods of Creativity, Inventiveness (eg Six hats to think ...)
- Accompanied the development of Business Plan and assists in obtaining financing
- Prototyping / test support
- Project organization, swot analysis, risk analysis
- Communication: thematic days
- Monitoring innovation and managing change
- ...

C. The Process

The process is defined as: the networking of resources, skills and knowledge necessary for innovation.

For the management of resources and skills, [19] proposes an "ASR" model, based on three mechanisms: Activation, Meaning and Revelation, which can be mobilized by cluster governance to combine strategic capacities not mobilized by the cluster actors.

1. Activation: consists of activating zones of potentiality. [19] refers to a zone of potentiality when the organization is aware that it has untapped resources and skills that it would like to operate . In this case, the cluster's governance structure links two or more enterprises around a project, through thematic meeting days, trade shows, technological platforms...

2. Meaning: consists in giving meaning to areas of indifference. In this case, the organization is aware that it has unexploited strategic resources and skills, but does not see their interest, to what extent and how it could make them operational. So, the cluster's governance structure will convince the company of the value of its untapped resources and skills, through individualized meetings in the form of assessments of organizational competence or more informal meetings.

3. Revelation: consists of revealing zones of latency. In this case, the organization has untapped resources and skills but is not aware of their existence. Thus, the cluster's governance structure leads the company to reflect on its strategic capacities, thanks to its privileged relationships and its repeated interactions with it.

Concerning knowledge management, there are several practices that clusters can develop. [41] cites:

- Mapping of sectors, territories, systems, skills, organization;
- Provision of tools or methodologies to help in the clarification of the collection and capitalization of knowledge;
- Development of a collaborative platform for the exchange of documents;
- Provision of a storage system and management of flows and stocks of information and knowledge;
- Proposal for e-learning tools;
- etc

D. The Results

The results can be analyzed in terms of collaborative projects. These projects are, moreover, the fields on which collaboration and innovation taking place.

These collaborative projects can generate all kinds of innovations: products, processes, services, organizational or marketing and can thus lead to patent filings or start-up creations for example.

In the end, the framework for analyzing collaborative innovation proposed in clusters can be illustrated as follows:

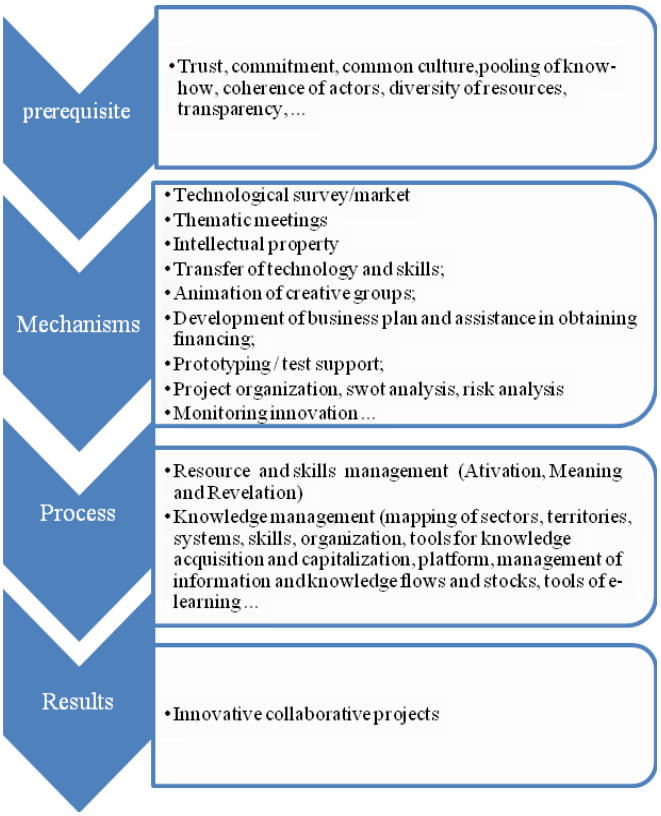

Fig. 1 Analysis Framework of Collaborative Innovation

VI. Conclusions

The innovation process is a complex process, especially the collaborative innovation, because it involves a multitude of autonomous actors with divergent interests.

Collaborative innovation requires partners to share resources, knowledge and skills.

We have tried through this work to propose a framework for the analysis of collaborative innovation within clusters. We have thus identified four organizational schemes namely: prerequisites, mechanisms, process and results, considered as essential vectors for the emergence of innovative projects.

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