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MSc DISSERTATION

# KNOWLEDGE AS COMMONS

*SPATIAL IMPLICATIONS AND INNOVATION CLUSTERS*



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## Abstract

The development of information technology, and of the learning society has brought the debate on access, ownership and generally on management of knowledge. One of the key problems developed connects knowledge as common (pool resources) (free access, risk of non sustainability of the resource, etc.) with the discussion on the management of the commons (identification of boundaries and users, collective action, compliance with the rules etc.). However, the ontological characteristics of knowledge (tacit, non-excludable, cumulative, sticky, non-transferable but acquired) distinguish it from other resources, such as the environment, natural resources and so on. Here, we examine the consequences of the ontological characteristics of knowledge when studying it within the context of common pool resource management. Subsequently, the spatial consequences of this analysis are examined in the regime of innovation clusters.

Key words: common pool resources, knowledge as common, common pool resource management, innovation clusters

## Περίληψη

Η ανάπτυξη της πληροφορικής και της κοινωνίας της γνώσης και της μάθησης έχει αναδείξει στο επίκεντρο της συζήτησης την πρόσβαση, την ιδιοκτησία και γενικότερα την διαχείριση – διακυβέρνηση της γνώσης. Μια από τις βασικές προβληματικές που αναπτύσσονται θέτει το θέμα της γνώσης ως κοινό (πόρο) (ελεύθερη πρόσβαση, κίνδυνος μη βιωσιμότητας του πόρου κλπ.) και το συνδέει με τη συζήτηση για τη ‘διαχείριση των κοινών’ (προσδιορισμός ορίων και χρηστών, συλλογική δράση, έλεγχος συμμόρφωσης στους κανόνες κλπ.). Εντούτοις τα οντολογικά χαρακτηριστικά της γνώσης (άρρητη, δεν μεταφέρεται αλλά αποκτάται, μη-ανταλλάξιμη κλπ.) τη διακρίνουν από άλλους πόρους, όπως το περιβάλλον, οι φυσικοί πόροι κλπ. Εδώ εξετάζονται οι συνέπειες των οντολογικών χαρακτηριστικών της γνώσης για τη δυνατότητα προσέγγισης της με το πλαίσιο ανάλυσης της ‘διαχείρισης των κοινών’. Στη συνέχεια αναλύονται οι συνέπειες της παραπάνω ανάλυσης στο πλαίσιο των καινοτομικών συστάδων.

Λέξεις κλειδιά: κοινοί πόροι, γνώση ως κοινό, διαχείριση των κοινών πόρων, καινοτομικές συστάδες

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## List of Acronyms and Abbreviations

API: Application Programming Interface	R&D: Research and Development
CPR: Common Pool Resource	
FOSS: Free/Open Source Software	
HR: Human Resources	
IPR: Intellectual Property Right	
OA: Open access	
OECD: Organization for Economic Co-operation and Development	
PD: Prisoner's Dilemma	

# **CHAPTER1**

## **Introduction**

## 1. INTRODUCTION

The debate on knowledge governance has thrived with the revolution of the World Wide Web, which made access to information easier. Formal property rights on intellectual works (copyright, patent, etc.) have been developed to ensure creator compensation, hindering access. As a result, knowledge governance is considered crucial for the viability of what we already know and for ensuring further knowledge production, as well as for the social welfare of modern societies. The goal of this study is to investigate which theoretical framework favors social wellbeing.

Owing to the fact that knowledge is cumulative and comes from former knowledge, Hess and Ostrom (2007) have attempted to apply knowledge in the theoretical framework of the commons, by treating knowledge as information. Here, knowledge management is studied in the context of common pool resources. Following the famous “Tragedy of the commons” theory (Hardin, 1968), the management of common pool resources (CPRs) has also been a controversial subject between academics. Ostrom (1990) defines common pool resources as “a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use” (E. Ostrom, 1990, p. 44). The regimes of privatization or state-control (Hardin 1968), and self governance (Ostrom, 1990) have been proposed as a response to CPR management. In chapter 2, after an overview of the theory of the commons, we evaluate it in relation to other theories used for CPR governance.

After that, we focus on the ways the framework of the commons may be utilized to offer a new approach for knowledge governance in chapter 3. But is there a “Tragedy of the commons” in knowledge commons? The nature of knowledge has been a source of confusion as it is difficult to describe and has many dimensions. Its ontological characteristics are much different from those of the traditional goods examined in common pool resource management regimes. Knowledge is tacit, non-excludable, non-rival, sticky and cumulative. As a result, being treated as a common is not a straight forward issue. We critically assess the knowledge as a common approach for knowledge governance based on its ontological characteristics and on what we know about knowledge so far.



Furthermore in chapter 4, we investigate knowledge commons in innovation clusters and the way actors cooperate and produce new knowledge. In the light of the theoretical approach of the commons and knowledge, we examine knowledge production, diffusion, assimilation and exploitation in the context of innovation clusters.

Through this approach, the prerequisites under which knowledge may be regarded a commons are defined.

# **CHAPTER 2**

## **Common pool resources**

## 2. 1. INTRODUCTION

Common pool resources are, as suggested by Williams (1998), “natural or man-made resources used simultaneously or sequentially by members of a community or a group of communities”. They have been studied by a variety of scholars and their management has been a controversial subject. Traditional theories (W. Tucker, 1950), (M. Olson, 1965), (G. Hardin, 1968) predicted overexploitation and degradation of the commons. Nevertheless, a new perspective has appeared that predicts successful self-governance of common pool resources (Ostrom, 1990).

In this chapter common-pool-resources are defined (1.1.), possible property right regimes are analyzed (1.2.) and theories of CPR management (1.3.) are studied. A shift in focus is supported that considers self governance much more efficient in relation to privatization or state control. Finally, the limitations of this mode of governance are explored. Through the former, we understand the way CPR self management can be efficient ensuring resource viability.

## 2.2. DEFINING CPRS

E. Ostrom (1990) has defined and clarified what CPRs, resource systems and resource units are:

“The term **common-pool resource** refers to a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use.” (Ostrom, 1990, p. 44)

**Resource systems** are best thought of as stock variables that are capable, under favorable conditions, of producing a maximum quantity of a flow variable without harming the stock or the resource system itself”. For example, ‘fishing grounds’, “bridges”, “parking garages” etc. are considered to be resource systems. (Ostrom, 1990, p. 44) [own underline]

**Resource units** are what individuals appropriate or use from resource systems. Resource units are typified by the tons of fish harvested from a fishing ground etc” (Ostrom, 1990, p. 44)

It is very important to keep in mind the difference between the former, as it has been a source of confusion in the literature.

In another occasion Ostrom et al. (1999) defines CPRs as a system where excludability is difficult and use is rival:

We use the term common-pool resources (CPRs) to refer to resource systems regardless of the property rights involved. CPRs include natural and human-constructed resources in which (i) exclusion of beneficiaries through physical and institutional means is especially costly, and (ii) exploitation by one user reduces resource availability for others. (Ostrom et al., 1999, p.278)

McCarthy et al. (2001) define the commons as follows:

These resources are characterized by joint access by a finite set of users and by rivalry in appropriation. When a community member decides individually on appropriation of a common pool resource, he generates negative externalities on others by reducing supply available to them. These externalities are, however, not taken into account in the individual’s profit maximization calculus, leading to overuse of the resource.

(McCarthy et al., 2001, p. 297)

The former stress the problem of overuse in common-pool resources. If actors harvest more than the appropriable quantity, the resource is led to depletion.

The fact that common pool resources allow everybody to use them, as exclusion imposes high expenditures, does not mean that they are public goods. Nobody can be excluded by both public goods and CPRs, but in the former depletion or subtractability do not exist as for example an individual benefiting by national defense does not leave less of it for the others. In contrast, CPRs may suffer from depletion or destruction when overusing, as consuming a resource unit leaves one less for the others.

The “free rider” problem is also present in CPRs:

Whenever one person cannot be excluded from the benefits that others provide, each person is motivated not to contribute to the joint effort, but to free-ride on the efforts of others. If all participants choose to free-ride, the collective benefit will not be produced. The temptation to free-ride, however, may dominate the decision process, and thus all will end up where no one wanted to be.

(Ostrom, 1990, p. 20)

As a result what is “rational” for each member is usually irrational for the viability of the commons; as such a behavior will probably lead to depletion or reduction of produced profits. The former argument is considered myopic, as actors may behave in a different way if they realize that what’s rational for the resource is rational for them as well. This is because the depletion of the resource will not benefit the actors involved, as they will no longer have the chance to obtain economic returns from it.

We have seen that the characteristics of non-excludability and subtractability are the source of CPR problems (free-riding and destruction). Four different property right regimes have been proposed and used for governing of the commons.

### **2.3. PROPERTY RIGHTS REGIMES IN CPRS**

As suggested by Ostrom et al. (1999), four kinds of property rights may be applied to common pool resource regimes: “Open access” which will probably lead to resource deprivation, as there are no rules or property rights imposed. “Group property” and “Individual property” where obviously property rights exist to help people control the resource and have the right of exclusion and “Government property” which “involves ownership by a national, regional, or local public agency that can forbid or allow use by individuals.”. We cannot support any of the above systems as they all have succeeded but also failed when used along many different CPRs.

Table 2.1. : Types of property-rights used to regulate common-pool resources

Property rights	Characteristics
Open access	Absence of enforced property rights
Group property	Resource rights held by a group of users who can exclude others
Individual property	Resource rights held by individuals (or firms) who can exclude others
Government property	Resource rights held by a government that can regulate or subsidize use

Source: Ostrom et al., 1999, p. 279

By studying all possible property right regimes in CPRs Baland and Plateau (1996, p. 266-7) conclude in proposing a combination of community and government control, in which the government can help people realize the benefits of prudent resource use and trust each other. Privatization “may be prohibitively costly (due to very high costs of fencing in the resource domain) and/or inequitable (if perceived as illegitimate, this solution may actually increase the attendant transaction costs)”, centralization is also not effective because it contains “high information costs, lack of adequate monitoring devices, trained personnel, or financial resources, and subordination of environmental to shorter-term economic or political interests”, and community governance may prove unsuccessful due to “recent changes in the rural scene and new challenges from the wider world, and/or to deep-rooted features of the social structure or to resource characteristics (the resource may spread over a large area; the evolution of its stock may not be visible; users may be highly scattered and reside far away from the resource, etc.)”. In my opinion, their view of self governance is only a possible case but not the de facto result of such a regime. In addition, people using a CPR are able to built trust and manage it without external help.

It is evident from the above analysis that the choice of a property rights regime for CPRs is difficult, because all regimes have weak points. Privatization, leaves many people aside, not being able to benefit from the resource. Centralization is not efficient because external actors cannot obtain accurate information about the resource environment. Nevertheless, under favorable conditions (cooperation between actors, rational behavior) it seems to me that the “common property” regime is the most appropriate for the resource and its users. What follows is a study of proposed CPR management regimes.

## **2.4. MANAGEMENT OF COMMON-POOL RESOURCES**

The management of common pool resources is a dominant problem that has been studied by many scholars. The fact that anybody can benefit from using CPRs causes the problem of overusing leading to their destruction. For example, if fishermen in a lake harvest a large quantity of fish everyday fish will be depleted (CPR destruction). In fact, according to Hardin (1968) the people using the commons do not care about its exhaustion but only for themselves and the benefits they get from harvesting. We shall now review the theories that have been used for the management of the commons and detect any possible weaknesses, so as to conclude to the most appropriate.

A group of theories have been used to study the particular field of the commons basically based on the “free rider” problem, which consist of the “Prisoner’s Dilemma” game (Tucker, 1950), the Logic of Collective Action theory (Olson, 1965) and the “The Tragedy of the Commons” theory (Hardin, 1968).

### **2.4.1. THEORIES APPLIED TO COMMONS**

#### **2.4.1.1. THE PRISONER’S DILEMMA”**

The “Prisoner’s Dilemma” game was developed in 1950 by the mathematician named A. W. Tucker. It is a two-person, noncooperative, non-zero-sum game of two criminals interviewed one by one in isolation for a crime. Each one of them is given a strong incentive to inform against the other. The prisoner’s dilemma is still popular maybe owing to the fact that it is very simple to understand and can quickly demonstrate the problems of collective action and irrational group behavior where trust and reciprocity have little opportunity to develop and be expressed (Ostrom, 1990). It is applied to CPRs, because actors should find a way to cooperate in order to manage the resource. According to this theory, actors will not develop trust bonds in order to cooperate and be aware of each other’s behavior. This will lead to CPR depletion as everyone will follow their personal interests.

Baland and Platteau (1996) challenge the “Prisoner’s Dillema” game and suggest that:

“even within the PD framework repetition can possibly get people out of the non-co-operative equilibrium trap”. This theory

although useful to account for many field situations which have really developed into the kind of tragedy envisioned by Hardin, is nevertheless too narrow to describe a whole range of other situations. Depending on the characteristics of the resource and the technique used as well as on various features of user groups (their size, their rate of discount of future income and the importance of their subsistence constraints, their exit possibilities, etc.), problems of resource exploitation may or may not be adequately described as PD games

(Baland and Platteau, 1996, p. 97)

Consequently, the “Prisoner’s dilemma is not valid in repeated games and does not depict the full array of CPR circumstances.

#### **2.4.1.2. THE LOGIC OF COLLECTIVE ACTION**

The Logic of Collective Action was developed by Mancur Olson in 1965 and rests on the thought that

Unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, rational, self-interested individuals will not act to achieve their common or group interests. In other words, even if all of the individuals in a large group are rational and self-interested, and would gain if, as a group, they acted to achieve their common interest or objective, they will still not voluntarily act to achieve that common or group interest

(Olson, 2002, p.2)

There is no logic in extending the thought of rational behavior from the individual to the group level. As suggested by Olson (2002) this is because “Just as those who belong to an organization or a group can be presumed to have a common interest, so they obviously also have purely individual interests, different from those of the others in the organization or group” (Olson, 2002 ,p. 8) . Members of a group may have not realized that there is a greater benefit, for everybody, in achieving their common interest instead of individual ones.



Small groups might have a better chance in achieving their common goal, in relation to larger ones. As suggested by M. Olson (2002),

In small groups there may very well be some voluntary action in support of the common purposes of the individuals in the group, but in most cases this action will cease before it reaches the optimal level for the members of the group as a whole. In the sharing of the costs of efforts to achieve a common goal in small groups, there is however a surprising tendency for the ‘exploitation’ of the great by the small”(Olson, 2002, p. 3). Members should equally share costs and benefits, as if someone’s cost is greater than his benefit he will not have the incentive to contribute to the team anymore. As a result, according to M. Olson “In any group in which participation is voluntary, the member or members whose shares of the marginal cost exceed their shares of the additional benefits will stop contributing to the achievement of the collective good before the group optimum has been reached.

(Olson, 2002, p. 18)

The difference between large and small groups is that the former should be organized and control free-riders. Furthermore, in large teams benefits are distributed to more people, so profits are reduced along with the incentives for contributing to the costs again. Last but not least, the expenditures for organizing such groups are high enough to form an obstacle for achieving the common goal. This is because actors should find a way to pursue their interests as a group by organizing their activity on their own, and this will be harder for a large number of people.

In contrast to M. Olson (1965), Agrawal (2001) states that “Instead of accepting that small resource systems are likely to have a positive relationship with institutional sustainability, it may be more defensible to hypothesize that ‘size of the resource system should vary with group size, and for larger resources, authority relations within a group should be organized in a nested fashion’” (Agrawal, 2001, p. 1660). This is a better way of analyzing resource use, as it is not that narrow-minded and encompasses more possible cases.

#### **2.4.1.3. THE TRAGEDY OF THE COMMONS**

The “Tragedy of the Commons” theory was created by Garrett Hardin, who states that people using a common resource try to make the best out of it, to their own interest, without caring about the degradation of the environment. This model can be applied to common resources around the world, so it has been used by many other scholars to describe various problems.

Hardin (1968) suggests that “the commons, if justifiable at all, is justifiable only under conditions of low population density. As the human population has increased, the commons has had to be abandoned in one aspect after another”. Privatization or centralization instead of common use, would be a solution for Hardin. The main argument here is that self rational behavior in a commons will lead to overharvesting, as the greater the use the more the benefits, and eventually to destruction of the common resource (Hardin, 1968). This is also a myopic argument, as it does not include the possibility of cooperation between actors for the resource management.

Littering the commons is also part of the “tragedy of the commons”, owing to the fact that individuals will release toxic waste to a commons without caring about the destruction of the resource as their benefits are higher than costs. Here the solution rests on imposing high fines to those who continue polluting for the benefits of doing so to become lower than the costs. “The pollution problem is a consequence of population” (G. Hardin, 1968). Population increase creates and worsens this problem. The more people who pollute, the greater the pollution.

This theory is also valid for common resources. If an individual harvesting a commons is asked to limit harvesting he will be caught in a “double-bind”, that is that he will first think that he is asked to act according to the laws but afterwards he will be sure that he will be the only one complying to the rules, in contrast to the others who will keep harvesting as before.

Hardin (1968) suggests that the solutions for the viability of the commons are privatization or centralization, but we all know that those regimes have been applied and have not been successful. As Dietz et al. (2003, p. 1) state, “He missed the point that many social groups, including the herders on the commons that provided the metaphor for his analysis, have struggled successfully against threats of resource degradation by developing and maintaining self-governing institutions. Although these institutions have not always succeeded, neither have Hardin’s preferred alternatives of private or state ownership”. Also, Hardin’s theory is possible in a commons but not valid for each one. As stated by Hess and Ostrom (2007) Hardin’s theory is problematic as:

- (1) he was actually discussing open access rather than managed commons;
  - (2) he assumed little or no communication;
  - (3) he postulated that people act only in their immediate self-interest (rather than assuming that some individuals take joint benefits into account, at least to some extent);
  - (4) he offered only two solutions to correct the tragedy—privatization or government intervention.
- (Hess and Ostrom, 2007, p.11)

Nevertheless, those models should not be used as the basis when constructing policies, as the circumstances and restrictions are not the same in every case and adopting the same policies will not lead to the desired outcomes. These theories refer to commons, but they cannot be applied to all kinds of common resources. As suggested by Ostrom (1990, p.8)

The similarity between the many individuals jointly using a resource in a natural setting and the many individuals jointly producing a suboptimal result in the model has been used to convey a sense that further similarities are present. By referring to natural settings as ‘tragedies of the commons,’ ‘collective-action problems,’ ‘prisoner’s dilemmas,’ ‘open-access resources,’ or even ‘common-property resources,’ the observer frequently wishes to invoke an image of helpless individuals caught in an inexorable process of destroying their own resources.

( Ostrom, 1990, pg 8)

All the former theories have been adopted in studying the commons for many years, but in the last decades there a shift in proposed CPR management has occurred.

Many believe that a factor outside of the commons could give a solution to the problem of the commons. This factor could be the government, which can either be responsible for a resource or privatize it by creating a suitable property rights regime.

As rightly suggested by Ostrom et al. (1999), the assumption that the members of a commons are always free-riding, and care only for themselves and not for the groups interest is just one of the cases that may apply to this regime. People in a commons may cooperate if they are sure that the rest will (through monitoring and trust relations) as well or be willing to be the first to do so hoping that the rest will follow or just because they have a good will for the prosperity of the CPR.

Users of a CPR include (i) those who always behave in a narrow, self-interested way and never cooperate in dilemma situations (free-riders); (ii) those who are unwilling to cooperate with others unless assured that they will not be exploited by free-riders; (iii) those who are willing to initiate reciprocal cooperation in the hopes that others will return their trust; and (iv) perhaps a few genuine altruists who always try to achieve higher returns for a group.

(Ostrom et al., 1999, p. 279)

As a result, member's behavior in a CPR are not always the same or a fixed variable. Its fortune and the way it should be managed depends on the behavior of the people in it and as we can see destruction is not certain and can be avoided. "Whether norms to cope with CPR dilemmas evolve without extensive, self-conscious design depends on the relative proportion of these behavioral types in a particular setting."

(Ostrom et al. , 1999, p. 279).

### 2.4.2. A SHIFT IN PROPOSED CPR MANAGEMENT

As we have seen the management of the commons has been a controversial subject but in our day and time the overall feeling is in favor of CPR self-governance, in contrast with the classic theories which considered such a regime as inefficient and the source of the commons “tragedy”. In this section, one of the most successful models of self-governance of CPRs is presented and criticized, so as to be led to a conclusion for the most suitable regime of management.

According to Quinn et al. (2007):

CPR management regimes have often been considered inadequate for the management of natural resources because of the problem of excludability. However, more recently there has been a shift in policy regarding CPR management. Instead of centralizing control the trend is now for devolution of control and management from state to local level, with more responsibility on local institutions.

(Quinn et al., 2007, p. 101).

The local government knows the resource much better than the central

Policymakers responsible for the governance and management of small-scale, CPRs should not presume that the individuals involved are caught in an inexorable tragedy from which there is no escape. Individuals may be able to arrive at joint strategies to manage these resources more efficiently. To accomplish this task, they must have sufficient information to pose and solve the allocation problems they face. They must also have an arena where they can discuss joint strategies and perhaps implement monitoring and sanctioning. In other words, when individuals are given an opportunity to restructure their own situation, they frequently-but not always-use this opportunity to make credible commitments and achieve higher joint outcomes without an external enforcer. We cannot replace the determinate prediction of no cooperation with a determinate prediction of always cooperate

(Ostrom et al., 1992, p. 414)

In addition, “In finitely repeated social dilemma experiments, a wide variety of treatments that do not change the theoretically predicted subgame consistent equilibrium outcomes, do change subjects' behavior”. (Ostrom et al., 1992, p.414)

We are therefore led to believing that self-governance is possible and there is no need for exterior help. People can manage their CPR successfully by communicating, taking common decisions and monitoring their progress.

Elinor Ostrom's book "Governing the Commons" (1990) proposes a model of successful self-governance of CPRs. Subsequently, this model is presented and studied.

#### **2.4.2.1. SUCCESSFUL COMMONS**

Ostrom believes that the people involved in a commons can find a solution to their problems on their own based on their experience and knowledge, without help from outside which is not that easy as especially the government has to be completely informed of the circumstances in a commons in order to create a suitable institutional regime that helps produce the desired result by avoiding free riding.

The latter regime is usually made up by both private and public made institutions:

A competitive market - the epitome of private institutions - is itself a public good. Once a competitive market is provided, individuals can enter and exit freely whether or not they contribute to the cost of providing and maintaining the market. No market can exist for long without underlying public institutions to support it. In field settings, public and private institutions frequently are intermeshed and depend on one another, rather than existing in isolated worlds. (Ostrom, 1990, pg 29)

Ostrom (1990) distinguishes the people using and managing the CPR in the following three categories:

“Appropriation” is according to Ostrom (1990, pg. 30-1) “the process of withdrawing resource units from a resource system” and as mentioned by the latter “appropriators” are “herders, fishers, irrigators, commuters, and anyone else who appropriates resource units from some type of resource” for selling or using it for their selves or for producing something else, “those who arrange for the provision of a CPR” are the ‘providers” (for example the state can provide a port to facilitate local fishermen in selling their products) and the term “producer” is for “anyone who actually constructs, repairs, or takes actions that ensure the long-term sustenance of the resource system itself” (for example fishermen undertake the responsibility of maintaining the port). “Appropriation” and “provision” regulation should always take in mind and reciprocate the characteristics of the CPR. This means that they will be different for every resource, meeting their needs and opportunities.

So, what makes the difference between successful and unsuccessful commons? Ostrom (1990) studied this difference by case studies and presents what makes a CPR successful in most cases, through eight “design principles” of CPR management.

Table 2.2.: Design principles illustrated by long-enduring CPR institutions

<b>1. Clearly defined boundaries</b>	Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.
<b>2. Congruence between appropriation and provision rules and local conditions</b>	Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labor, material, and/or money.
<b>3. Collective-choice arrangements</b>	Most individuals affected by the operational rules can participate in modifying the operational rules.
<b>4. Monitoring</b>	Monitors, who actively audit CPR conditions and appropriator behavior, are accountable to the appropriators or are the appropriators.
<b>5. Graduated sanctions</b>	Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both.
<b>6. Conflict-resolution mechanisms</b>	Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.
<b>7. Minimal recognition of rights to organize</b>	The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.
<i>For CPRs that are parts of larger systems:</i>	
<b>8. Nested enterprises</b>	Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Source: Ostrom, 1990, p. 90

The first principle is very important for organizing, as it helps avoid free riding, by people who have not offered their impact to the common resource, and consequently depletion of the resource. Specifying who is allowed to benefit from the CPR also assures that members will not share their profits with others, receiving less than expected.



Furthermore discount rates, which according to Ostrom (1990, p.34) are a situation where “Individuals attribute less value to benefits that they expect to receive in the distant future and more value to those expected in the immediate future. In other words, individuals discount future benefits” increase when members are not sure if other people from outside the CPR have the opportunity to harvest their work or are not completely informed about the actions of the other members. This way, in the short-term they will try to harvest as much as they can, leading the resource to depletion. Some may argue that the first principle characterizes “common property” regimes, but it is crucial for the viability of CPRs as well.

The members of the CPR are the most appropriate for forming regulation, as they know the resources character and the way interactions take place between them better than anyone. So, they have all the information needed to create regulation (second principle. Of course the expenditures for the altering and adjusting regulation should not be high. Sethi and Somanathan (2006, p. 728) rightly argue that “owing to setup costs, it is costly to start cooperating following a noncooperative phase, as is likely in many situations, this explains why attempts to cooperate on the basis of such strategies are not observed”. Complying with the rules is also not a matter of help from outside in those successful commons.

But, as mentioned by Ostrom (1990)

In these models, participants adopt resolute strategies to cooperate so long as everyone else cooperates. If anyone deviates, the models posit that all others will deviate immediately and forever. Information about everyone's strategies in a previous round is assumed to be freely available. No monitoring activities are included in these models, because information is presumed to be already available.

(Ostrom, 1990 pg 93).

People in the CPR do not want to stain their reputation and be marginalized by the others for betraying their trust and as a result complying is much easier in those situations without the need of expenditures for supervising actions and punishing. Nevertheless, in the long run both “monitoring” and “graduated sanctions” are essential and members do it themselves without external help. Actors need to be certain that everybody keeps complying with the regulation to keep doing so themselves.

To understand the reason why the members of successful commons have achieved “self-compliance” we can use M. Levi’s (1988) “quasi-voluntary compliance”. Levi studies the way people react in complying with the tax system. This study can also be applied in the common resources regime, as settling taxes is also a voluntary procedure in many respects, but one will be punished if noticed.

Ostrom (1990) summarizes her arguments in the following lines:

When CPR appropriators design their own operational rules (design principle 3) to be enforced by individuals who are local appropriators or are accountable to them (design principle 4), using graduated sanctions (design principle 5) that define who has rights to withdraw units from the CPR (design principle 1) and that effectively restrict appropriation activities, given local conditions (design principle 2), the commitment and monitoring problem are solved in an interrelated manner. Individuals who think that a set of rules will be effective in producing higher joint benefits and that monitoring (including their own) will protect them against being suckered are willing to make a contingent self-commitment of the following type:

I commit myself to follow the set of rules we have devised in all instances except dire emergencies if the rest of those affected make a similar commitment and act accordingly.

(Ostrom, 1990, pg 99-100)

As far as the sixth principle is concerned, such mechanism is needed so as to avoid conflict due to misperceptions of the rules. Users should be able to apologize for any rule infractions. “If individuals who make honest mistakes or face personal problems that occasionally prevent them from following a rule do not have access to mechanisms that will allow them to make up for their lack of performance in an acceptable way, rules may come to be viewed as unfair, and conformance rates may decline” (E. Ostrom, 1990, p. 101).

The seventh principle is crucial for the viability of the resource, as users should be able to craft resource use rules without being disturbed by the state, which can support them by recognizing their rules.

The eighth principle refers to the management of larger CPRs, which can be achieved if they are governed “in multiple layers of nested enterprises” (Ostrom, 1990, p.101). Regulation must be present in the whole set of levels for management to be successful.

However Ostrom's (1990, p. 26) study is limited to common pool resources that are:

- A) Renewable rather than nonrenewable resources,
- B) Situations where substantial scarcity exists, rather than abundance, and
- C) Situations in which the users can substantially harm one another, but not situations in which participants can produce major external harm for others

In addition, Ostrom (1990) studies small local CPRs (50-15.000 people) where inhabitants are reliant on the CPR and as a result heavily motivated to manage it successfully, so that in case self-management proves unsuccessful it will be attributed to the indifference of users for possible returns from the resource.

The former model has been used and criticized by an abundance of scholars. Quin et al. (2007) state that "community management based on traditional institutions for resource use does not necessarily lead to sustainability in the face of increasing population densities, technological advances and the influence of markets. While there have been high expectations of community-based approaches the practical implementation of community management has not always been successful" (Quinn et al., 2007, p.101). But, whether self governance will prove successful or not depends on the circumstances of each case.

In other words, the above believe that not all Ostrom's principles need to be valid for a CPR to be successful, as some of them may harm the resource. This is what Ostrom states as well. She does not propose that her principles must always be valid in their entirety. In addition, Quinn et al. (2007) suggest that what is proposed by the design principles does not fully satisfy successful governance of common-pool resources. This is because success should be assessed in terms of all social groups (poor and rich) and of resource conservation. CPR management should adopt to the characteristics of each case.

Agrawal (2001) studies the models of Ostrom (1990), R. Wade (1988) and Baland-Platteau (1996) and summarizes the factors they consider crucial.

Table 2.3.: Critical enabling conditions for sustainability on the commons

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<p>1. <i>Resource system characteristics</i></p> <ul style="list-style-type: none"> <li>(i) Small size (RW)</li> <li>(ii) Well-defined boundaries (RW, EO)</li> <li>(iii) Low levels of mobility</li> <li>(iv) Possibilities of storage of benefits from the resource</li> <li>(v) Predictability</li> </ul> <p>2. <i>Group characteristics</i></p> <ul style="list-style-type: none"> <li>(i) Small size (RW, B&amp;P)</li> <li>(ii) Clearly defined boundaries (RW, EO)</li> <li>(iii) Shared norms (B&amp;P)</li> <li>(iv) Past successful experiences—social capital (RW, B&amp;P)</li> <li>(v) Appropriate leadership—young, familiar with changing external environments, connected to local traditional elite (B&amp;P)</li> <li>(vi) Interdependence among group members (RW, B&amp;P)</li> <li>(vii) Heterogeneity of endowments, homogeneity of identities and interests (B&amp;P)</li> <li>(viii) Low levels of poverty</li> </ul> <p>1. and 2. <i>Relationship between resource system characteristics and group characteristics</i></p> <ul style="list-style-type: none"> <li>(i) Overlap between user group residential location and resource location (RW, B&amp;P)</li> <li>(ii) High levels of dependence by group members on resource system (RW)</li> <li>(iii) Fairness in allocation of benefits from common resources (B&amp;P)</li> <li>(iv) Low levels of user demand</li> <li>(v) Gradual change in levels of demand</li> </ul> <p>3. <i>Institutional arrangements</i></p> <ul style="list-style-type: none"> <li>(i) Rules are simple and easy to understand (B&amp;P)</li> <li>(ii) Locally devised access and management rules (RW, EO, B&amp;P)</li> <li>(iii) Ease in enforcement of rules (RW, EO, B&amp;P)</li> <li>(iv) Graduated sanctions (RW, EO)</li> <li>(v) Availability of low cost adjudication (EO)</li> <li>(vi) Accountability of monitors and other officials to users (EO, B&amp;P)</li> </ul> <p>1. and 3. <i>Relationship between resource system and institutional arrangements</i></p> <ul style="list-style-type: none"> <li>(i) Match restrictions on harvests to regeneration of resources (RW, EO)</li> </ul> <p>4. <i>External environment</i></p> <ul style="list-style-type: none"> <li>(i) Technology: <ul style="list-style-type: none"> <li>(a) Low cost exclusion technology (RW)</li> <li>(b) Time for adaptation to new technologies related to the commons</li> </ul> </li> <li>(ii) Low levels of articulation with external markets</li> <li>(iii) Gradual change in articulation with external markets</li> <li>(iv) State: <ul style="list-style-type: none"> <li>(a) Central governments should not undermine local authority (RW, EO)</li> <li>(b) Supportive external sanctioning institutions (B&amp;P)</li> <li>(c) Appropriate levels of external aid to compensate local users for conservation activities (B&amp;P)</li> <li>(d) Nested levels of appropriation, provision, enforcement, governance (EO)</li> </ul> </li> </ul>
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Source: Agrawal, 2001, p. 1659

Owing to the fact that factors are too many and cannot be compared across different works of scholars, Agrawal (2001, p. 1655) proposes “a shift toward comparative rather than case study analysis”.

Also according to the former, there is a “need for new research that would (a) postulate casual links that can be investigated through structured case comparisons, (b) use a large number of cases that are purposively selected on the basis of casual variables and (c) undertake statistical tests to examine the strength and direction of casual relationships.” (Agrawal, 2001, p. 1655). In my opinion, Ostrom’s (1990) principles cover all possible occasions in CPR management, as actors that decide for the rules take in mind the external environment and act accordingly.

As Madani and Dinar (2012) state, “non-cooperative management institutions” may also lead to successful management of common pool resources, as actors will take in mind that the results of overexploiting will be against their personal interests as well. In my opinion, owing to the fact that individuals will not be aware of the other’s behavior, they will try to harvest as much as they can from the resource and lead to CPR depletion.

#### **2.4.2.2. LIMITATIONS: HETEROGENEITY**

Heterogeneity can occur due to “class-based differentiation, gender relations, divisions between landowners and tenants or squatters” (Cousins, 1996, p. 199)

As suggested by the former negotiations and “An analysis which recognizes the reality of social differentiation, in its various guises, will assist in the design of more effective interventions.” (Cousins, 1996, p. 202)

The differences between men and women are another source of heterogeneity, “because of the often critical role women play in the gathering and harvesting of products from common-pool resources.” Agrawal (2003)

According to Baland and Plateau (1996, p. 138) “...where agents are heterogeneous, regulating the commons efficiently may cause conflicts of interest to erupt”. A possible reason of heterogeneity is that between high and low income groups with different interests. In contrast, Varughese and Ostrom (2001, p. 750) argue that “while too much disparity in wealth distribution diminishes shared interest in the collective good (and subsequent capture by elite), some inequality of wealth provides incentives for certain individuals in the community to bear a disproportionate share of the costs associated with organizing collective action”. Generally, no heterogeneity leads to absence of motivation to organize the community, while too high heterogeneity triggers cooperation.

Dayton-Johnson and Bardhan (1998, p. 586), study wealth inequality in fisheries and conclude that “A significant result is that the relationship between inequality and collective action is not necessarily monotonic. In fact, the relationship may be U-shaped: at very low and very high levels of inequality, conservation is possible, while for some middle range of inequality it is not.”

As suggested by Janssen and Ostrom (2001), if heterogeneity exists owing to “new settlers moving to a region”, disagreements increase and enforcing regulation is harder and more costly. Nevertheless it is not evident that they will not cope with existing rules.

Consequently, heterogeneity may make cooperation harder but it may also constitute a factor of motivation to organize. Through the third design principle “collective choice arrangements” groups with different interests can find a way to negotiate and reach a solution.

## 2.5. CONCLUSION

In this chapter we have analyzed all possible CPR modes of governance and their limitations. Private ownership does not ensure overall welfare, as many people no longer have the right to harvest from the resource. Centralization is not efficient, owing to the fact that external actors are unable to possess the right information, so as to manage the resource successfully and make it sustainable. In contrast, self governance has proved the most efficient and successful regime, because the people who are part of it hold the information needed to create the right rules and can monitor resource use better than anyone. They are also motivated to pursue the resources viability, as it is the only source of income for the most of them.

There are some core assumptions for this to happen, depicted by Ostrom's design principles. If actors in a common realize that cooperation will benefit them much more than just pursuing their personal interests, they have the opportunity to manage a resource on their own and make it sustainable. Generally, one cannot presume certain success or failure, as this depends on the choices of actors. Small size resources are of course much more easily managed, in relation to larger ones. But, management of large scale resources is achievable as well.

During the last decades, a new kind of commons has emerged. That is the knowledge commons. This discourse will be discussed in the next chapter.

# **CHAPTER 3**

## **Knowledge as a commons**



### 3.1. INTRODUCTION

Knowledge is not something simple to understand and cannot be described in a few words. Its characteristics distinguish it from other kinds of goods and make it kind of “special”. For those reasons figuring out a way to manage its use has been a source of conflict. In this chapter the characteristics of knowledge (non-rival, tacit, non-excludable, cumulative, sticky etc) are presented and analyzed. In addition, the way knowledge is created and distributed is studied (for example R&D, innovation etc).

As suggested by Hess and Ostrom (2007), knowledge can be treated as a commons, although they identify knowledge as information. We investigate knowledge in the context of commons, based on its ontological characteristics that are much different from those of the classic resources (the sea, environment, etc) and assess it as a new approach for knowledge policy.

In the first part of the chapter, knowledge ontological characteristics, creation and learning are discussed, in order to investigate the way knowledge can be shared and diffused. The second part is devoted to studying the discourse of knowledge as commons, clarifying its difference from information that has been a source of confusion, and figuring out whether it can work and under which conditions.

### 3.2. KNOWLEDGE AS COMMONS VERSUS MAINSTREAM THEORY

The theory of the knowledge commons proposes that access to knowledge should be available for everyone. It contrasts with the mainstream theory, which suggests that intellectual property rights (IPRs) are essential for the further production of knowledge. Boyle (2007, p. 138) suggests that according to the “standard intellectual property theory”:

To get high-quality factual reference works, we need strong property rights and single-entity control for at least three independent reasons related to the tragedy of the commons:

- the need for exclusive control over reproduction in order to produce
- the incentives necessary for large-scale investment in writers and fact checkers,
- the need for control over content and editing in order to ensure quality, and
- the need for control over the name or symbol of the resource itself as a signal to readers and an inducement to invest in quality in the first place.

According to Ghosh (2007), IPRs are considered to serve three functions in relation to the formation of knowledge commons:

- to hinder, as access to knowledge is made more difficult
- to assist, because IPRs motivate creators to work for the production of new knowledge and share in publicly, without the fear of not being rewarded for their efforts or
- to have no relation to knowledge commons, owing to the fact that “informal norms and customs” are the most important part for the creation of information commons

Hess and Ostrom (2007), the general editors of the book “Understanding knowledge as commons”, refer to digital knowledge commons. In the same book, Suber analyses open-access literature in the Internet and Schweik open source software, considering those cases as knowledge commons. By reviewing the nature of knowledge and applying it to the common framework, we will investigate whether the former models refer to knowledge commons. Also, we will examine whether the theory of the commons is useful for knowledge and its limitations.

### **3.3. KNOWLEDGE AND INFORMATION**

Defining knowledge is a difficult task, due to its special and complicated nature. Foray (2004, p. 4) tries to describe it by drawing a parallel with information:

In my conception, knowledge has something more than information: knowledge – in whatever field- empowers its possessors with the capacity for intellectual or physical action. What I mean by knowledge is fundamentally a matter of cognitive capability. Information, on the other hand, takes the shape of structured and formatted data that remain passive and inert until used by those with the knowledge needed to interpret and process them.

According to David and Foray (2002, p. 12) information is “structured and formatted data-sets that remain passive and inert until used by those with the knowledge needed to interpret and process them”.

The distinction of knowledge and information is basic and necessary in studying knowledge, as information is identified as knowledge in many studies leading to misleading results.

As suggested by Hess and Ostrom (2007, p. 7-8), knowledge “ refers to all intelligible ideas, information, and data in whatever form in which it is expressed or obtained” furthermore this applies ”to all types of understanding gained through experience or study, whether indigenous, scientific, scholarly, or otherwise nonacademic”. Knowledge comes from information and information comes from knowledge. Also, works of art (musical, theatrical or cinematographic) can be included to knowledge.

In my opinion, the former definition refers mostly to information, as knowledge is something more than that and a more complicated good. Nonaka and Takeuchi (1995, p. 3) study knowledge creation in the regime of Japanese companies and define “organizational knowledge” as “the capability of a company as a whole to create new knowledge, disseminate it throughout the organization, and embody it in products, services, and systems”. This is the knowledge that is created and exists in organizations and businesses.

Knowledge has two forms, the tacit and the non-tacit:

### **3.3.1. TACIT KNOWLEDGE**

“We can know more than we can tell” is the way Polanyi (1966, p.4) describes tacit knowledge in a few words. It is not easily transferred and acquired through experience.

As suggested by Nonaka and Takeuchi (1995, p.8) tacit knowledge “is highly personal and hard to formalize, making it difficult to communicate or to share with others. It is also “deeply rooted in an individual’s action and experience, as well as in the ideals, values, or emotions he or she embraces”.

The former divide tacit knowledge in two “dimensions” the “technical” and the “cognitive”. The first one contains “the kind of informal and hard-to-pin-down skills or crafts captured in the term ‘know-how’” and the second “schemata, mental models, beliefs, and perceptions so ingrained that we take them for granted. This dimension “reflects our image of reality (what it is) and our vision for the future (what ought to be).” (Nonaka and Takeuchi, 1995, p.8)

According to Collins (2010, p. 85) “The tacit is that which has not or cannot be made explicit.” The former divides tacit knowledge, depending on the possibility of its transformation to explicit knowledge, into three categories: “weak”, “medium” and “strong”. “Weak or relational” tacit knowledge is “knowledge that could be made explicit...but is not made explicit for reasons that touch on no deep principles that have to do with either the nature and location of knowledge or the way humans are made”.

Figure 3.1.: The terrain of tacit knowledge

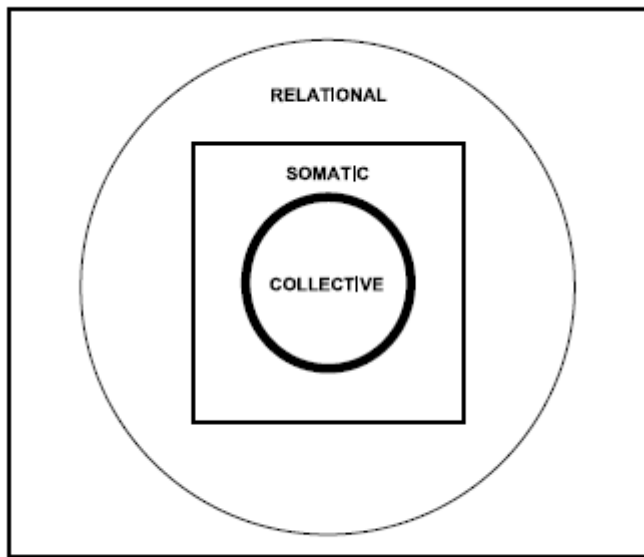


Figure 8. The terrain of tacit knowledge

Source: Collins, 2010, p. 158

As we can see from the above map the part of “collective” tacit knowledge is the most difficult to make explicit and understand, although it is practically the world where we live. It is not easy to describe it, maybe because we cannot realize the tacit knowledge contained. The part of “somatic” tacit knowledge contains the nature of creatures in the world and is easier to be made explicit through study. “Relational” tacit knowledge refers to “human- to-human communication that are continually coming into existence and going out of existence (switching between tacit and explicit), depending on the relationship of the particular humans who are in interaction.” (Collins, 2010, p.158-9) and cannot immediately become explicit to its entity, even though explication is much easier than in the other forms of tacit knowledge.

The tacit nature of knowledge is one of its most distinctive and complicated characteristics, and covers a large scope of its study. Tacit knowledge is not easy to transfer and this implies one of the core limitations for the common knowledge discourse.

The tacit nature of knowledge is one of its most distinctive and complicated characteristics, and covers a large scope of its study. Tacit knowledge is not easy to transfer and this implies one of the core limitations for the common knowledge discourse.

### **3.3.2. NON-TACIT KNOWLEDGE**

According to Nonaka and Takeuchi (1995, p.9) “Explicit knowledge can easily be “processed” by a computer, transmitted electronically, or sorted in databases”.

Furthermore Nonaka (2007, p.165) defines explicit knowledge as “formal and systematic” that is “easily communicated and shared, in product specifications or a scientific formula or a computer program.”

Explicit knowledge is easy to define, transmit and see. It is the part of knowledge that exists in the World Wide Web and all kinds of drafts, but the existence of tacit knowledge is essential to understand and use it. This part of knowledge can easily be a common, but the large part of tacit knowledge cannot. For better understanding of the limitations implied to common knowledge we will describe the characteristics of knowledge, which are also kind of special and relate to each other.

### **3.4. KNOWLEDGE CHARACTERISTICS**

Knowledge is non-rival, non-excludable, cumulative, localized, sticky, dispersed and not easy to control. Those characteristics are distinctive and depict the differences of knowledge with traditional goods.

According to Romer (1990, p. S73) “a purely nonrival good has the property that its use by one firm or person in no way limits its use by another”. Knowledge is non-rival because there are no limits in its use. When someone uses knowledge, he does not deprive it from someone else. (Foray, 2004, p. 93). A group of scholars like Keely and Quah (1998) use the term “infinitely expansible” instead of non-rival. As suggested by Antonnelli (2008), when using knowledge non-rivalry exists, in contrast to exchanging it where actors or organizations impose a price for their new innovative knowledge.

As suggested by Romer (1990, p. S75) “treating knowledge as a nonrival good makes it possible to talk sensibly about knowledge spillovers, that is, incomplete excludability”. The former believes that a patent for example can exclude people from using a product but not from studying it, so as to create new knowledge as a result knowledge is non-excludable. This is what is stated by Foray (2004, p.15) as well: “making knowledge exclusive and controlling it privately are difficult and costly. Knowledge continuously escapes from the entities producing it.”

Knowledge can also be used as a basis for the production of fresh knowledge, making it cumulative. As Foray (2004, p. 94) states “what spreads and can be used an infinite number of times is not only a consumer good (say, a piece of music) but essentially an intellectual input likely to spawn new goods that will also be usable an infinite number of times”. As suggested by the former cumulativeness can be short-as well as long-term, depending on the knowledge product’s characteristics.

There are diverse opinions among scholars for the localized nature of knowledge. Here unintentional spillovers and absorptive capacities are vital for understanding. Some argue that the knowledge generated in a specific place for a reason cannot easily be applied and used somewhere else (Foray, 2004, p. 95). This is probably the reason why businesses form clusters in specific geographical locations, where it is easier to take advantage of externalities. “Involuntary spillovers” occur due to the inability of actors to “capture all the benefits resulting from its inventive activity”. In fact these spillovers are mostly local.

As suggested by Keely and Quah (1998, p. 26), this occurs due to “lack of contact between scientists in different physical or technological areas, and the absence of an infrastructure to introduce and utilize new products or processes”. Moreover, Atkinson and Stiglitz (1969) state that spillovers do not exist everywhere, as the neoclassical approach proposes, as this can be valid only if the new knowledge affects every other related scheme. New knowledge is usually embodied in its creators and as a result transferring it necessitates their “the active participation” (Zucker et al., 1994).

In my opinion, spillovers usually have a local character due to the common knowledge base that people may share in a geographical location. Actors invest in creating new knowledge and developing absorptive capacity, to be able to assimilate new external knowledge and stand competition (Foray, 2004). As a result, an individual or organization needs to be able to understand the new knowledge in order to use it and make it part of their own knowledge base.

Consequently, according to Cohen and Levinthal, (1989, p. 131) not everyone can take advantage of spillovers and this is why they are not uniformly distributed. R&D (Research and Development) in an organization produces new knowledge and improves its absorptive capacity and the assumption that the costs of transferring knowledge are minor should incorporate the fact that there have been previous investments in absorptive capacity. Otherwise the costs are higher. Also, as mentioned by the former, the absorptive capacity of an organization is not “simply the sum of the absorptive capacities of its employees” and depends on the internal and external environment. Each organization develops its absorptive capacity on its own, as it is usually “*firm specific*” and cannot so easily be incorporated in another organization.

As we can see, knowledge is localized in part, because adopting existing knowledge is not a simple procedure and the development of related knowledge base and absorptive capacities are needed for transferring it. If a non-local organization has the absorptive capacity to exploit new knowledge created somewhere else, it is possible to achieve it but with the help of the creators.

Knowledge is, due to its tacit nature, also sticky. According to von Hippel (1994, p.3) stickiness is “the incremental expenditure required to transfer that unit of information to a specified locus in a form usable by a given information seeker”. The degree of stickiness depends on the expenses of transferring, the capabilities of the receiver, the decision of the “provider” about the price, and naturally on the stickiness of the information itself. The latter occurs because knowledge can be tacit and as a result not transferable. Furthermore, organizations as mentioned before should have developed the required absorptive capacities so as to surpass this aspect. Agents must select the group of information needed for correcting mistakes, out of a huge amount of available information (von Hippel, 1994).



Stickiness also exists within organizations, as knowledge possessed across different departments of a firm is not common between them. “Organizations do not necessarily know all that they know” (Szulansli, 2000, p. 10) but through experience in transferring knowledge, firms become better in surpassing knowledge stickiness.

Knowledge is dispersed and uncontrollable. As long as knowledge is made known and is available, there is no way to control it Foray (2004). But, as suggested by Zucker et al. (1994) knowledge or innovation creators have the option of keeping their creations for their selves, in order to benefit as much as they can out of them. In such cases, knowledge can be controlled.

The localized nature of knowledge poses the limitation of spatial proximity for its common use. Previous investments in absorptive capacity are also essential for assimilating knowledge. The latter is also a prerequisite to surpass knowledge stickiness and transfer knowledge between actors. By taking in mind the nature of knowledge and its characteristics, we shall now proceed in studying the ways knowledge is created.

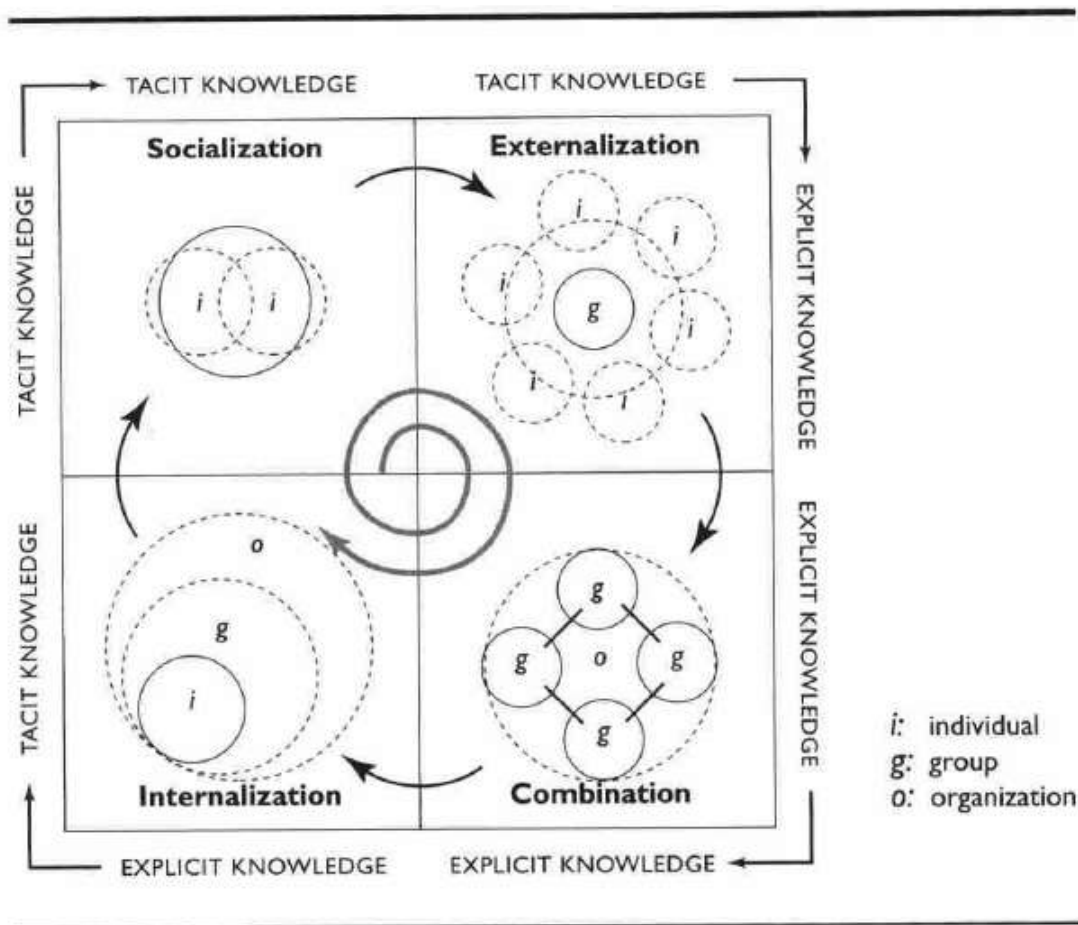
### **3.5. KNOWLEDGE CREATION**

The process of knowledge creation has been studied by a number of scholars, with a different focus.

According to Foray (2004, p. 15) knowledge is created through discoveries, which are “the accurate recognition of something which already existed but which was concealed” and inventions which are “produced” by man”. Also, as suggested by the former knowledge is created from “formal research and development work off-line” and “on-line”. (Foray, 2004, p.49)

Knowledge creation in organizations has also attracted academics to study it. Nonaka and Konno (1998, p.42) study knowledge creation in organizations and state that “Knowledge creation is a spiraling process of interactions between explicit and tacit knowledge”. Combining the two forms of knowledge gives us four “conversion patterns” as depicted bellow.

Figure 3.2.: Spiral evolution of knowledge conversion and self-transcending process



Source: Nonaka and Konno, 1998, p. 43

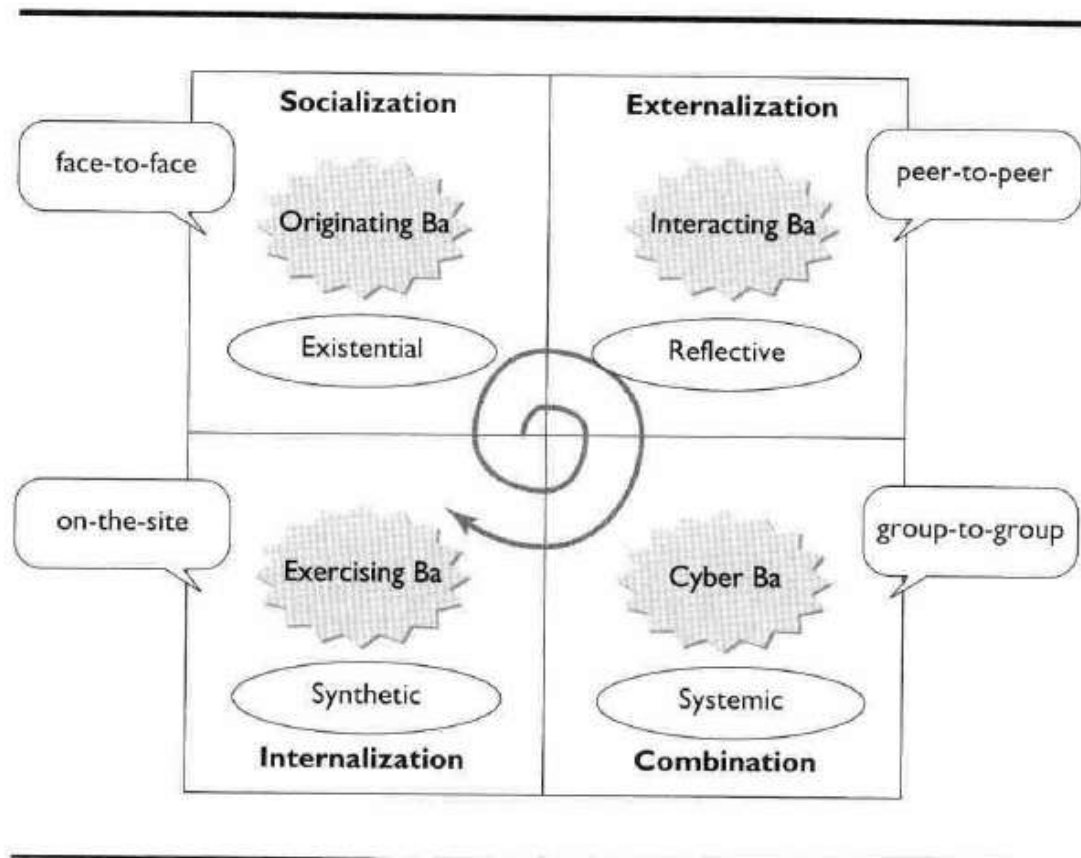
As suggested by Nonaka and Konno (1998) “Socialization” encompasses “The sharing of tacit knowledge between individuals” which “is exchanged through joint activities- such as being together, spending time, living in the same environment- rather than through written or verbal instructions.” (Nonaka and Konno, 1998, p. 42). In this phase “physical proximity” is vital, tacit knowledge is transferred in every interaction within and outside the organization.

“Externalization” involves “the expression of tacit knowledge and its translation into comprehensible forms that can be understood by others” (Nonaka and Konno, 1998, p.43). Now, tacit knowledge is made explicit, and “, an individual commits to the group and thus becomes one with the group” (Nonaka and Konno, 1998, p. 44)

In the next stage “combination”, explicit knowledge is converted into “more complex sets of explicit knowledge”. Here, “diffusion processes and the systemization of knowledge” (Nonaka and Konno, 1998, p. 44-5) as well as communicating are very important. The last phase “internalization”, involves converting the novel explicit knowledge created in the company into tacit knowledge. “Learning –by-doing, training, and exercises allow the individual to access the knowledge realm of the group and the entire organization”.

Nonaka and Konno (1998) use the “ba concept” which is “a shared space for emerging relationships.” and can be “physical (eg. Office, dispersed business space), virtual (eg. E-mail, teleconference)”, mental (eg. Shared experiences, ideas, ideals) or any combination of them.” to explain the creation of knowledge. There are four kinds of ba which keep up a correspondence with the four phases of the SECI model.

Figure 3.3.: The four characteristics of Ba



Source: Nonaka and Konno, 1998, p. 46

The “originating ba” is “the world where individuals share feelings, emotions, experiences, and mental models.” pg 46 (Nonaka and Konno, 1998, p. 46). This ba reflects the “socialization” stage.

The “interacting ba” is the phase where “Through dialogue, individual’s mental models and skills are converted into common terms and concepts” (Nonaka and Konno, 1998, p.47). Here tacit knowledge is converted into explicit (“externalization” stage).

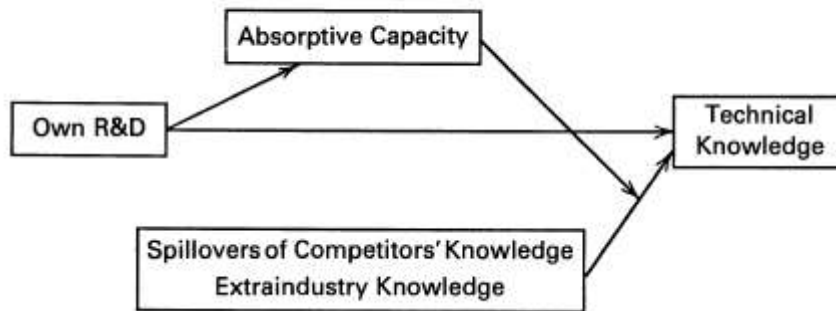
In the “cyber ba” we have “the combining of new explicit knowledge with existing information and knowledge generates and systemizes explicit knowledge throughout the organization” and “The combination of explicit knowledge is most efficiently supported in collaborative environments utilizing information technology.” (Nonaka and Konno, 1998, p.47). The “combination” phase is represented by this ba.

The “exercising ba” involves “Focused training with senior mentors and colleagues” with “continued exercises that stress certain patterns and working out of such patterns.” (Nonaka and Konno, 1998, p. 47). This ba reflects the “internalization” stage. The former regard the roles of managers and leaders very important for supporting knowledge creation in an organization.

The combination of knowledge created into the organization and of knowledge acquired from other exterior sources is considered important for knowledge creation in businesses. Of course this does not mean that the organization can work only with “exterior” knowledge. (Antonelli, 2008)

According to Cohen and Levinthal (1990) the organization’s absorptive capacity is crucial for its ability to utilize exterior knowledge and it is created through the business’s R&D.

Figure 3.4.: Model of sources of a firms technical knowledge



Source: Cohen and Levinthal, 1990, p.141

Consequently, knowledge creation is a complex process, and demands investment in resources and absorptive capacity. R&D and innovation are very important sources of new knowledge. This process involves knowledge transfers between actors sharing similar knowledge bases and knowledge assimilation.

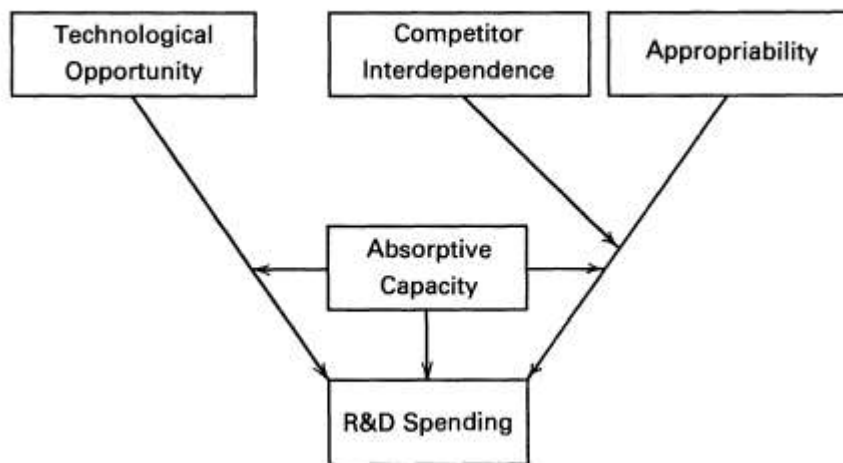
### 3.5.1. R&D AND INNOVATION

According to Foray (2004, p.50) R&D is “intellectual creation undertaken systematically for the purpose of increasing the stock of knowledge.”. The former distinguishes three types of R&D: the “Basic or fundamental research”, “Applied research” and “Infratechnology”. The first category refers to generating “basic knowledge that allows for a fundamental understanding of the laws of nature or society”. Through the second type, knowledge is created so as to help solving realistic difficulties. The last one, refers to “sets of methods, scientific and engineering databases, models, and measurement and quality standards that support and coordinate the investigation of fundamental physical properties of matter and the practical implementation of basic knowledge” (Foray, 2004, p.51)

The R&D does not simply create novel knowledge; it also helps the organization acquire external knowledge. As suggested by Cohen and Levinthal (1989) there are three factors that determine “R&D intensity”: “demand”, “appropriability” and “technological opportunity”.

As far as demand is concerned, it determines the organization's profit after an innovative step in production, which will lead to a price decrease. Appropriability is “the degree to which firms capture the profits associated with their innovative activity and are often considered to reflect the degree to which valuable knowledge spills out into the public domain” (Cohen and Levinthal, 1990, p.139). Technical advance is very important for organizations. Last but not least, the technological opportunity stands for the circumstances and expenses under which an organization can accomplish a “technical advance” in a specific sector.

Figure 3.5.: Model of absorptive capacity and R&D incentives



Source: Cohen and Levinthal, 1990, p.140

Through the former model, Cohen and Levinthal (1990, p.139) state that inducements to learn affect R&D investment, the absorptive capacity of the organization and its competitors determine technological opportunities and appropriability. The latter depends on “competitor interdependence”, which is “the extent to which a rival's technical advances diminish the firm's profits”.

Nonaka (2007), has a different opinion about innovation and R&D. He states that R&D is not the only essential activity for an organization to innovate, but “The essence of innovation is to re-create the world according to a particular vision or ideal. To create new knowledge means quite literally to re-create the company and everyone in it in a nonstop process of personal and organizational self-renewal”.

As a result, knowledge is created through formal and informal R&D, innovations, discoveries and whichever activity that leads to new understanding. As suggested by Arrow (1962), “The acquisition of knowledge is what is usually termed ‘learning’”.

### **3.6. LEARNING**

According to Arrow (1962), “Learning is the product of experience. Learning can only take place through the attempt to solve a problem and therefore only takes place during activity”.

Learning can be divided in two categories: Learning-by-doing and Learning-by-using. As suggested by Foray (2004, p.58), learning-by-doing is “a form of learning that takes place at the manufacturing (and/or utilization) stage after the product has been designed (i.e., after the learning in the R&D stages has been completed” and can also lead to innovations.

Learning-by-doing is also argued to be situated and according to Tyre and von Hippel (1997), as “the ability to understand and resolve problems is only partly located in experts' heads”. This means that whatever an individual has learned in a specific organization cannot be transferred to a different setting or organization as it depends on the physical setting.

Learning-by-using is another form of learning that takes place when using manufactured goods, and practices. According to Foray (2004, p. 62), through learning-by-using “using generates problems; problem-solving capacities are deployed and learning occurs”. Problems that have not been detected by the producers occur when using a product.

Lave and Wenger (1991, p.122) provide a new approach for learning. They believe that learning has not only a situated, but also a social character and that is because “Knowing is inherent in the growth and transformation of identities and it is located in relations among practitioners, their practice, the artifacts of that practice, and the social organization and political economy of communities of practice”. Learning is not only related to particular tasks, but also to “social communities”, in which participants are related and characterized by the relations between them.

The former analyze learning in the context of legitimate peripheral participation, which is not a way for learning but the environment where learning occurs in communities of practice that as stated by the former “have histories and developmental cycles, and reproduce themselves in such a way that the transformation of newcomers into old-timers becomes unremarkably integral to the practice”.

After reviewing what knowledge is with the analysis of its characteristics, the way it is created and the way learning takes place, the way knowledge may be governed will be studied. The nature of knowledge poses many limitations to its common use (tacit, located, sticky, created through cooperation). R&D and innovation are fundamental sources of new knowledge. Absorptive capacity is an essential aspect for knowledge creation and assimilation and learning is a way of acquiring knowledge through experience. As suggested by Boyle (2008, p.45) “we are in the middle of a second enclosure movement”, owing to the fact that intellectual property rights are applied to intellectual creations.

In the standard economics school knowledge was thought of as a public good as nobody could be excluded from using it and because of the fact that when somebody used it another person’s use was not subtracted. On the one hand, knowledge as commons is supported by universities and many scholars, while on the other hand copyright laws exist to ensure limited access to knowledge in the form of business or scientific patents. As a result there is a dilemma in the use of knowledge. (Hess and Ostrom, 2007)

The term property right has been defined by Ostrom (1999) as “an enforceable authority to undertake particular actions in a specific domain. Property rights define actions that individuals can take in relation to other individuals regarding some ‘thing’. If one individual has a right, someone else has a commensurate duty to observe that right.”



### 3.7. INTELLECTUAL PROPERTY RIGHTS

Intellectual property is about works of the mind, as WIPO (p. 2) puts it “inventions; literary and artistic works; and symbols, names and images used in commerce”. Creators are motivated to innovate knowing that under intellectual property rights they will bear the fruit of their creations. Industrial property and Copyright are the two parts that define intellectual property, therefore it is essential not to forget mentioning them when we acknowledge intellectual property. Industrial Property is comprised of: “patents for inventions, trademarks, industrial designs and geographical indications”. Copyright refers to “literary works”, “artistic works”, music, etc. (See Appendix)

Nevertheless, there are alternative systems that can provide incentives for intellectual creations without keeping them protected. As suggested by Keely and Quah (1998, p.17) except for patents “publicly-financed prizes or research grants awarded for proposals judged in competition with others” or a regime where “a public body contracts out in advance for a piece of research to be undertaken” leaves knowledge free to the public afterwards.

In sum, intellectual property rights on the one hand provide incentives to the creators of new knowledge, but on the other hand keep it enclosed. As a result, knowledge creation is blocked, owing to the fact that knowledge comes from knowledge. As argued by Boldrin and Levine (2002, p.1) IPRs have become an intellectual monopoly as “‘intellectual property’ has come to mean not only the right to own and sell ideas, but also the right to regulate their use”.

But will anybody be motivated to invest or get involved in commons? Privatization gives a solution to “The tragedy of the commons” problem and helps to get as much as possible from a resource. Knowledge does not belong to the same category with other resources and although it is becoming more and more important in modern societies it wouldn’t be right to block access to it, as information or works of this kind are the starting point for the next one and in this framework innovation is fostered.

### 3.8. KNOWLEDGE AS COMMONS

In this section, knowledge managed as a common will be analyzed (taking in mind its special nature that distinguishes it from the traditional goods) and the conditions under which knowledge can be a commons are figured out.

It was in mid-90's that the correlation between commons and information became apparent with a number of people from different disciplines beginning to study it. The Internet made this connection obvious, as it had the characteristics of other kinds of commons - congestion, free riding, conflict, overuse, and "pollution" (Hess and Ostrom, 2007, p. 4).

The classic theory of the "tragedy of the commons" is not valid in knowledge commons as the use of a unit of knowledge does not deprive it from others. As stated by Foray (2004, p.17), "Knowledge commons" are not subject to the classic tragedy of commons that describes the case where exhaustible resources (such as a pasture or a shoal of fish) are subject to destruction by unregulated access and exploitation. Knowledge may be used concurrently by many, without diminishing its availability to any of the users, and will not become "depleted" through intensive use".

Tragedy can only occur if people do not create but only free-ride or if producers are not motivated to create due to lack of rewards for their work. University deposits can also suffer from free riding, when some scholars do not offer their work like the others, but the unusual problem of underusing could cause much more harm as the published books and articles are not sufficiently used and exploited.

Nevertheless, knowledge commons have been identified as information commons. But as mentioned before, information is much different from knowledge because it can easily be transferred, as it is codified. Hess and Ostrom the editors of the book "Understanding knowledge as commons" suggest that knowledge can and should exist in a common regime.

They believe that knowledge commons were created due to novel technologies, as before them knowledge was only depicted in books etc. Digital information altered the characteristics of knowledge (the same could be for every common resource) and made it a commons. The members of this kind of commons are divided into “information users”, “information providers” and “information managers” (Hess and Ostrom, 2007, pg 48-9). This approach is valid for information commons. Knowledge is not that simple to transfer and obtain, through large distances.

Suber (2007, pg. 174-5) analyzes open-access literature in the World Wide Web. “The focus of the OA movement is on a special category of content that does not earn royalties for its creators: peer-reviewed research articles and their preprints”. This is because works of that kind do not compensate their creators financially; they are paid by universities for teaching anyway, but offer them better career options if their article is “noticed, read, taken up, built upon, applied, used, and cited.” In open-access literature, creators pay for the publication.

In my opinion open access literature is not a knowledge common. This is because somebody reading an article should already have the absorptive capacity in order to understand it and for it to become knowledge for him. This means that we can have knowledge commons under the prerequisites of the existence of previous investments in absorptive capacity. Also, as mentioned before a part of knowledge is tacit, sticky and localized, and not easily transferred especially through distance as implied by the Internet. As a result this regime refers to information and not knowledge commons.

Schweik (2007, p.284-5) talks about Free/Open Source Software (FOSS) and considers it a knowledge common that can be a paradigm for other kinds of knowledge. “In FOSS settings, the community is composed of users of software and software providers (programmers)”. The contribution of creators to FOSS is attributed to 3 types of incentives: “technological” (“need for software that is unavailable or too expensive, and the individual realizes he or she cannot develop it working alone”), “sociopolitical” (Free Software Foundation, personal motivation) and “economic”. (HR production and work experience are the economic explanations. Usually FOSS teams are made up by a small number of participants or at least small part of the big team contributes).

The evolution of FOSS programs is the result of the creation of regulation like “licensing” and “governance structures”, the characteristics of group members (“motivated volunteers and users or paid programmers”) and the software construction that facilitates cooperation and managing.

The latter regimes can be considered a kind of knowledge commons, as they are managed under regulation and members are motivated for their existence. FOSS can be a commons example that can be applied to other commons as well, as not only the actual product but also developing the program is also a common procedure, people inside and outside the procedure can take part in it, free copying and distributing is permitted, and the online nature of FOSS facilities enable quicker publishing. The geographical locations of users and contributors have been studied and show that they are usually located in specific regions.

By collecting the public application programming interface (API), following, repository-watching and code contributions of Github et al. (2010) find that “Participants are spread around the world, though concentrated substantially in some regions”. The user percentage in North America is about 43% and 23% in West and South Europe. The contributions rise to 48% in North America. Users and contributors are concentrated in local clusters. The first 10 are for the 29% of users and 35% of contributors and are depicted in the figure below.

Table 3.1.: Github participation by local clusters (%)

Cluster	Share of users	Share of contributors	Share of contributions
San Francisco, USA	7.4	7.4	9.7
London, UK	4.2	4.4	3.7
New York, USA	3.9	3.7	4.1
Tokyo, Japan	2.6	2.7	3.2
Boston, USA	2.2	2.4	3.3
Seattle, USA	2.0	2.0	2.2
Chicago, USA	1.9	2.1	2.4
Washington, USA	1.8	2.1	1.9
Los Angeles, USA	1.8	1.6	2.9
Paris, France	1.6	1.8	1.6

Source: (Github et al., 2010, p.8)

Here we can note the existence of clusters apart from North America, like the one of Tokyo which takes the fourth place.

Furthermore, Takhteyev and Hilts (2010) have found 51.507 “contributor-owner pairs” 24% of which were located in the same cluster, with the percentage of contributions to be 43% within the same local cluster. As result, the existence of ties is also noticed.

In contrast, Ghosh et al. (2002) study the FLOSS (Free/Libre and Open Source Software) and find that 71 percent of the developers come from European Union countries, 17 percent from the rest European countries and only 17 percent from North America. But the case is where those people actually live or work. As far as the latter is concerned, results are also in favor of European Union countries that capture 70 percent of the total, with 16 percent for the rest European nations and 14 percent for North America. By drawing comparisons on the former results of ethnicity and place of habitation Ghosh et al. (2002) calculate “country-specific mobility balances”, in order to estimate the “attractiveness” of countries.

The most attractive country is the United States of America, followed by Norway, Italy and Germany but with much lower mobility balances. There are also many countries with a negative mobility balance. Those results come in contrast with the place of ethnicity and habitation, where Europe prevails.

Gonzalez-Barahona et al. (2008) study the SourceForge database and the mailing lists archives from some large projects and find that Europe and North America have the most users. But, as far as active users are concerned (those who alter the code), the European Union countries are better. The same result is also drawn by the mailing lists.

Table 3.2.: Number of users in SourceForge by region

Region	Developers
Africa	12,560
Asia	127,275
EU	401,845
Europe	466,792
North America	485,679
Oceania	46,422
South America	36,330

Source: Gonzalez-Barahona et al., 2008, p. 359

As a result FOSS users are geographically located, and the most favorable regions come first. This means that users form a kind of a local common and try to find the most proper environment for it. Open source software exists in a codified form and as a result users and contributors can learn through this procedure.

By investigating whether Ostrom's (1990) principles for successful CPRs are applicable to knowledge commons or have to be revised we can conclude to their characteristics.

These principles are

- Clearly defined boundaries should be in place.
- Rules in use are well matched to local needs and conditions.
- Individuals affected by these rules can usually participate in modifying the rules.
- The right of community members to devise their own rules is respected by external authorities.
- A system for self-monitoring members' behavior has been established.
- A graduated system of sanctions is available.
- Community members have access to low-cost conflict-resolution mechanisms.
- Nested enterprises—that is, appropriation, provision, monitoring and sanctioning, conflict resolution, and other governance activities—are organized in a nested structure with multiple layers of activities.

(Hess and Ostrom, 2007, p. 7)

The first principle is valid for knowledge commons, as the boundaries of such communities are clear, taking in mind that knowledge is situated, sticky and tacit. Those characteristics make transferring and sharing it a complex process. Becoming a member of such a community presupposes that one has a similar knowledge base and absorptive capacity. Members have usual interactions and know each other very well. Those characteristics clarify the boundaries of knowledge commons, making them participation specific. Also, if knowledge commons are internal in businesses, boundaries are certainly well defined. Nevertheless, during cooperation between businesses boundaries may be extended, but in my opinion they still remain clear.

As far as the second principle is concerned, the creation of appropriate rules for achieving goals and cooperating effectively is crucial for knowledge commons. If actors do not find a way to share their knowledge and experience, knowledge creation and diffusion will be hindered. Through the formation of a relating regulation, which ensures that everybody offers to the team, knowledge commons will be sustainable and thriving. Those rules can be formal, as well as informal.

Also, according to the third principle the members of those communities are the ones who decide for the regulation, as they know the ways of cooperation between them better than anyone. In the case of knowledge commons, this is not always the case especially if they exist inside firms. In the latter context, regulation may be imposed by higher levels of administration, in respect to the organizations goals.

Monitoring in knowledge commons can take place between members –as they know the part of the work each member is expected to do- but also by external actors, who will check each members work. Actors need to be sure that everyone offers their work to the team and no free-riding takes place, in order to act accordingly. This procedure is essential, because as mentioned before knowledge comes from previously produced knowledge. If part of the actors stops offering to the team, knowledge production may be hindered.

Graduated sanctions are essential for compliance to the rules from all members. Small fines with the first sighs of non-compliance by a member and exclusion in case this behavior becomes a habit, ensure the commons sustainability. In the case of businesses, graduated sanctions may range from a warning to dismissal.

Conflicting interests among actors may lead to disagreements. Each member in knowledge commons may be motivated to take part for a different personal reason. Being able to solve those problems through “low-cost conflict-resolution mechanisms” is important for the common’s wellbeing. This can take place in regular meetings, where actors pose their opinions and concerns, ending up with a solution

In cases where knowledge commons are made of many actors, the last principle should be applied, and actors should organize themselves in “nested enterprises”. In this case, the large knowledge common is made of many smaller ones in and between which all the above procedure takes place. This way, larger knowledge commons are effectively organized.

Consequently, Ostrom’s (1999) principles can be applied to knowledge commons, but in case some of them are not followed, successful governance may take place as well. This does not mean that the commons theory is irrelevant and cannot be used as a new approach to knowledge governance. The context of the commons may be a solution for the “tragedy of the commons” in knowledge as well, because it ensures cooperation and therefore new knowledge production, without keeping knowledge behind the bars.

Knowledge as commons can exist locally between people who have the same knowledge base and as suggested by Foray (2004, p. 179) “The emergence of “open knowledge” institutions is always based on the historical emergence of structures of mutually consistent expectations, resulting in the creation of “common knowledge. It becomes common knowledge that openness increases the general performance of the system and that diffusing one’s own knowledge contributes to a positive sum game”. As a result, knowledge commons can exist among groups of people that are locally concentrated-so that tacit, sticky and localized knowledge can be transferred as well, have about the same knowledge base, absorptive capacities and share common goals for the development of knowledge.



### 3.9. CONCLUSION

A source of confusion has emerged in the management of knowledge, as it has been equalized with information. Having specified knowledge we have understood that it is very different from information and has special characteristics that make its creation and diffusion a difficult process. Unlike traditional goods, the nature of knowledge implies limitations to its use and to being common for people. This is because the transfer of tacit knowledge is achieved through experience and spatial proximity. Surpassing the stickiness of knowledge also asks for cooperation and personified interactions.

R&D and innovation are crucial sources of new knowledge and demand cooperation and spatial proximity. Being able to acquire already created knowledge, like knowledge spillovers, presupposes previous investments in absorptive capacity and similar knowledge bases between the receiver and the creator. Knowledge creation is fostered in “communities of practice” where actors combine their knowledge and experience, forming knowledge commons, and is crucial as new knowledge comes from existing knowledge. For this to happen, existing knowledge should be transferred and exchanged between actors, which implies the prerequisite of absorptive capacity.

Ostrom’s (1999) design principles have been applied to knowledge commons and we have concluded that the theory of the commons can be utilized to offer a new approach for knowledge governance. Of course, the application of all principles is not essential for successful governance, but this is what Ostrom states as well.

Consequently, knowledge commons and their success depend on the prerequisites of being able to share explicit as well as tacit knowledge that implies the existence of similar knowledge bases and culture. Spatial proximity is also a critical factor for knowledge to become common within a group of people, as it enables tacit, localized and sticky knowledge transfer through cooperation and akin absorptive capacities. Communities of practice may be considered as knowledge commons, owing to the fact that they fulfill all the former prerequisites.

This is what takes place in innovation clusters as well (analysed in the next chapter), where businesses involve in the same industrial sector, sharing the same culture and knowledge bases.

Through this perspective, knowledge may be released from the context of austere copyrights and be exploited, shared, diffused and assimilated, between specific actors, facilitating knowledge creation and fostering social welfare.

# **CHAPTER 4**

## **Knowledge in innovation clusters**

#### 4.1. INTRODUCTION

The geographic dimension of innovative activities and its implications on economic clustering has inspired the studies of many economists, as many regions made efforts to imitate the successful cases of Silicon Valley and Baden Wurttemberg. As a result a range of theories emerged.

One of them has to do with localized knowledge spillovers, which argues that closely located actors are more likely to transfer new knowledge in contrast with Krugman and others who believe in an unbounded world of information that cannot be measured. According to this theory the spatial proximity makes the cost of transmitting the knowledge lower, due to its tacit nature and complexity.

Furthermore the effective transmission of knowledge can be achieved through interpersonal contacts and inter-firm mobility of workers. Consequently innovation is likely to cluster and be generated in places where the key knowledge inputs are available, knowledge tends to spill over locally and takes time to diffuse across geographic distance and the extend of spatial clustering varies across industries depending on the stage of the industry life cycle and the importance of tacit knowledge.

However this theory has left behind a number of important factors which have been studied by other theories like the economic geography and regional economics. The latter include technological districts, new industrial districts, the innovative milieu, the French school on proximate and other. As far as this category is concerned firms are attracted to creating clusters because they gain knowledge through user-producer relationships, formal and informal collaborations, inter-firm mobility of skilled human resources and the spin-off of new firms, universities and public research centers. (Moulaert and Sekia, 2002)

Firms form a network of knowledge sharing which depends on the establishment of close social interactions, trust and informal relations between them, and are supported by exogenous factors like universities and endogenous ones like skilled employees. The evolutionary theory provides a different perspective where agents are heterogeneous in experience, competences and performance and work in diverse environments.

As far as innovation is concerned actors are restricted by technology, knowledge base and institutional context in which firms operate, so firms having to do with related technologies have many other things in common. For this reason the procedures of innovation and production will be different for every industry, as concentration differs according to sector specific key-drivers of agglomeration. (Moulaert and Sekia, 2002)

Next, in the innovation systems approach it is assumed that firms do not innovate by themselves but in interaction with each other and with other organizations, like universities and government agencies, and are influenced by the local institutional framework. This approach is considered to be either regional, as the borders of the innovation clusters cannot be ignored, or sectoral, owing to the differences between industries. (Moulaert and Sekia, 2002)

The goal of this chapter is to discuss the roles of the different actors in producing knowledge in an innovation cluster and the way knowledge is diffused, assimilated and exploited in it. Furthermore, we will examine the way knowledge constitutes a common resource in those clusters and to what extent.

## **4.2. INNOVATION CLUSTERS**

According to Porter (2000, p. 16) a cluster is a “geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities. The geographic scope of clusters ranges from a region, a state, or even a single city to span nearby or neighboring countries”. Actors in clusters range from cluster members and “suppliers of specialized inputs like components, machinery, and services” (Porter, 2000) to state or non-state institutions like universities, which support it technically and educationally. Also, external businesses can be part of a cluster if they have invested in it permanently. Cluster boundaries are not fixed, owing to the fact that businesses come and go and their institutions are under continuous development.

Also, as suggested by Hart (2000, p.2) an innovation cluster is “a cluster of inter-acting firms operating, often in a particular industry, within a fairly small spatial compass and the firms are ‘embedded’ in their local area in terms of production linkages including their workforce and communication flows”, while according to an OECD study (1999) clusters are “reduced-scale national innovation systems.

The dynamics, system characteristics and interdependencies of individual clusters are similar to those of national innovation systems. With its focus on knowledge linkages and interdependencies between actors in networks of production, the cluster approach offers a useful alternative to the traditional sectoral approach”. (OECD, 1999, p.8). As a result, innovation clusters are areas where actors communicate and have similar knowledge bases and goals. As stated by Audretsch and Feldman (2011), “innovative activity clusters in industries where knowledge-generating inputs and knowledge spillovers are intense. Knowledge spillovers are more important in R&D intensive industries and in industries where the labor force is made of skilled workers.” (Audretsch and Feldman, 2011)

Clusters lead to innovation as they allow fast awareness of new buyer needs, concentration of knowledge and information, rapid absorption of new technological potentials, they offer richer insights into new management practices, they assist ongoing interactions with other institutions (as well as universities) and provide localized knowledge resources.

As it is suggested by the OECD (1999, p. 11) study “innovation is no longer perceived as a linear process, but as the result of a complex interaction between various actors and institutions. These actors and institutions and their interconnections constitute a system of strongly interdependent agents”. Institutions include “organizations such as universities, research organizations, financial institutions or all kinds of brokerage organizations that are in one way or the other involved in innovation processes” as well as the local culture. This is what takes place in an innovation cluster. Actors depend on each other and businesses can have the roles of a customer, a supplier or a subcontractor exchanging knowledge while being engaged in “mutual learning”. This procedure is supplemented by the presence of and interaction with universities and other relating structures.

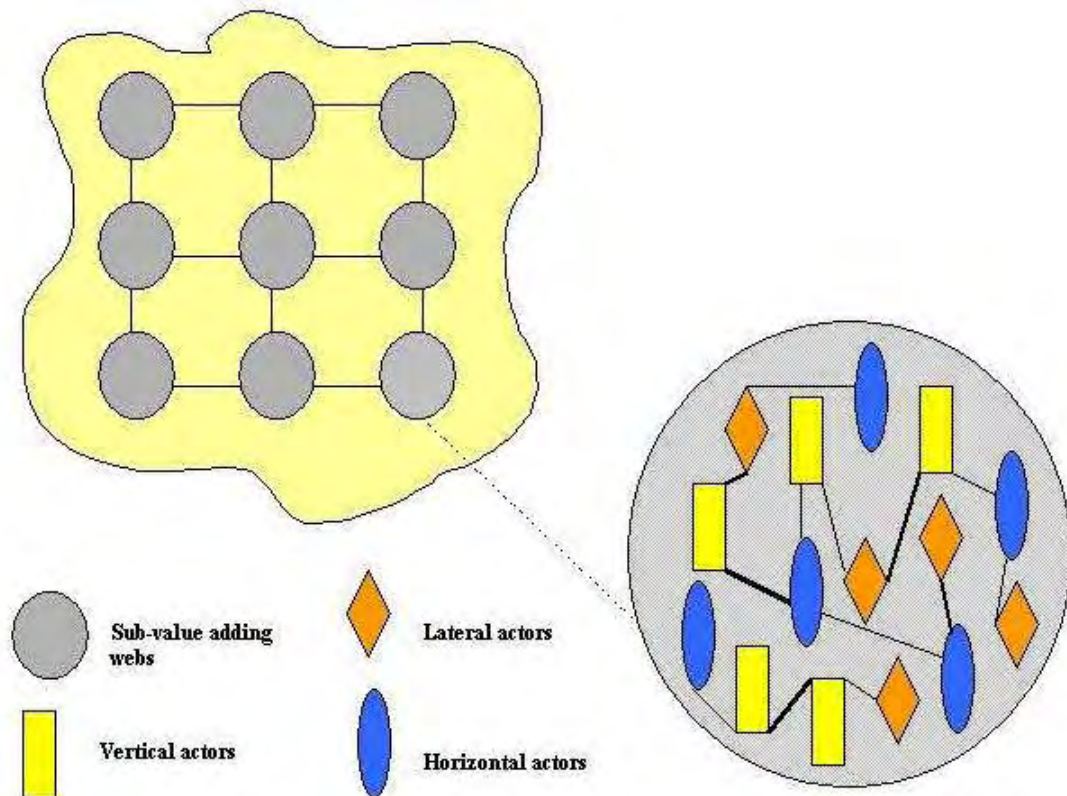
The local culture is embedded by the actors of the cluster, and affects their behavior leading to the development of trust among them. According to Wei and Xiang (2010) “cultural proximity will be important for the formation of trust relations between firms and inter-firm network relationships.

Conversely the cluster’s behavior will influence the local culture. The cluster’s structure and behavior change will have an impact on its capabilities, capacity and competitive advantage” (Wei and Xiang ,2010, p. 1662). Hart (2000) states that there are three types of embeddedness: “institutional embedding”, “structural embedding” and “relational embedding” . The first one has to do with the embeddedness of institutions and is not always local, the second one has to do with the “that depends on size (number of participants or ‘nodes’), density (actual number of direct ties between nodes as a ratio of the maximum possible number), centrality (of which there are several forms), and stability of structure (rate of entry and exit)” (Hart, 2000) and the third refers to the “strength of ties”.

Brown et al. (2007) distinguish interactions between the actors of a cluster into “internal” (interactions inside the cluster), “external” (interactions with exterior actors). “Internal” interactions can be “direct” (direct interaction between businesses) or “indirect” (where “a third party functions as a connector between firms within the cluster”).

In the latter case the interfering actor can be another business or the university. They also distinguish actors in a cluster into “Lateral actors”, that can be “universities or economic development agencies that facilitate the firms in a cluster to perform better”, “Horizontal actors” that represent the businesses producing manufactured goods inside the cluster and “Vertical actors” being the actors who supply or buy the products of the “vertical actors’.

Figure 4.1.: The cluster as value adding web



Source: K. Brown et al., 2007, p. 7

As a result Brown et al. view clusters as a “value adding web” comprised of “sub cluster value-adding webs”, where businesses produce knowledge for their selves and indirectly for the entire cluster. All actors are in constant interactions with each other.

#### 4.2.1. FIRMS IN INNOVATION CLUSTERS

Firms in a cluster work to produce their own knowledge, as well as take advantage of the knowledge spillovers and the research conducted by universities. Firms also exchange knowledge by cooperating with each other.



According to Christ and Slowak (2008) businesses have to do with novel knowledge (K1), “approved knowledge stocks” (K2), “knowledge flows” (D1) from economic relations and knowledge spillovers from other businesses (D2). D1 and D2 are the result of the cooperation between businesses. In this way clusters create competitive advantage and attract skilled human resources and finance.

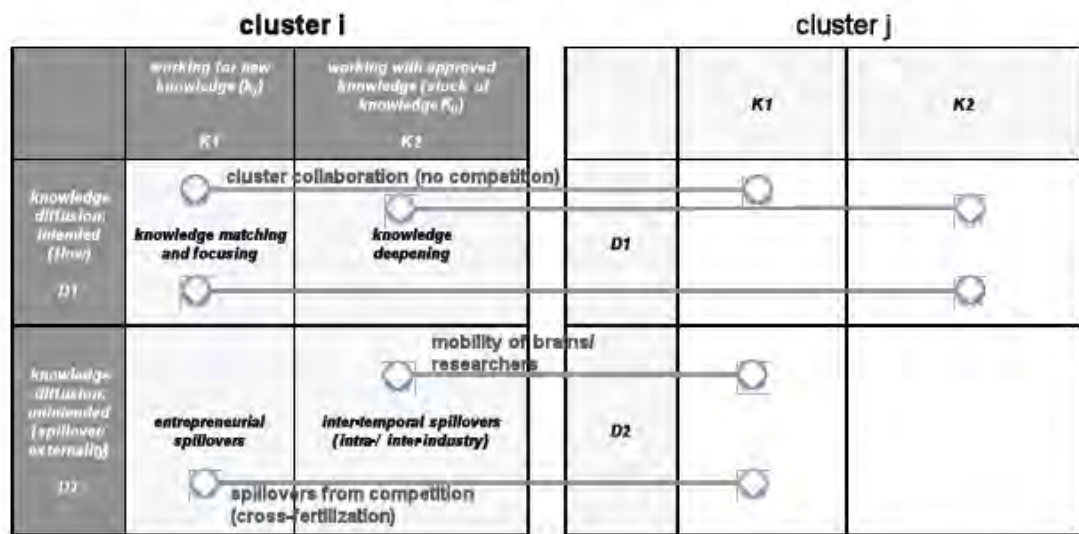
Figure 4.2.: Knowledge dynamics in innovation clusters

<b>cluster i with affiliated agents j=1...n</b>		
	<i>working for new knowledge (<math>k_i</math>)</i> <b>K1</b>	<i>working with approved knowledge (stock of knowledge <math>K_i</math>)</i> <b>K2</b>
<i>knowledge diffusion: intended (flow)</i> <b>D1</b>	<b>knowledge matching and focusing</b>	<b>knowledge deepening</b>
<i>knowledge diffusion: unintended (spillover/externality)</i> <b>D2</b>	<b>entrepreneurial spillovers</b>	<b>inter-temporal spillovers (Intra/ interindustry)</b>

Source: Christ and Slowak, 2008, p. 32

Knowledge is exchanged between clusters as well. Those can take place due to cooperation between clusters, mobility of human resources and knowledge acquired from spillovers between competing businesses.

Figure 8: Knowledge dynamics between innovation clusters



Source: Christ and Slowak, 2008, p.34

The former model leaves behind the possible intermediates assisting the cooperation between firms. As stated by Wolfe and Getler (2004), businesses interact indirectly through “civic associations” and neighboring organizations”.

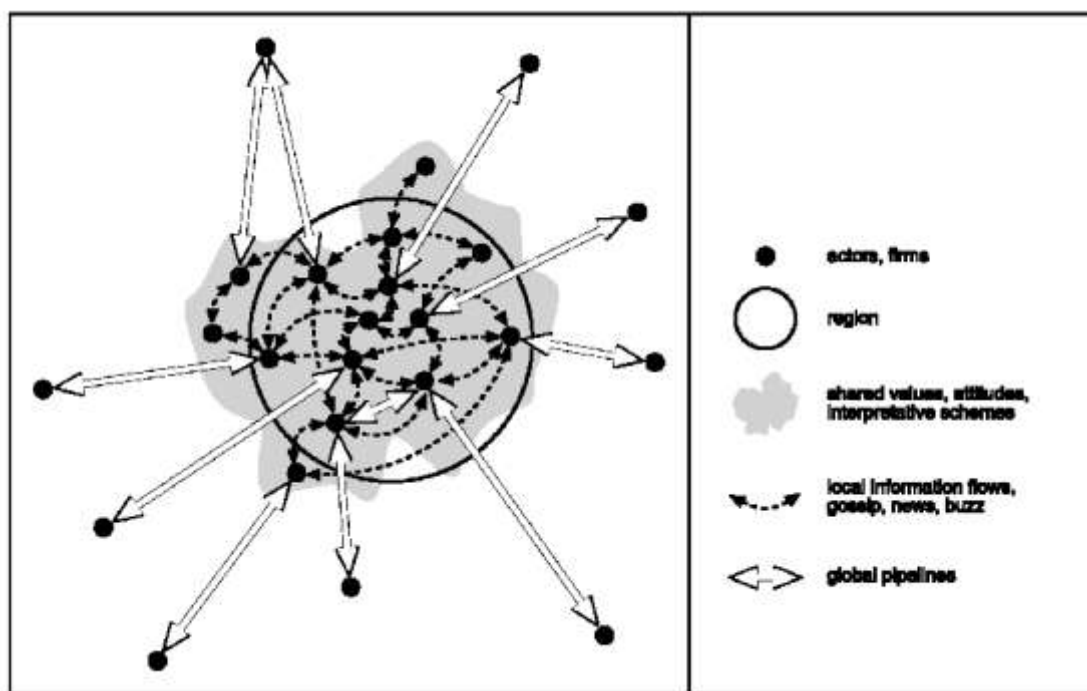
Bathlet et al. (2004) make a distinction between the “horizontal” and “vertical” dimensions of a cluster. The first dimension includes competing businesses that create akin products. Here, competition leads to innovative activities and monitoring of competitors is facilitated. The second dimension includes “those firms which are complementary and are interlinked through a network of supplier, service and customer relations” (Bathlet et al. 2004, p.36).

As suggested by Brown et al. (2007), the competitive advantage of businesses in a cluster emerges when it is better than the others, due to the difficulty of being imitated. The latter can be attributed to “physical uniqueness, path dependency, causal ambiguity, and economic deterrence” (Brown et al., 2007, p.9).

The former conceptualize a cluster as a place where “information flows, gossip and news create a complex multilayered information and communication ecology” (“local buzz”) (Bathelt et al., 2007, p.38).

The “local buzz” is a crucial factor for a cluster’s development. “Pipelines” with external firms bring in new knowledge to the firm and the rest of the cluster and a cluster can use many “pipelines” due to the number of firms located in it, in contrast to a firm located in isolation. The next figure depicts “a cluster of interrelated actors and firms which are bound together through interfirm transaction and communication linkages within a particular value chain.” (Bathelt et al., 2007, p.45)

Figure 4.4.: The structure and dynamics of local buzz and global pipelines



Source: Bathelt et al., 2007, p. 46

A local culture is developed in the cluster, that fosters trust and cooperation. As we can see, a cluster is not constrained inside the region, but can expand to interactions with external actors as well.

Firms benefit in many ways by being part of a cluster. According to Baptista and Swann (1998) on the one hand, firms exploit the high rates of demand in this place gaining part of the customers -due to the existence of similar businesses in the cluster- and take advantage of the opinions of “key-users” located close to the cluster. On the other hand, benefits derive from the available skilled workforce in the district and from the knowledge spillovers facilitating innovation.

#### **4.2.2..UNIVERSITIES IN INNOVATION CLUSTERS**

Universities provide a cluster with knowledge and skilled human resources. According to Chis et al. (2008, p. 5) universities stand for:

- “- a very important factor in the research activity;
- a vector of knowledge in economy and society;
- an important actor can participate at the economical and general development strategy elaboration and implementation.”

As suggested by the former, the university's operation is to create knowledge through its R&D, provide a highly skilled work force, provide firms with the novel knowledge and function as a manager of innovation projects in the region. Universities cooperate with local and external firms, the state and further research institutes facilitating knowledge creation.

Garcia and Sapsed (2011) state that universities among the its other provisions also facilitate working out of problems, “through contract research, consultancy work, or other mechanisms for university-industry collaboration such as Knowledge Transfer Partnerships (KTPs) and support businesses by “spin-off firms” using university R&D and other products and by providing “incubator spaces” for newcomers [“low cost access to high quality infrastructure, studio and office space in the proximity of university experts and other innovative businesses, with the ensuing opportunities for networking and information sharing]” (Garcia and Sapsed, 2011, p.23)].

Table 4.1.: University activities

Activity	Outputs	Observations
Increase and organise the stock of knowledge	Papers, books, dissertations and reports Workshops, conferences and presentations Archives, museums and content repositories	High tech creative sectors rely on advances in the state of STEM knowledge Arts and humanities research helps creative organisations make sense of emerging media landscapes, and contextualise and understand creative ideas and cultural trends Practice-based research outputs act as sources of new ideas, inspiration and debate Archival content inspires and, in some cases, form part of new creative works
Create new instruments, tools and methodologies	Patents and other IPs [E.G. copyright; informal IP advantages]	Technology outputs from STEM disciplines are valuable for increasingly digitised creative sectors. Methodologies and tools developed by Arts and Humanities researchers are applicable in the Creative Economy.
Supply of talent/human capital	Graduates and post-graduates Events that socialise graduates into wider creative communities CPD courses	Creative talent is the main source of value in the Creative Economy. Rapidly shifting technologies and markets mean that practitioners need strong 'core skills' that can be adapted rapidly to new developments in the field, as well as ways to upgrade their skillsets. Studio model in UK Arts colleges help students to learn their practice and get socialised within their peer group and wider creative communities
Build and convene networks	Events, conferences and workshops Festivals, exhibition and performances	Highly networked creative organisations use university events and spaces as venues for discussion and information sharing University conveyed/sponsored 'temporary clusters' support the creation of wider connections (e.g. from regional to national to international)
Problem solving	Contract and collaborative research and access to facilities Consultancy	Creative SMEs draw on university expertise & infrastructures to resolve technical and organisational challenges, and access strategic insights
Support entrepreneurialism	Spin offs Start-up incubators and SME Networks	The potential of spin offs as a channel for the commercialisation of STEM outputs for cultural and creative markets increases as the Creative Economy becomes digitised Incubators help high growth creative businesses by providing them with cheap office space, access to university expertise & opportunities to network with other organisations

Source: Garcia and Sapsed, 2011, p.24

### 4.3. KNOWLEDGE IN INNOVATION CLUSTERS

Knowledge in clusters is diffused in a variety of ways and has many forms. Actors interact and share or produce new knowledge. According to Todtling et al. (2009) there are “traded” and “untraded” relationships and “static” and “dynamic” knowledge interactions during the innovation process.

Table 4.2.: Types of knowledge interactions in the innovation process

	<b>static (knowledge transfer)</b>	<b>dynamic (collective learning)</b>
<b>formal / traded relation</b>	(1) market relations	(3) cooperation / formal networks
<b>informal / untraded relation</b>	(2) knowledge externalities and spillovers	(4) milieu / informal networks

Source: Todtling et al. 2009, p.61

“Untraded” relationships are the reason why firms concentrate in a particular district. “Static” knowledge interactions are the exchange of already created knowledge between actors, and “dynamic” knowledge interactions refer to “interactive learning” and the creation of new knowledge that occurs when actors cooperate. “Market relations” are formal knowledge exchange, when firms buy ready-to-use knowledge and “knowledge externalities and spillovers” are the result of informal knowledge exchange due to spatial proximity. Furthermore, “cooperation/formal networks” refer to knowledge diffused through formal cooperation between firms, while “milieu/informal networks” are informal cooperation owing to a common culture.

(Todtling et al. 2009)

#### 4.3.1. CLUSTER-SPECIFIC KNOWLEDGE

Many scholars consider that knowledge is location or cluster specific. Christ and Slowak (2008) state that innovation is affected by the local knowledge spillovers and the close distance between companies in a cluster. As a result cluster specific knowledge exists and relies on the Research & Development conducted in the cluster and on knowledge spillovers from other clusters located in a close distance. In fact the former conclude that:

“In terms of knowledge we define the core concept respecting the common set of technology standards of a cluster as established from firm-specific knowledge stocks, representing particular individual firms’ knowledge stocks, that in turn represent the cluster-specific knowledge, which the standard-setting partners agree on at the start of a new technology diffusion process” (Christ and Slowak, 2008, p.37).

Also, according to Maskel and Malmberg (1999, p. 173):

“Firms locate and build their competitiveness in interaction with localised capabilities, which are primarily based on:

- the region’s infrastructure and built environment;
- the natural resources accessible in the region;
- the region’s specific institutional endowment; and
- the knowledge and skills available in the region.”

In addition, Chist (2007, p.30) states that owing to the fact that knowledge is sticky

- it is hard to transfer it to distant areas,
- “a context-specific nature that needs common social, organizational and even institutional set-ups”
- “organized learning processes” are needed

Also, knowledge is tacit and can be diffused through experience or “handshakes”.

Brown et al. (2007, p. 10) divide resources in a cluster in three groups: the “regionalness”, “cluster-specific” and “firm-specific” resources. The first one refers to the place where the cluster is located and its characteristics (“urban or rural” etc), the second involves the way a cluster is managed and it is economically funded. Last but not least, the third category refers to “the image of the firm, skilled employees, patents, etc”. Consequently, knowledge is in a high degree cluster- and firm-specific.

As argued by Maskel and Malmberg (1999, p.180) “in an era when codified knowledge is globally disseminated faster than ever before, tacit and spatially more ‘sticky’ forms of knowledge are becoming increasingly important as a basis for sustained competitive advantage”. So, this cluster-specific knowledge is what’s important for an innovation cluster’s development. When the biggest part of the available knowledge is tacit, proximity is essential for its transfer.

As a result proximity matters. Knowledge is also “pathdependent” and depends on the existence of priori produced knowledge. The latter can lead to “lock-in” if the openness of the cluster to new knowledge is not enough. Proximity within and among clusters facilitates knowledge transfer. Boschma (2005) suggests that there are five kinds of proximity: the “cognitive”, the “organizational”, the “social”, the “institutional” and the “geographical” proximity.

The “cognitive” proximity refers to the knowledge base that should be similar for knowledge to be communicated. The “organizational” proximity is the level of the ability to control tasks inside and between firms, while the “social” proximity refers to embedded social relationships between actors. Furthermore, “institutional” proximity is the shared culture between actors. Last but not least, the “geographical” proximity is “physical distance between economic actors, both in absolute and relative meaning.” (Boschma, 2005, p.69). Too much or too little proximity of any kind can cause problems, but as obvious proximity is an essential feature for knowledge sharing and it is usually valid within innovation clusters.



#### 4.3.2. COOPERATION-SPECIFIC KNOWLEDGE

With the existence of cluster-specific knowledge, firms within the cluster cooperate much more easily as they have similar knowledge bases and the same culture. Cooperation with external firms is also possible, but the levels of trust between the firms are low and have to be built during cooperation.

Fritsch and Lukas (2001) present four categories of “cooperation partners”:

- customers,
- manufacturing suppliers,
- “other” firms, and
- publicly funded research institutions.

The third category refers to “non-vertically related businesses”, maybe competition as well. The former also consider that the role of a “Gatekeeper” screening exterior information of interest, is crucial in cooperation between firms. Firms cooperation leads to intensified “specialization” more than to the creation of novel products.

According to the above categories of relationships the former investigate the kind of cooperation, illustrated in the Table below.

Table 4.3.: Share of enterprises with a certain kind of cooperative relationship (percentages)

Type of relationship	Share of enterprises with the respective type of relationship (%)
Customers	61.6
• casual contact for information purposes	52.6
• organized exchange of information and experiences	40.0
• involvement in planning and operation of projects	44.0
• pilot use of an innovation	32.2
Suppliers	49.5
• casual contact for information purposes	40.8
• organized exchange of information and experiences	31.2
• involvement in planning and operation of projects	36.1
• pilot use of an innovation	21.4
“Other” firms	32.5
• casual contact for information purposes	25.6
• organized exchange of information and experiences	19.3
• joint use of equipment or laboratories	12.8
• joint R&D projects	14.6
Publicly funded research institutions	33.8
• use of equipment or laboratories	16.5
• research contracts	14.9
• joint R&D projects	22.2
• thesis collaboration	18.8

Source: Fritsch and Lukas, 2001, p. 299

The most usual kind of interaction occurs during searching information, while cooperation with customers takes the lead, followed by suppliers. Nevertheless, as I see it the relationships producing actual results are knowledge exchange and working together for a purpose (combining knowledge).

Becker and Dietz (2004), divide R&D in two categories: the “idiosyncratic” and the “generic” R&D. The first category refers to the R&D produced inside the firm, while the second stands for codified knowledge that can be utilized by cooperators.

The more the firms that cooperate, the better the results for innovation. During cooperation innovation is facilitated, as novel products are perceived through acquiring new knowledge from partners. Of course, this procedure is possible with prior investments in “idiosyncratic” R&D. This is because a firm should have invested in absorptive capacity, which as Bathlet et al. (2004) state is “a mediating variable between the firm’s environment and its organizational adaptation”.

Furthermore, as suggested by Todtling et al. (2009) “advanced innovations” are the result of cooperation with universities and other related institutions, while adopting new knowledge for the business comes from cooperation between firms. The degree of absorptive capacity needed is higher for the former and lower for the latter. (Todtling et al. 2009)

#### **4.4. COMMUNITIES OF PRACTICE IN INNOVATION CLUSTERS**

As suggested by Wenger et al. (2002, p. 4) the communities of practice are “are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis”. The members of those communities cooperate and share knowledge in order to find solutions in difficulties or for their personal pleasure. Those communities in businesses facilitate knowledge management, firm cooperation and tacit knowledge exchange. Communities of practice exist in all organizations, but fostering their development leads to much better results. The dynamic nature of knowledge is exploited and new knowledge is created through interaction and experience combination. (Wenger et al. 2002)

According to Bathlet et al. (2004, p.39) communities of practice are made of “agents which are bound together through day-to-day interaction, based on the same expertise, a common set of technological knowledge and similar experience with a particular set of problem-solving techniques”. They share a common culture and learn through interaction.

Communities of practice help businesses exploit and create new knowledge. Indeed, they facilitate the management and exchange of the most important and difficult to manage type of knowledge, tacit knowledge. Naturally, communities of practice foster innovation through their work. As Brown and Duguid (1991, p.50) state that, “Communities-of-practice like the reps continue to develop a rich, fluid, noncanonical world view to bridge the gap between their organization's static canonical view and the challenge of changing practice. This process of development is inherently innovative”.

Innovation as mentioned before stems from cooperation in a large extent. Communities of practice as also mentioned by the former “span the boundaries of an organization” and are a “conduit of external and innovative views into an organization”. Businesses should foster their independence and at the same time built connections between them.

#### **4.5. KNOWLEDGE COMMONS IN CLUSTERS**

As suggested by Grant (1996) part of knowledge is common in firms. Knowledge is integrated among actors, as they simultaneously share and absorb it. This common knowledge facilitates the exchange of firm-specific knowledge. The former states that common knowledge is comprised of the “common language” among actors in an organization facilitating communication and includes “other forms of symbolic communication” like for example common knowledge in using “computer software”.

Furthermore, “commonality of specialized knowledge” provides a base for knowledge integration, because even though actors possess diverse knowledge they share a common knowledge base. Finally, “shared meaning” exists between actors enabling the easier assimilation of tacit knowledge without the need to make it explicit first, and the “recognition of individual knowledge domains” facilitates cooperation, as everyone knows the knowledge possessed by each actor. (Grant, 1996)

As a result common knowledge exists and is vital for the development of businesses, as through it employees cooperate so as to produce new knowledge and innovations. This common does not have clear boundaries, because it can extend during cooperation with other firms. Nevertheless, as suggested by Bathlet et al. (2004) diverse knowledge bases can exist in an organization, but they are shared and internalized during the creation of novel products, that requires the combination of knowledge from different departments.

Knowledge is in part common within clusters as well. This occurs owing to knowledge spillovers within an innovation cluster, which as suggested by Wolfe and Getler (2004) include knowledge:

- deriving from the universities' and other related institutions' R&D,
- transferred through highly skilled work force from universities to firms or between firms,
- diffused through "peer-to-peer mentoring and knowledge sharing that is organized through local civic associations",
- and deriving from "infrastructural knowledge resources" by firms focused on economic operations.

Of course, an organization should have previously invested in developing its absorptive capacity through its own R&D, in order to be able to take advantage of knowledge spillovers. This is because without a good knowledge base, the company will be redundant in absorbing and exploiting external knowledge. Consequently, knowledge in a cluster is common among the actors that possess the similar knowledge bases.

Ostrom's (1990) model of successful CPRs cannot be applied to clusters as:

- boundaries are not that clear, because firms constantly cooperate with many different actors and organizations
- rules are not always created by actors in the knowledge commons, owing to the fact that employees in a firm have to follow the rules imposed by directors
- monitoring may be performed by members as well as by an agent addressed by the firm
- graduated sanctions are obviously imposed by directors for non compliance to the rules or for under-production of an employee
- disagreements are also arranged by higher levels of administration, as in a business employees are not the ones who decide for the way things work

Accordingly, knowledge commons in clusters are not fully self-governed, but their independence as far as the cooperation between actors is concerned should be fostered. In this way, the production of new knowledge and innovation is facilitated. The latter principles are not always necessary for successful knowledge commons.

#### **4.6. TRAGEDY OF THE COMMONS IN INNOVATION CLUSTERS**

The tragedy of the commons in innovation clusters can occur due to a “technological lock-in”. If actors have invested in a specific technology and have developed relating norms, they might be unwilling to get involved with other kinds of knowledge because this implies further investments in absorptive capacity and changes in their routines. According to Maskell and Malmberg (1999) “it is difficult to un-learn successful habits of the past, even when they hinder future success”. As stated by Foray (2004, p. 185) “The capacity of a strongly decentralized community to extract itself from the situation of decreasing returns and technological lock-in is weaker than that of an R&D laboratory with centralized coordination”.

A “lock-in” might also result from the high degree of proximity that characterizes innovation clusters. As suggested by Boschma (2005), this is because “firms do not have much more to learn from each other and may be led to a “cognitive lock-in” being uneager to acquire new knowledge. Furthermore, rival firms of the same sector can very easily take advantage of knowledge spillovers undermining the firm’s knowledge”.

On the other hand, a “technological lock-in” helps businesses concentrate on an activity and follow the relating development of technology (Foray, 2004). But, this should not keep on for long, as knowledge transfers are in the heart of knowledge production. If firms do not remain open to new knowledge, no further development and knowledge creation will occur. As mentioned before, the reasons why firms concentrate in a specific district and of the competitive advantage of clusters, is that the take advantage of knowledge spillovers and cooperate for the production of new knowledge (innovation). Through the former procedure and continuous investments in absorptive capacity, the “tragedy” of the knowledge commons in clusters can be avoided.

#### **4.7. CONCLUSION**

Clusters foster innovation through facilitation of knowledge diffusion and exchange. Spatial proximity is a crucial factor for that, especially for tacit knowledge exchange. Different actors (firms, universities etc) combine their knowledge to produce something new and “communities of practice” foster this procedure. Knowledge commons in clusters exists among actors with the ability to exploit and understand externally produced knowledge, which means that having invested in absorptive capacity is very important.

Firms cooperate with other firms, universities and other actors producing, assimilating and exploiting knowledge. In this way knowledge commons are created where actors work for the production of new knowledge.

Universities produce new knowledge and diffuse it among firms, either through cooperation relationships or through the provision of a highly skilled workforce that possesses embodied knowledge. Furthermore, universities help actors in the cluster begin their innovative process and solve various problems.

Knowledge commons in innovation clusters are successful due to spatial proximity, similar knowledge bases and absorptive capacity between actors. Ostrom's (1990) principles for successful governance are not valid to their entirety, because in the case of knowledge the former prerequisites lead to further knowledge production and success.

The "tragedy" of the knowledge commons occurs owing to "technological lock-in", when actors are trapped in a specific technology and routines remaining blind to new opportunities. Knowledge is produced through continuous interactions. Refusing change and new practices, leads to underuse and to the "tragedy" allowing competitors to take the lead in the market. Businesses should remain open to possible new information and invest in relating absorptive capacity to exploit them.



# **CHAPTER 5**

# **CONCLUSION**

## 5. CONCLUSION

Knowledge governance has been addressed by many scholars with conflicting views. We have evaluated knowledge governance in the context of the commons. Knowledge governance should foster development and social welfare in contemporary societies.

The theoretical framework we use is the commons. In the second chapter, theories applied to the governance of common pool resources [Prisoner's dilemma (Tucker, 1950), Logic of collective action (Olson, 1965), Tragedy of the commons (Hardin, 1968)] are analyzed and assessed in relation to each other. The mode of governance that proved to be the most efficient for resource sustainability and social welfare is self-governance. The basic principles to achieve that are depicted in Ostrom's (1990) model,

- Clearly defined boundaries should be in place.
- Rules in use are well matched to local needs and conditions.
- Individuals affected by these rules can usually participate in modifying the rules.
- The right of community members to devise their own rules is respected by external authorities.
- A system for self-monitoring members' behavior has been established.
- A graduated system of sanctions is available.
- Community members have access to low-cost conflict-resolution mechanisms.
- Nested enterprises—that is, appropriation, provision, monitoring and sanctioning, conflict resolution, and other governance activities—are organized in a nested structure with multiple layers of activities.

(Hess and Ostrom, 2007, p. 7)

Although success is never certain and depends on local conditions (CPR physical characteristics) and the decision of actors to cooperate and act rationally.

The assessment of common pool resource management regimes has been followed by an analysis of the ontological characteristics of knowledge and of its creation. We have applied the latter framework to knowledge and evaluated it, drawing its core limitations in the third chapter. By analyzing the ontological characteristics of knowledge, we have found that its tacit dimension along with its located and sticky character have proved core limitations to its common use.

Furthermore, the process of knowledge creation is based on cooperation, knowledge transfers and knowledge assimilation. It highlights that spatial proximity, investments in absorptive capacity and the existence of similar knowledge bases are vital for the creation and assimilation of new knowledge.

Consequently, knowledge as a common exists between actors that are spatially concentrated to surpass the limitations of the tacitness, stickiness and the located character of knowledge, have similar knowledge bases and have already invested in developing their absorptive capacity in order to have the ability to detect available opportunities and assimilate external knowledge. This is what takes place in various “communities of practice”, where actors meet the all the former requirements and share common knowledge.

The framework of the commons has proved to be useful as a new approach to knowledge management, although Ostrom’s (1990) principles for successful management are not necessary conditions in this case.

The “tragedy” of the knowledge commons (possible underuse) can be avoided, if actors within them cooperate, act according to the rules and do not free ride on the efforts of others without producing new knowledge.

Subsequently in the fourth chapter, the knowledge as a common discourse is applied in the concrete context of innovation clusters. Here innovation (knowledge creation) is fostered through the spatial proximity of firms and universities, as they have the ability to exchange tacit knowledge and cooperate through their similar knowledge bases. Knowledge is common inside and between businesses. “Communities of practice” are core possessors of common knowledge and creators of new one. Firms should foster their development, in the chase of comparative advantage.

Ostrom’s (1990) principles for successful CPR management are also not valid in the case of innovation clusters, as knowledge commons are basically internal to firms and have to follow the rules imposed by directors. But what’s important for knowledge commons is ensuring that explicit as well as tacit knowledge is successfully transferred.

The “tragedy” of the knowledge commons in innovation clusters occurs due to a “technological lock-in” where businesses refuse to change the technology they are using and their norms, being locked in the same procedures. In this context, new knowledge stops being produced and the “tragedy” occurs.

This dissertation can be the starting point of further in depth analysis in the field of knowledge governance and knowledge commons. Even if the issues discussed are rejected as not viable, they can also trigger the discussion for choosing the proper governance theory for knowledge, which in the end will produce further results to accept the notion that knowledge is a common.

In conclusion this dissertation has certainly offered a clarified picture of knowledge, its characteristics and the way it can work in the context of the commons. Additionally, clarification of the difference between information and knowledge has been discussed, and the differences in the ways of governance accordingly.

## APPENDIX (CHAPTER 3)

### Patent

A patent is:

“An exclusive right granted for an invention – a product or process that provides a new way of doing something, or that offers a new technical solution to a problem. A patent provides patent owners with protection for their inventions. Protection is granted for a limited period, generally 20 years.” (WIPO) and such regimes “protect the products of inventive activities” (Ghosh, 2007). The creator is obliged to publish “technical details” of his work, for the society to benefit from his work as well. In my opinion, this obligation fosters the development of new knowledge, as it makes it available to others (Foray, 2004).

According to Boyle (2008)

“Patent law offers us a decentralized system that, in principle, will allow individuals and firms to pick the problem that they wish to solve. Inventors and entrepreneurs can risk their time and their capital and, if they produce a solution that finds favor in the marketplace, will be able to reap the return provided by the legal right to exclude—by the legal monopoly over the resulting invention”.

(Boyle, 2008, p.5)

A creation is considered a patent if it is about something novel, has not existed or have been thought of in the past and can be used in relating industries. Patent creators can also allow others to use it being paid for it or sell the patent, but are obliged to bring published every detail of their work after the patent expires, so as to avoid fading away of this creation, if the owner fails to keep it into life, and for the new knowledge not to be kept a secret by the owner for financial gaining.

### Trademark

A trademark is defined as:

“a distinctive sign that identifies certain goods or services produced or provided by an individual or a company”(WIPO) or as suggested by Ghosh (2007) trademarks are here in order to “protect business signifiers that are valuable to consumers for distinguishing the source of a product or service”. The trademark allows people to recognize the brand and keep using it if they are satisfied, and motivates producers to keep quality of the product the same in order for consumers to prefer it preventing the use of an akin brand sign by others.

### Industrial design & Geographical Indication

As mentioned in WIPO an Industrial Design “refers to the ornamental or aesthetic aspects of an article. A design may consist of three-dimensional features, such as the shape or surface of an article, or two-dimensional features, such as patterns, lines or color” and a Geographical Indication “is a sign used on goods that have a specific geographical origin and possess qualities or a reputation due to that place of origin. Most commonly, a geographical indication consists of the name of the place of origin of the goods”. The latter products usually have the name of the place they are produced or the place they were firstly produced.

### Copyright

Copyright “covers literary works (such as novels, poems and plays), films, music, artistic works (e.g., drawings, paintings, photographs and sculptures) and architectural design. Rights related to copyright include those of performing artists in their performances, producers of phonograms in their recordings, and broadcasters in their radio and television programs.” (WIPO)

and in a phrase, as suggested by Ghosh (2007), “protects the products of expressive activities”.

Foray (2004, p.132) describes the Copyright law in another way:

*“Copyright protects the expression of an idea and not the idea itself. There is no inventive step or threshold of novelty. This protection acts with regard to patrimonial rights (protection against reproduction or representation) and moral rights (protection of the integrity of expression). But with copyright, parts of a protected work can be extracted and recombined to produce an original work. Copyright, unlike patents, gives the creator immediate, free protection without involving a lot of red tape.”*

So, the protection of intellectual property under the copyright law, gives the creators the chance to “be paid for allowing the world to copy, distribute, and perform” (Boyle, 2008, p.5) their work. A copyright for a work lasts at least fifty years after the creators passing away, but duration can be further extended.

But does this procedure work the way it is supposed to? The duration of copyright licenses is being extended implying barriers to knowledge creation, owing to the cumulative nature of knowledge (Boyle, 2008). For example, for many creations copyright is valid for over a hundred years and has become a barrier for development and innovation, as they are not available to the public.

When developing the GNU system, Stallman wanted his creation to be available to the public without being restricted by the Copyright law. It was then that he thought of the Copyleft that uses, not replaces, Copyright so as to allow people to:

- (1) access and read the program logic or source code,*
  - (2) copy and redistribute the software, and*
  - (3) make modifications to the source code*
- (C. Schweik, 2007)

The same man also produced implementations of copyleft, which are the GNU (General Public License) and the Free Software Foundation.

Except for Copyleft, other related licenses applicable to other forms of commons have been created, like the “Free Documentation License” (GFDL) which as suggested by Schweik (2007) “specifies the sections of the document that must remain unmodified from version to version (such as the original author’s copyright notice) and the terms of distribution, and requires a list of previous authors to be maintained” and the Creative Commons which were created in 2001 and give the creator the opportunity to retain the copyright and at the same time consent to its copying and distribution provided that he is still recognized as the creator of the specific work. Indeed, creators who use this kind of licenses are able to choose the rights they want to keep and those they want to give up. It is practically, as suggested by Schweik (2007) “some rights reserved” licenses.

The problem with these licences in the scientific community could be a kind of plagiarism that they could impose when a writer bases his work in a high degree on another one. A solution to this problem could be to retain the right of forbidding derivatives and allow making copies and distributing it.

Although the Internet has given the whole world easy open access to almost every online resource, there are still phenomena of enclosure to knowledge commons. More and more digital knowledge is not available to everybody, due to governmental and market interests. (Hess and Ostrom, 2007)

Information is being more and more protected by intellectual property rights included in agreements like the TRIPS Agreement (Agreement on Trade-Related Aspects of Intellectual Property Rights), through the WTO (Agreement Establishing the World Trade Organization) (Maksus and Reichman, 2004).

WTO and TRIPS are generally practically produced and in favor of developed countries and bring with them many disadvantages for the developing ones even when being used at the minimum level. In contrast, TRIPS's goal was entirely different, as it was created in order to protect new knowledge of being exactly copied. "First, TRIPS constrains them from pursuing certain avenues for promoting imitation, innovation, and related social policies. Second, stronger private rights in information may raise roadblocks against deploying new technologies that could help improve the provision of environmental protection, health care, biological diversity, and basic scientific research." (Maksus and Reichman, 2004, pg 9)



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