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Collaborative Advantage

Parallel Session 5:
Staffing of Science Parks

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Executive Summary

Apparently collaboration has become one of the management challenges for the next 15 years. But the subject remains as something intuitive. Many disciplines do research about collaboration but there are not sound methods to make collaboration work from a management point of view.

This paper makes a brief review about what we know about collaboration and cooperation. From the general to the concrete, first we take the biological perspective to understand cooperative behaviour as something as valuable as competition, second we take the main conclusions of game theory about how cooperation works and third we enter the domain of knowledge management to distinguish interactions and collaborations. From this review we present a model and the frame of a research experiment to test the model in four Spanish Scientific and Technological Parks in order to obtain some guidelines for Park´s managers to foster collaboration within firm's residents.

Keywords: *Collaboration, cooperation, knowledge sharing, game theory.*

1. Introduction

"*Scientific and Technological Parks are organizations managed by specialized professionals. One of the main objectives of their professional activity is to increase the knowledge and the competitiveness of firm's residents. Therefore Park´s managers should foster and stimulate the flux of knowledge and technology between universities, research centres, firms and markets trying to promote new firms and spin-offs, offering qualified services including quality spaces and facilities*". This is a declaration of IASP Board, made it the 6th February 2002.

Following this recommendation and according to APTE[1] the Parks offer general services of infrastructure like, logistics, financial, sports, and mainly infrastructure in telecommunications. On the other hand there are services like assessment, training, innovation support and promotion of cooperation. The promotion of cooperation can be indeed one of the main value drivers of STPs in the future.

Science[2], the most accredited publication in the field of science, published in its front page that one of the most important challenges of the science in the 21st century is the knowledge of cooperation. The Economist in their prospective number, Foresight 2020- "Economic, industry and corporate trends"[3] included; Knowledge Management as one of the key issues for the next 15 years. Knowledge Management is understood as the ability of organizations to share and leverage knowledge. Bain Company[4], rates collaboration as one of the first tools for managers in the near future.

This collaborative behaviour is now affecting also the process of corporate innovation. In the literature about Open Innovation (Chesbroug[5] Chesbroug and Vanhaverbeke[6]) the central idea is that when companies look outside their own boundaries, they can gain better access to ideas, knowledge, and technology than they would if they only relied on their own resources. Some executives are now familiar with the many alternatives of open innovation, a number of which stray a considerable distance from traditional "closed" models of innovation management. The foundation of collaboration in innovation resides in the need of rapid answer to the need of rapid change in open and global markets. The need to create and embrace opportunities is more important than optimization.

Collaborative innovation applies the principles of free trade of ideas and it tries to drive the allocation of resources to the best ideas. By promoting collaboration within different companies, managers of STP, within the park and between parks can import – export low cost- high quality ideas. This discipline refocuses the concept of innovation and its resources.

The advantages are enormous for companies: The company can concentrate in exploiting core business and at the same time obtain benefits of selling some ideas to other companies. The company can obtain cash for new investments in R&D. On the other hand is a way to value research including intermediate outputs of research by selling licences or know-how.

2. Who knows how to produce effective collaborations?

[1] APTE (Asociación Española de Parques Tecnológicos), Spanish Association of STP
[2] E. Pennisi, *Science* 309, 93 (2005)
[3] http://www.eiu.com/site_info.asp?info_name=eiu_Cisco_Foresight_2020&rf=0
[4] http://www.bain.com/management_tools/tools_collaborative.asp?groupCode=2
[5] Chesbrough, Henry William. *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press, 2003.
[6] Dawkins, Richard. *The selfish gene*. New York : Oxford University Press, c2006

Surely STP´s managers will be deeply involved in promoting collaboration in the next future. From one point of view they need to provide the context for collaboration, on the other hand, they can also act as brokers in knowledge sharing activities. The question is that for collaboration we need something more than good will, something more than some intuitive skills.

But although collaboration and cooperation belongs to the management rhetoric, we have not found evidence of sound methodologies or approaches to build collaboration. Paradoxically we know that many disciplines have studied collaboration and cooperation: sociology, psychology, biology, physics, mathematics, together with an important number of developments of statistical and computer sciences. In the field of management itself we have seen the raising topic of Communities of Practice, within the knowledge management theory. There is a new window – opportunity for open innovation and co-creation capitalizing on the enormous potential that computer networks offer for collaboration and collective action.

In summary, cooperation is a subject within economics, sociology, social anthropology, evolutionary psychology, mathematics, statistical physics and innovation in networks. What we want with this work is to recover the main findings of some of these disciplines to put them together, integrate them and try to find a new and practical perspective of collaboration.

For the scope of this paper we will present three perspectives of collaboration: The biological, the Game – Theory, and the knowledge Management perspective.

2.1 The roots of cooperation

Dawkins[7] in the "Selfish Gene" presents the biology of selfishness and altruism. Previous authors about this subject made the erroneous assumption that the important thing in evolution is the benefit of the species (or the group) rather than the benefit of the individual (or the gene) according to Dawkins.

Our genes have survived millions years in a highly competitive world. They are selfish genes and in consequence we can expect that individuals would have the same ruthless selfish behaviour. Genes are replicators: They leap from body to body through sperm, ore eggs. But not all genes replicates successfully, some are more successful and this is natural selection.

But Dawkins demonstrates that there special circumstances in which a gene can afford selfish goals best by adopting a limited form of altruism. In the same sense Peter Corning, Director of the Institute for the Study of Complex Systems, says that "synergy" has played a key causal role in the evolution of human kind and complex societies. This theory also applies to social behaviour including cost and risk sharing, division of labour (combination of labour better said), functional complementarities, synergies of scale, information sharing and collective action among others. Many examples can be seen in the natural world. Many examples show that collaboration is basic in natural selection although the dominant metaphor is depredation and competition.

Axelrod[8], like many political scientists, economists, mathematicians and psychologists, was fascinated by a simple gambling game called Prisoner's Dilemma. In its original, human,

[7] Dawkins, Richard. *The selfish gene*. New York : Oxford University Press, c2006
[8] Axelrod, Robert, *The evolution of cooperation* New York : Basic Books, 2006

version, here is how the game is played. There is a 'banker', who awards and pays out winnings to the two players. There are only two cards in each of our hands, labelled "cooperate" and "defect". To play, we each choose one of our cards and lay it face down on the table. Facing down so that neither of us can be influenced by the other's move: in fact we move simultaneously

There are four possible outcomes:

- Outcome I: We have both played cooperate. The banker pays each of us $300. It is Reward for mutual cooperation.
- Outcome II: We have both played defect. The banker fines each of us $10. This is called the Punishment for mutual defection.
- Outcome III: You have played cooperate; I have played defect. The banker pays me $500 (the Temptation to defect) and fines you (the Sucker) $100.
- Outcome IV: You have played defect; I have played cooperate. The banker pays you the Temptation payoff of $500 and fines me, the Sucker, $100.

Now, why the 'dilemma'? If you think carefully the conclusion is that, regardless of which card you play, my best move is Always Defect. Regardless of what you do, I must defect.

There is no mechanism to the players to make cooperation work, except if the players expect to meet again. The question change to be "what is the best possible strategy to obtain the highest score" The strategy that works depends directly on what strategy the other player is using and in particular if the strategy leaves room for mutual cooperation. Unlike the simple game, which is rather predictable since defect is the only rational strategy; the iterated version offers plenty of strategic scope.

The task that Axelrod put himself was to find the best strategy. He ran a competition and some ingenious strategies were submitted. The winning strategy, remarkably, was the simplest and superficially least ingenious of all. It was called Tit for Tat, and was submitted by Professor Anatol Rapoport a mathematician psychologist. Tit for Tat begins by cooperating on the first move and thereafter simply copies the previous move of the other player. The important characteristic of this strategy is its stability. It means that it carries on doing well when it is already numerous in the population of strategies.

But none of this works unless the game is iterated. The players must know (or 'know') that the present game is not the last one between them. In Axelrod's phrase, the **'shadow of the future'** must be long. But how long must it be? It can't be infinitely long. From a theoretical point of view it doesn't matter how long the game is; the important thing is that neither player should know when the game is going to end. Also it is important, for any member of the Tit for Tat family of strategies, that the players are punished for defection.

In the iterative prisoner dilemma the best choice is the equilibrium of minimising loss rather than optimising profits. From this evolutionary perspective, where partners can collaborate in the future, reputation needs to be taken into account.

2.2. Knowledge Sharing

Patterns like the Linux movement or Wikipedia, reveal intriguingly promising "networks of creation" (or "creation nets"), where hundreds and even thousands of participants from

diverse institutional settings collaborate to create new knowledge, to learn from one another, and to appropriate and build on each other's work.

Nowak and May[9] were one of the first to demonstrate that social networks promote collaboration. Computer sciences enable to represent within complex networks "small worlds" as social structures. Brown and Duguid[10] following the work about Communities of Practice (CoPs) worked in the social perspective of knowledge management. They found that practice is the factor that explains the fluidity of knowledge conversion. People tend to naturally joint someone's practice, as a way of obtaining identity and at the same time as a way to learn and find new knowledge for this practice. As a new unit of analysis this communities trespass the boundaries of companies saying that knowledge, tacit and explicit, resides in broader structures. These communities of practice (CoPs) provide the basis to take this behaviour and translate it into more small communities like STP. Coordinating and promoting these structures can be beneficial, according to Seely and Duguid, for both agents and firms, to uncover the innovative potential of these firms.

The environment, from different perspectives, comes into the new theories of knowledge and innovation in three main aspects:

1) They reflect the holistic idea, where Research and Development is completed with a wider and more complex system where different agents interact and learn together.
2) Knowledge as a resource is more effective when is shared and therefore cross cooperation for innovation is necessary.
3) The knowledge resides basically in the heads of specialists in two dimensions, tacit and explicit, and needs for development interaction and cooperation.

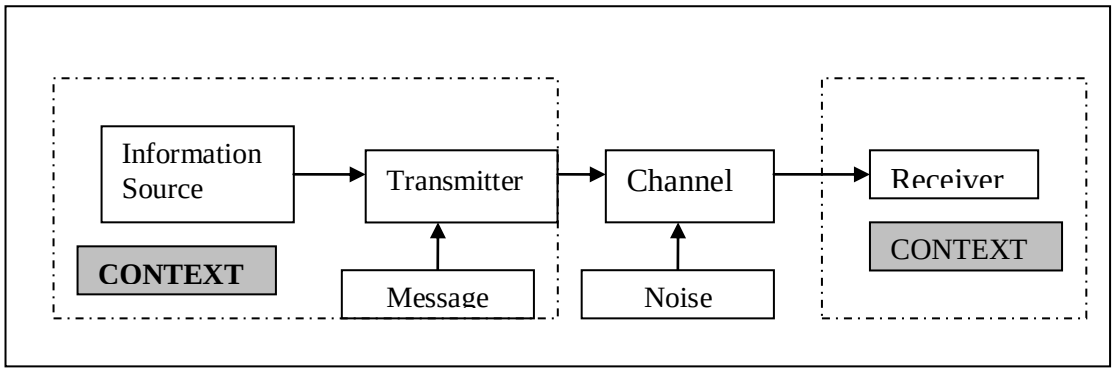
Subsequently the work environment, in two senses, physical and behavioural, is determinant. Hundred of companies have redesigned their buildings and workplaces with the intention of reshaping employee's attitudes and behaviours.

The knowledge sharing practice brings many benefits for practitioners. The flow of explicit and tacit knowledge has two side effects. One is the contribution to a solution like need of customers, technical expertise, product improvements, etc. and the other is new background knowledge and knowledge about other firms and their capacities.

Now the question remains in the understanding about how knowledge flows. Sharing of knowledge can not take place without some forms of communication. Talking about communication most of us have an image of communication based on the Shannon and Weaver[11] model of direct communication represented in the next Figure 1.

[9] M. A. Nowak & R. M. May, *Nature* 359, 826 *(1*992)
[10] Brown, J. S. and Duguid, P. "*The social life of information",* Harvard Business School Publishing. (2002)
[11] Shanan, C.E, and Weaver, W. "*The mathematical theory of communication"* USA. University of Illinois Press

Figure 1. Enriched Model of Shannon and Weaver.



In this model the attention is placed in the message and in the need of clear transmission (no noise). But if we take into account that knowledge means more than information and data, we have to take into account not only the content, but also the knower and the context. The enriched model would be a model where we acknowledge the importance of the transmitter and the receiver each in their own context. Information does not travel objective but mixed with past framed experiences, including values, expert insight, and private conversations. The main aspect of this dynamic view of knowledge is that we are talking about flows of knowledge not as stock but as a capacity to act.

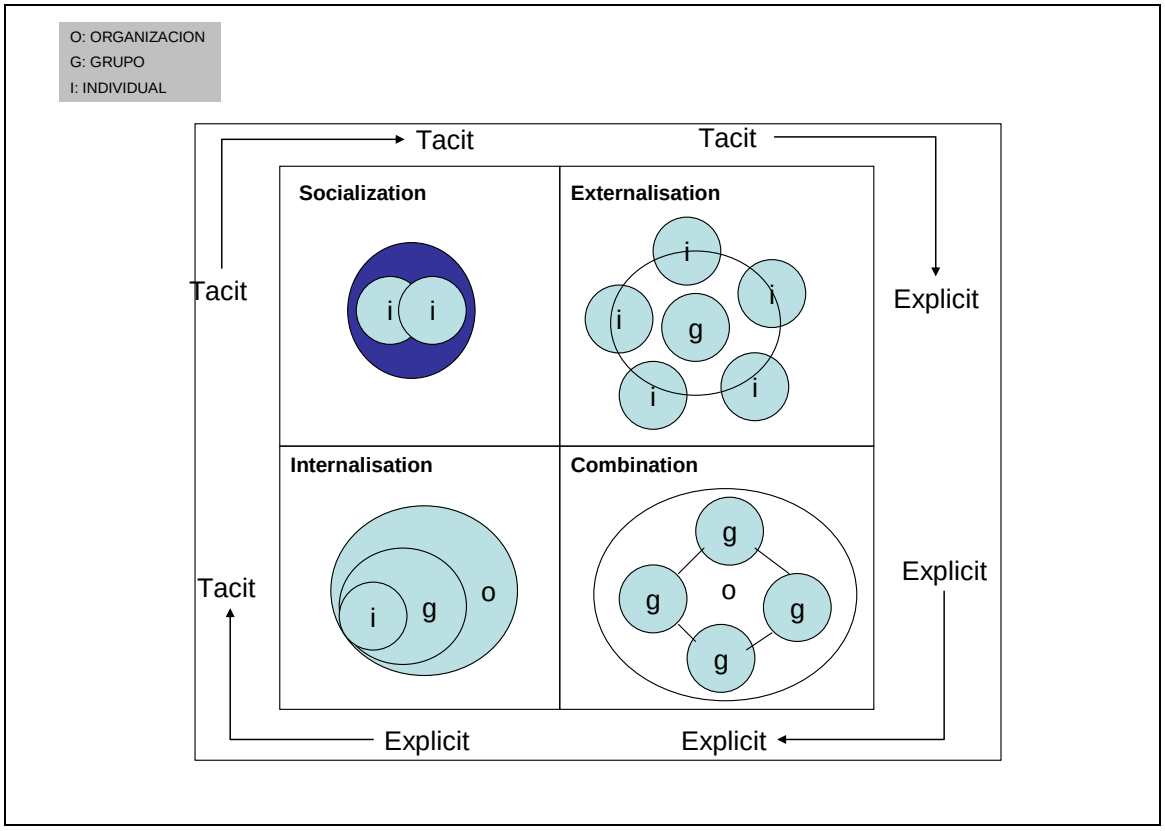
But how this collaborative behaviour emerges?. Nonaka and Takeuchi[12] stated in their seminal work that this process is a spiral of interaction between tacit and explicit knowledge, individual, teams, and firms. This model is called SECI, Socialization, externalization, combination, and internalization. The model works as follows:

Socialization- Tacit to tacit knowledge between individuals
Externalization- Tacit Knowledge of individuals to explicit knowledge in group of individuals.
Combination – The combination of explicit knowledge between groups of firms
Internalisation – From explicit to tacit. It is the individual interiorisation of knowledge as capacity to act.

Graphically is shown in Figure 2.

[12] Ikujiro Nonaka and Hiro Takeuchi. *The Knowledge Creating Company*. New York : Oxford University Press, 1995

Figure 2: SECI Model

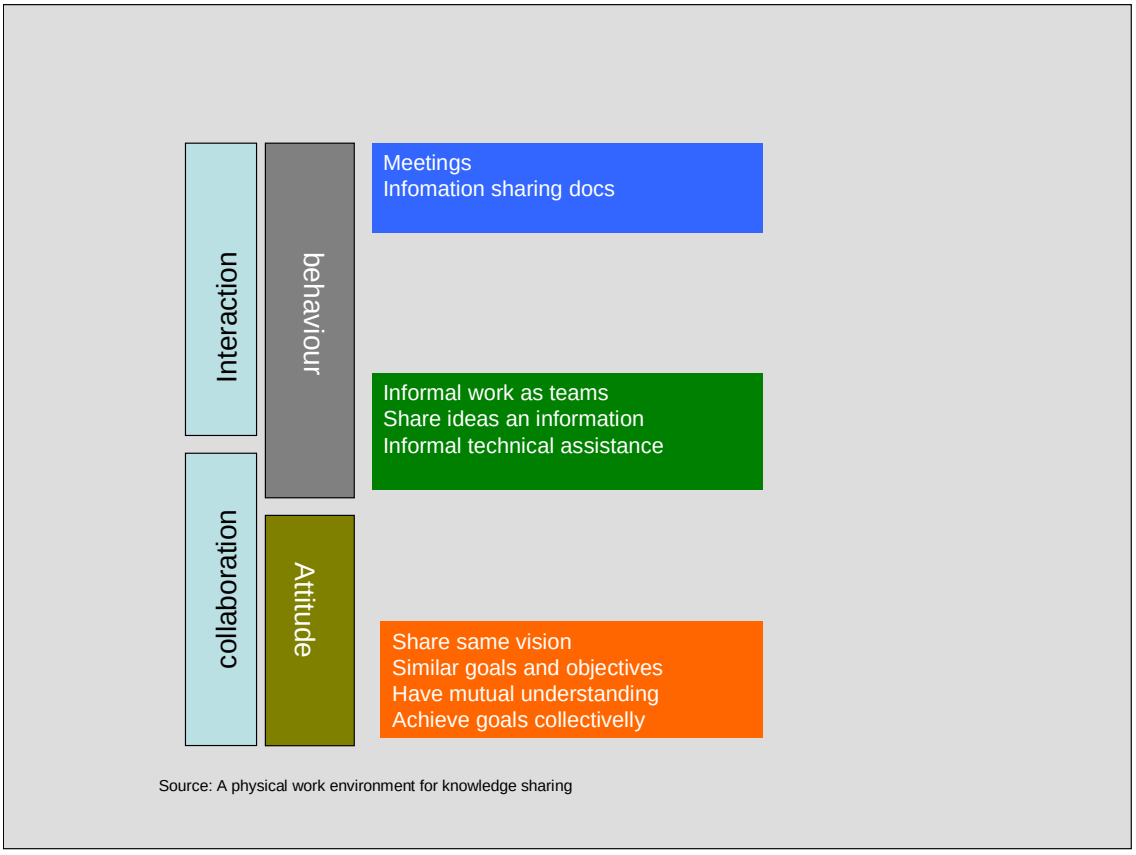


The perspective of the SECI model gives us a very good understanding about how knowledge flows between individuals, groups, having in mind the tacit – explicit duality of knowledge. But for managing the process we need other dimension. This knowledge dynamic process can be also targeted along a new longitudinal dimension which is the degree of collaboration. As Nonaka and Takeuchi say we can not manage knowledge but we can manage the interactions.

According to Kahn[13] there are two main forms of relation with others: Interaction and collaboration. These two main identifiable aspects are mixed by behaviour (what we do) and attitude (intention and motivation). A literature review made by Appel – Meulenbroek[14] in the subject provides a view of different activities within these four forms of relation as shown in the figure 3

[13] Kahnm K.B. "*Inteerdepartamental integration: A definition with implications for product development performance*", Journal of Product Innovation Management, Vol 12. pp 137-151
[14] Appel – Meunlenbroek, R. " *A physcial wrok environment for knowledge sharing in organisations*", ISPIM Proceedings, Athens, 2005

Figure 3: Activities and communications channels in the cooperation process



3. Research on cooperation

This research comes under the assumption that "stimulating cooperation remains in the field of good will. It is still a missing part in management". Therefore the research will try to offer insights, guidelines and eventually tools for STP´s managers to stimulate cooperation.

3.1 The model

From previous sections we have captured some important elements for research

1- There are special circumstances in which individual can afford selfish goals best by adopting a limited form of altruism.
2- Axelrod demonstrated that this occurs in the so called TIT for TAT strategy. Tit for Tat begins by cooperating on the first move and thereafter it simply copies the previous move of the other player. The rule is imitation. This is a stable and evolutionary strategy for cooperation.
3- This strategy needs one special condition: the scope of the players should be placed on minimising risks and loses, rather than on maximising gains. For that view to be taken players need to know that they will meet again and again.

i. Lesson 1. To foster cooperation we need to prompt first move
ii. Lesson 2. The members need to talk about the future
iii. Lesson 3. The members need to know that the group will meet again and again

4- Knowledge resides on individuals. Knowledge flows from individuals through groups and companies.
5- For knowledge to flow the content is important but at the same level of importance should be placed the knower and the context.
6- The knowledge sharing process is a spiral, not a linear process,
7- There a distinction between interaction and collaboration, behaviour an attitude. This difference matters and it represents different degrees of implication for co-operators.

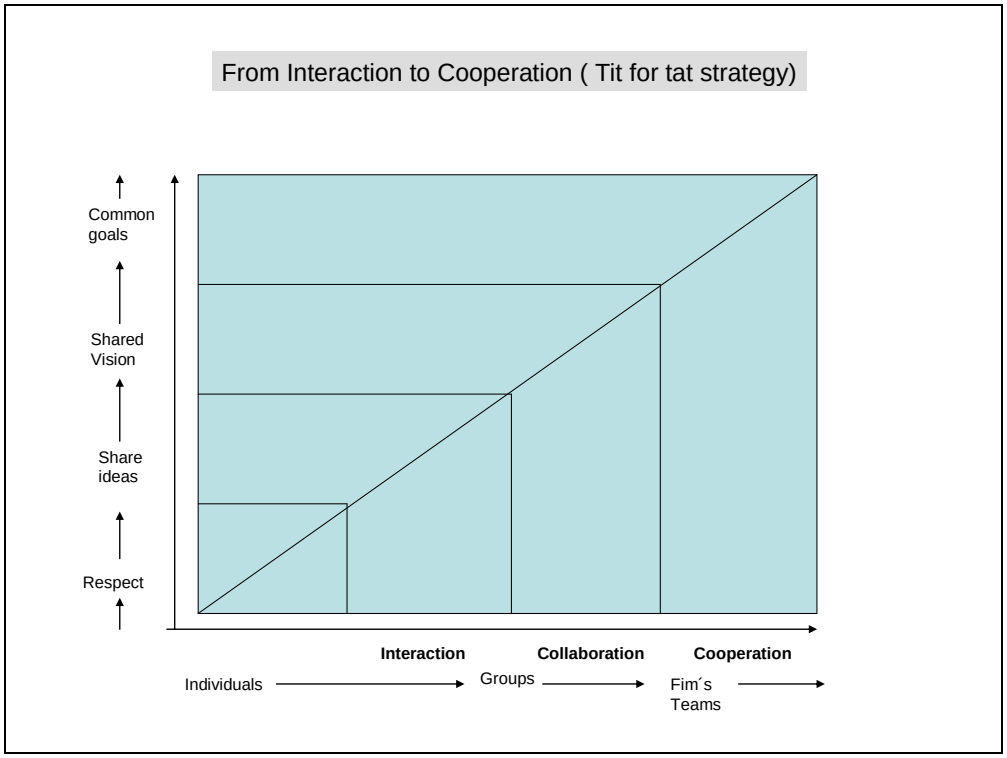
iv. Lesson 4. We should call individuals for cooperation not firms. Them they can form groups for collaboration and them companies can cooperate
v. Lesson 5. Resources and time are needed for contextualization
vi. Lesson 6. Cooperation is the objective but is not affordable directly. The entire process should be split on three parts: 1) Interaction 2) Collaboration 3) Cooperation.

Many words are used as synonymous in the field of collaboration. Among others the use is almost similar for collaboration, cooperation, interaction, integration, etc. In the semantic jungle authors use indifferently acts of cooperation at the same level attitude, intention etc.

Capitalising in the precedent reflections we present a model in a new range of cooperative behaviour along with an increasing attitude for cooperation. Obviously these characteristics are the two parts of a scissor. When the scissor cuts the fabric you can not say which part of the scissor is doing the most important work. In the same sense attitude and behaviour have a self reinforcing character. But strictly speaking the most relevant support for cooperation is the TIT for TAT strategy.

The model is represented in figure 4.

Figure 4. Interaction, collaboration and cooperation scale.



3. The research experiment

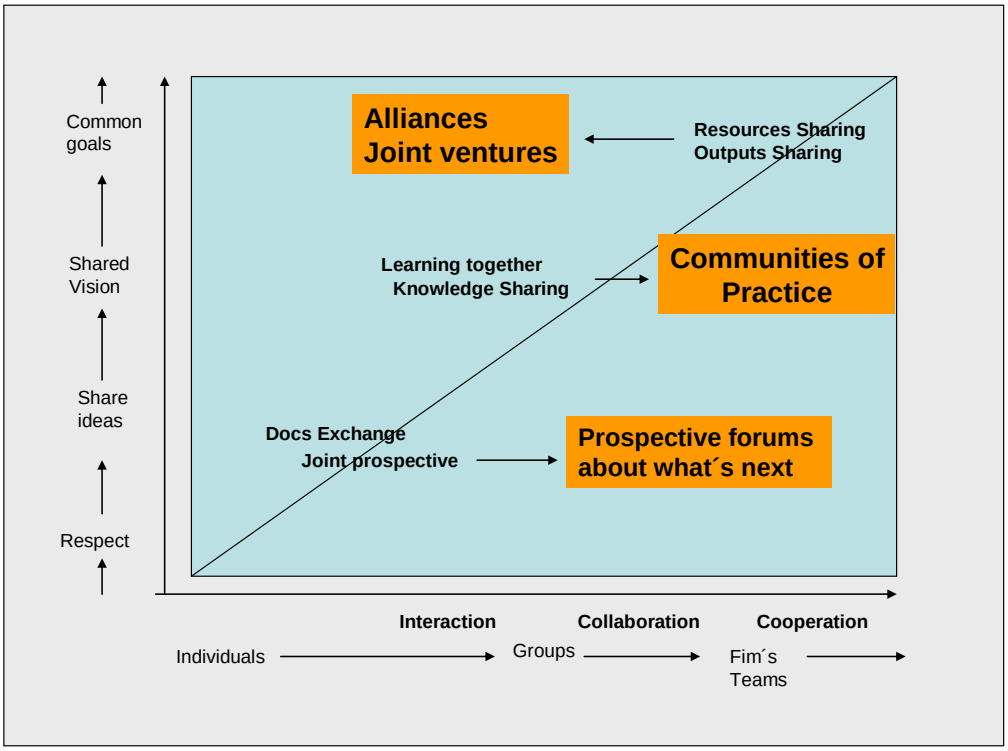
We are working in this experiment with four STP in The Basque Country (Spain) to produce some models of collaboration. Capitalising from the findings of Game Theory, and Knowledge Management we will observe how interactions evolve to be collaboration and finally cooperation.

The hypotheses to be tested are:

1- There are three degree levels of cooperation: Interaction, collaboration and cooperation itself.
2- The first level is interaction and it is related with cognition (sharing information) and ca be applied mainly to individuals.
3- The second level of collaboration is related with knowledge sharing and can be applied mainly to groups or Communities of Practice
4- The third level is cooperation and it is related with the sharing of resources and outputs and ca be applied mainly to firms.

The Model will be tested using the following path: Documents Exchange and **Prospective Forums** about the future trying to naturally build **Communities of Practice** and finally **Alliances and Joint Ventures** as shown in Figure 5.

Figure 5. Testing Path



Taking into account the lessons 1- to 6 lessons learned the setting of the experiment would be a call to see together the future expecting the creation collaborative groups in different domains and finally the emergence of cooperation between firms.

The experiment will find how to improve circulation of ideas.

- Building information systems to capture insights, minimize duplication of efforts, improve teamwork and increase the speed of innovation
- Increase innovation imports. Access world-class ideas, complement core innovation advantages and strengthen the company's cooperative abilities and its reputation;
- Increase innovation exports. Establish incentives and processes to objectively assess the fair market value of innovations raise incremental cash and strengthen relationships with trading partners.

Benefits for firms

- Maximize the productivity of new product development without increasing R&D budgets.
- Increase the speed and quality of new product introductions.