PROSUMER MODEL: IMPLEMENTATION FOR ECHEMTEST ELECTRONIC TESTS

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1. INTRODUCTION

During the most recent meeting of Master Up (monday 30th october) I was given the opportunity of presenting a report about the role innovation plays in modern economics and, more specifically, which are the perspectives of intervention for small companies (as Master up is, the company I am currently doing a six-month training period as part of my Master's degree path in International Business and Management by Mr. Runfola 's chair).

Throughout last years, economics' literature has been giving much more importance to innovation as one of the main, if not the most important, driver of economic growth, especially in the most developed economies. For these the accumulation of capital it does not seem to be enough to spur economic growth and, according to economists as Solow, when capital is not enough to make economies grow, only innovation through technical progress can make an economy more competitive and productive. In particular modern economies are evolving rapidly towards new models defined *learning economies* (OECD, 1996; Morone & Taylor, 2006) [1]. In this paper I will try to illustrate, through the analysis of various economic theories, how new models of distribution of knowledge, like the prosumer model, can create a knowledge network, capable to sustain and spur innovation and so economic growth.

2. INNOVATION, KNOWLEDGE A COMMON GOOD AND EXTERNALITY

Innovation, as already told before, became a central issue both from a macroeconomic point of view, for what it concerns a country's economic growth, and

[1] Cfr. A.Frasca, P. Morone, quaderno n.4/2007, "Innovazione, network di imprese e conoscenza: quale ruolo la geographical proximity?", pag .1

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from a microeconomic point of view, regarding not only companies' competitiveness but also their ability to cope with the rapidly evolving present technologies.

Innovation can be defined as the process through which new kinds of knowledge, or just new combinations of the existing genres of knowledge, are used to design new products or productive processes. Then, we can state that innovation is the product of learning processes[2] from which new kinds of knowledge are sprung, (where) knowledge is to be intended as the structure of news able to generate value, with particular reference to its nature, creation, diffusion, transformation and utilization by any means possible. (Peter Drucker)[3]

Knowledge, in economic literature, is considered a common good as it can be of public access, so anyone who is interested can make use of it. In the economic environment the common nature of knowledge causes the market failure. The market in fact does not produce social efficiency if the actions of producers and consumers, which have direct effects on other people's wealth (beyond their own), are not registered from it. This distorts the signals coming from the market itself too. About that it is popular the paradox shared by K. J. Arrow, which states that information is not to be owned and so, once it is revealed, it lasts its value[4].

In economics, the effects (labeled as external effects or external economies) that an activity from an economic unit (individual, company etc.) exerts, beyond the market transactions over production or other units' wealth, are called externalities. In particular when the action of the economic agent determines benefits to others and it does not lead to a (monetary) reward then we can talk of positive externalities. When, otherwise, the action taken by the economic agent duties costs to others, we are speaking of negative externalities (external diseconomies)[5]. If the externalities concern the productive field, either goods or services, they are defined production externalities.

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[2] P. Morone e R.Taylor, (2006), "Knowlege, innovative and Economic Geography" paper presented at the Knowledge and Regional Economic Development Conference, june 9-11-2015, Barcelona.

[3] www.socialenterprise.it/index.php/2011/03/24/da-taylor-a-drucker-ottimizzare-per-la-conoscenza/

[4] www.treccani.it/enciclopedia/conoscenza_%28Dizionario-di-Economia-e-Finanza%29/

[5] www.treccani.it/enciclopedia/esternalita/

Negative production externalities are the ones that occur when the Marginal Social Cost (MSC) of the production exceeds the Marginal Private Cost (MPC), therefore MSC > MPC. While positive production externalities occur when the Marginal Social Cost in lower than the Marginal Private Cost (e.g. scientific research), therefore MSC <MPC.
Consumption externalities are those effects that are related to the consumption sphere. Negative consumption externalities occur when the Marginal Benefit decreases with the increasing of the distance between the producer and the consumer. The optimal distance is the one that matches the point in which the Marginal Benefit of the hypothetic user is equal to the price. A positive consumption externality is the public education, which belongs to the category for which positive externalities are much elevated to private benefits that the free market, both perfect or imperfect, tends to not produce them. These goods are known as public goods (which knowledge belongs to) and have two meaningful characteristics:

- **non-rivalry**, since these goods can not be substituted from other consumption goods;

- **non-excludability**, since they are available to anyone because of their social utility, just think about public roads, public lightning etc.

Public goods have marginal social benefits larger than the corresponding marginal private benefits. This characteristic makes them socially desirable, but not profitable from a private point of view. For example, in a city it is in likely that someone would be willing to pay on its own to redo the road surface where it lives, since the private benefit would be lower than the cost. Though the social benefit of all those who use it would be by far more superior.

This non-excludable characteristic makes possible that individuals get however advantages e so they are not stimulated to take part to the payment. People who takes advanced from the utilization of public goods without contributing to their costs, are defined «free-rider». At a social level the problem is about avoiding, or at least setting borders to these cases since the free market would not produce any of them in any case. It has to be noticed that not all the goods and services produced by the public sector are collected in the public goods category: for example education and sanity are provided from the government, but they could also be, and in many cases it happens, provided from the private sector.

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3. PATENT ECONOMICS: MODEL OF ARROW

After having considered the concepts of innovation and knowledge and focused our attention on how the knowledge can produce externalities that generate market distortions which cause its failure, now there will be illustrated some economic theories that give the idea for resolving this problem following the aim of sustaining innovation.

In economic theories there is a strong debate on how innovation can be prompted and distributed in an optimal way, one of the main contributes is offered by Arrow in his article "The Economic Welfare and the Allocation of Resources for Invention" (1962).

The patent (or more properly "invention patent") is legal title by means of which it is given to the owner an exclusive right of exploitation, in a territory and for a determined period, and the capability to forbid to others to produce, sell or utilize the invention without the inventor's consent [6] (and the eventual payment of a royalty). The patent therefore gives to the inventor a temporary ownership right on the invention, assigning to it his exclusive utilization.

Now it's time to open a parenthesis about the protections of softwares, which during last years have been taking a central role in the innovation processes thanks to the advent of new technologies. About their safeguard there is a strong juridic debate about the nature of softwares and their kinds of protection. In fact, according to many, softwares gave a technical nature therefore they must be covered by a patent protection, while according to many others a software is considered a kind of writing so it has to be protected by copyright [7] (it is a juridic institution that aims to protect all the works of the intellect that belong to literature, music, figure arts, architecture, theatre and cinema, elaboration programs and databanks) [8] and not by a patent.

The reasons of this choice are related to the fact that conferring the state of patent to a software, its consequent protection would be too strong and then it would obstruct

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[6] F. Pompei, "Economy of Innovation", University of Perugia, 2017

[7] According to a consolidated principle "copyright protection covers the expressions and not the ideas, the procedures, the methods of which the mathematical concepts as such" (art.9, comma2 TRIPS)

[8] Art.1 LDA, law 22 April 1941, n. 633 and subsequent modifications - Protection of copyright and other rights related to its exercise

further others investments. For this reason since the European Directive 91/250/CEE it has been introduced, in the whole community, the software as a good able to be protected by copyright. And yet it should be said that the European Patent Convention (art. 52), just as the Italian Code on Industrial Property (art. 45), exclude the state of patent off a software only if considered "as such", yet totally. Trying to interpret such laws, the final result is the recognition of the possibility to patent a software that has determined characteristics. [9]

First off a software, like any other invention, to be patented has to have a "technical nature". It has to be a software that aims to solve a technical problem and offer a solution that has technical elements that let possible to get a technic effect.

A software can so represent a real technic tool, under the guise of a programmed processor, that interacts with the other components of a machine to check certain functionalities, becoming then a tool that can be patented.

It was established so that a software can be patented if it has a technic character that derives from a technic effect, obtained by the functioning of the software that goes beyond the normal, basic, physical interaction between software and machine (T1173/97).

According to Arrow, the key characteristic of patents is the one related to the deep knowledge of a product or an innovation process and the one about the conferring of a short term monopoly to its inventor, protecting in this way the invention and stimulating the research and the innovation processes that, otherwise, would not be praised.

The new knowledge, protected by a patent, enclosed in the new product or process has got a considerable economic value but, at the same time, characteristics that make it less possible to the normal functioning of the market, as already it is thought that patent of an intention that it comes to be generated a monopoly that obstructs the correct functioning of the market (Arrow 1962).

In fact, according to Arrow, knowledge is a public good and, as such, it has determined characteristics:

[9] www.ufficiobrevetti.it/software/

- **non-rivalry** of the consumption, or the consumption of a public good from an individual does not imply the impossibility for someone else to consume it, even at the same time (e.g. arts such as music or painting);

- **Non-excludable** of the consumption - once the public good is produced, it is hard or even impossible to avoid its fruition to subjects who have not paid for it.

It is easily verifiable how in a system of a competitive market the presence of public goods generates problems particularly in the innovation field. In fact an inventor in the course of its own activity incurs the costs of the relative innovation. Because of the public nature (not excludible) of the knowledge, however, being everyone able to benefit from a discovery sourced from it, every innovative activity would be deterred. Consequently the intrinsic externalities associated to this class of public goods can generate the market failure. It can be expected then that a competitive market system allows a level of innovation intrinsically weak.

The intellectual copyrights generally, and particularly patents, face this problem, attacking the non-appropriability of the knowledge that is at the base of the market failure. In particular, giving the innovators copyrights on their discoveries such as the patents, it is offered to the, legal means for the attribution of exclusion attributes from a good, considered yet purely public.

So protection of the intellectual property makes esclusive the ownership of a good as knowledge that for its nature, as already said, it is not appropriable. In this way knowledge transforms itself in a good which is not public anymore and so it will be solved the problem of the externalities with benefits and costs related to the nature of the market which we are referring to.

In 1962 Arrow published his article “Economic Welfare and the Allocation of Resources for Invention” where he proposes a solution to such problem generated from patenting. According to him, to have an optimal allocation of resources (meant as knowledge) it is necessary that Policymakers and non-governative and non-profit agencies would carry on financially research and innovation, starting from the following assumptions:

- the knowledge developed from innovation is a public good

- innovation reduces costs

- innovation is a racial change in processes

- a patent system pushes only one enterprise to innovate

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- indivisibility and uncertainty characterize the productive process
- it exists a Technological Incentive called “TI” defined as

  TI= π Post innovation – π Pre innovation

  where π is the Profit

Arrow assumes the following possible situations.

A) Monopolistic market

The monopolist firm decides to innovate on the basis of its TI, i.e. the positive difference between post-innovation profit and pre-innovation profit. According to Arrow introducing a radical process innovation the enterprise not only fixes the price from the lowest post-innovation (P' M) than before (PM), but P’M is lower than the previous marginal cost (c) as illustrated in Fig.1

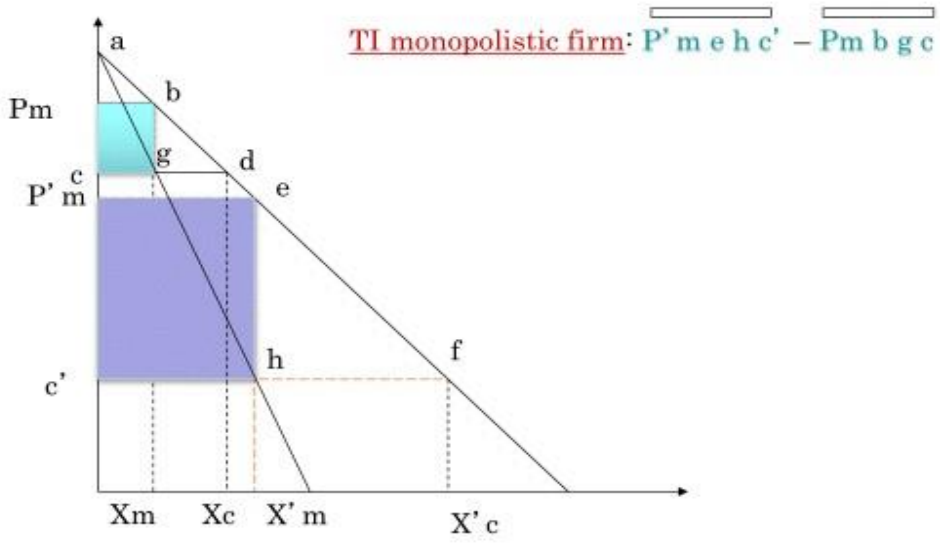

Fig.1 The monopolistic market

B) Competitive Market

Many firms work on innovation but only one can get the patent. In this scenario the TI will be the result from the positive difference between the post-innovation profit rectangle and zero (as in Fig. 2). The TI of the competitive firms is major than the firms in the monopolistic market, that is why enterprises would have never matured any pre-innovation profit, so after the obtainment of the patent the enterprise becomes monopolistic.

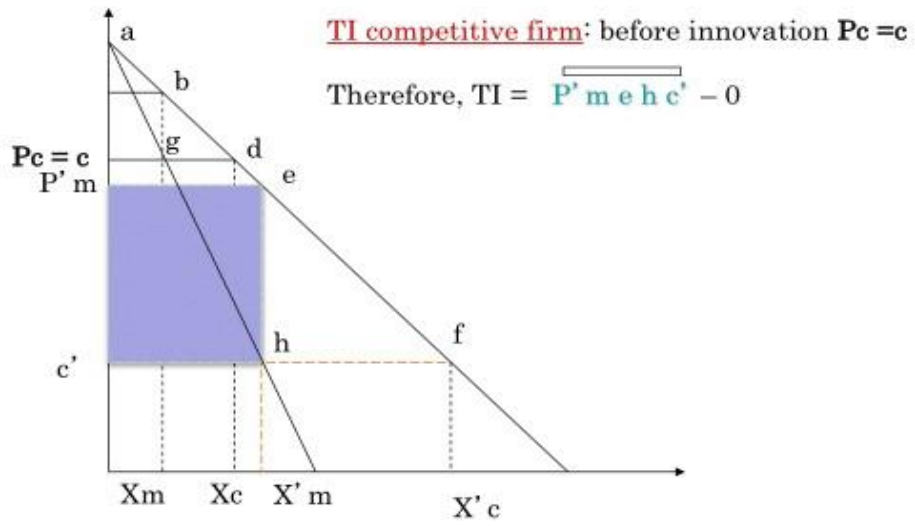

Fig.2 Competitive Market

As we can simply look in both the situations, through the system of patenting Monopolies are generated, threatening the competitiveness of the market and causing its failure. The solution Arrow proposed was the government to sustain innovation. In that way in fact it takes place a reduction of the prices, monopolies are not formed and welfare is increased. This is called by Arrow "TI of the social planner". According to Arrow, in a system in which it is the government to finance innovation (social planner), the TI would be greater both than the one of the monopolistic market and the one of the competitive market (as in Fig. 3) because the social planner maximizes welfare too.

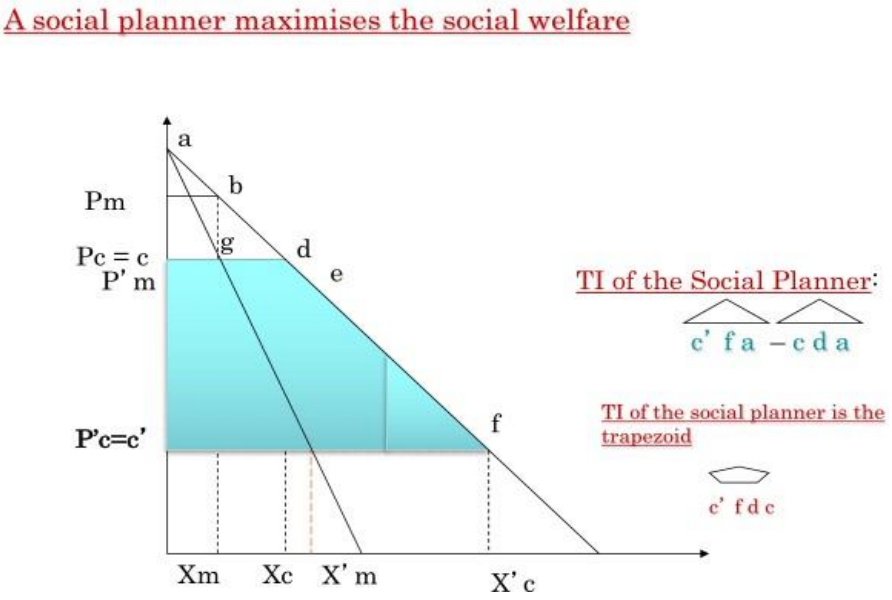

Fig.3 maximises the social welfare

Arrow's model caused an authentic debate regarding the actual economic and social efficiency of the patent system. In particular questioning the principle according to which patents, though creating situations of monopoly, they improve knowledge and prompt innovation more than a perfectly competitive market. For this reason according to Arrow, policymakers should project a patent system able to exploit its advantages and to cancel its negative effects.

4. **THE REWARD THEORY OF PATENT BY NORDHAUS, 1969**

A critique against Arrow was lifted by Nordhaus with his model of the reward theory of patent, which states that introducing a potential monopolistic power (generated from the patent) the exclusivity gives a renumeration for successful innovators. If the cost to generate an innovation is private, then the anticipation of such private reward (due to the monopolistic power) is a necessary reward to lead innovation in a market context with pro-maximizing agents. If exclusive rights would not be available from the innovator since the knowledge is a pure public good, anyone could use this load of information to duplicate the invention and compete with the owner of the invention. Therefore, the patent system by giving exclusive rights promotes the innovation avoiding that this one could get deterred from a lack of protection [10].

[10] Cfr. F. Pompei, *Ibidem*, pag. 18

Nordhaus (1969) states that the length of the protection should be balanced between two forces:

1) for the first time, for an innovation that can potentially give benefits to the society for ever, the length should be long (possibly forever).

2) Since the protection is based on the exclusive property, this creates a potential sharp loss because of the monopolistic price. From this point of view the length of the patent protection should be limited.

5. PRODUCTION AND UTILIZATION OF INFORMATION AND TECHNOLOGICAL KNOWLEDGE

Information and technological knowledge are innovation points. Knowledge gives the opportunity to act widening the cognitive capability of an individual, while information is a group of structured data that need knowledge to be articulated through cognitive processes that make them operative [11].

Both information and knowledge have high generative costs, but almost no reproduction costs (cd. Scale free property).

As opposed to other economic inputs, they both are not subject to depreciation (or at least in economic terms). This implies that they would both be characterized from an increasing output on their property which, as Arrow specified, is incompatible with the idea of economic balance.
According to the SYS (Stanford –Yale- Sussex Sintesis) technological and scientific knowledge have each one important characteristics:

- non-exhaustibility: the permanent capability of reproduction and transfer;
- tacit knowledge: a portion of knowledge related to a specific firm or, however places along the production process seems clarification for the usability by other people.

[11] Cit. A. Frasca, P. Morone, *Ibidem*, pag.4

5.1. TRASFERRING OF INFORMATION AND TECHNOLOGICAL KNOWLEDGE

The replication cost of information and knowledge is usually among the other economic actors positive though it tends to vary on different technologies and its degree of tacitness and innovativeness.

Knowldege defers from pure information exactly in its ways and replication costs. In fact replication costs of the information are limited to the simple physical cost of the copy, while reproduction is a completely more expensive process, since the cognitive capabilities are hard to be codified and transferred. Then, knowledge reproduction can happen only through and articulate and complex learning process [12].

Tacitness concept refers to the inability of the agent to articulate explicitly sequences of procedures according to which things are made, or rather the know-how itself of innovation.
One has knowledge but tacit, in the sense that it does not automatically transmit the know-how to activate it, and this varies according to the different sectors.

In many words the "tacitness" is the measure of "what we know more than what we can say [13]" (Polanyi, 1966). Greater is the Lebel of tacitness in a technological field greater will be the transfer cost of that knowledge among the enterprises.

5.2 TACIT AND EXPLICIT KNOWLEDGE

Knowledge obviously belongs to each individual but when these gathers themselves is some kind of association they give birth to sort of a systemic knowledge that it could not be owned separately.

Starting from the hypothesis that knowledge is insufficient and incomplete, organizations must be able to valorize employees' diversity and their single knowledge.This all happens through an encouraging system based on intention.

Michael Polanyi was the first to distinguish knowledge in tacit and explicit:

1) TACIT: not codified and not easily transferable;
2) EXPLICIT: codified and easily transferable.

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[12] Ivi.

[13] M.Polany,*The tacit dimension,* University of Chicago Press, edition, 2009

An organization creates knowledge through the interaction between this two forms of knowledge. This interaction is called Knowledge Converdsation. Polanyi himself states that hardly tacit knowledge work in isolation the codifies one and so the right combination of those two cam generate a competitive advantage for the enterprises.

Inside firms the conversion of tacit knowledge in explicit and vice versa, gives a start to a learning process called “four-phase learning process” by Nonaka and Takeuchi (2002).

5.3 NONAKA AND TAKEUCHI MODEL

This model analyzes those processes that lead to the creation and sharing of knowledge and how it can become explicit, regenerating itself.

The model is based on two dimensions of knowledge: the ontological dimension and the epistemological dimension.

a) ontological dimension: knowledge is created only by individuals, so the organizational knowledge that is created within an organization is solely the result of the combination of individual knowledge.

b) epistemological dimension: the whole of tacit and explicit knowledge.

Based on the studies carried out by Nonaka and Takeuchi, we can state that there is an interaction between tacit and explicit knowledge that interacts with each other. This interaction is called "knowledge conversion"[14].

This learning process consists of 4 phases:

1) SOCIALIZATION: learning as knowledge that transfers itself from one agent to another by creating and sharing tacit knowledge through direct experience (TACIT TO TACIT KNOWLEDGE)

2) EXTERNALISATION: learning as an ability to induce new relevant fragments of knowledge by articulating tacit knowledge through dialogue and reflection (TACIT TO EXPLICIT)

3) RECOMBINATION: learning how to improve knowledge and applying explicit and information (EXPLICIT TO EXPLICIT)

[14] Cfr. L.Cavalli, il modello di Nonaka e Takeuchi, “ *Considerazioni sul processo di creazione e condivisione della conoscenza*”, librishop.it, copyright 2000 LibriShop.

4) INTERNALIZATION: learning as absorption capacity acquiring new knowledge during practice (EXPLICIT TO NEW TACIT)

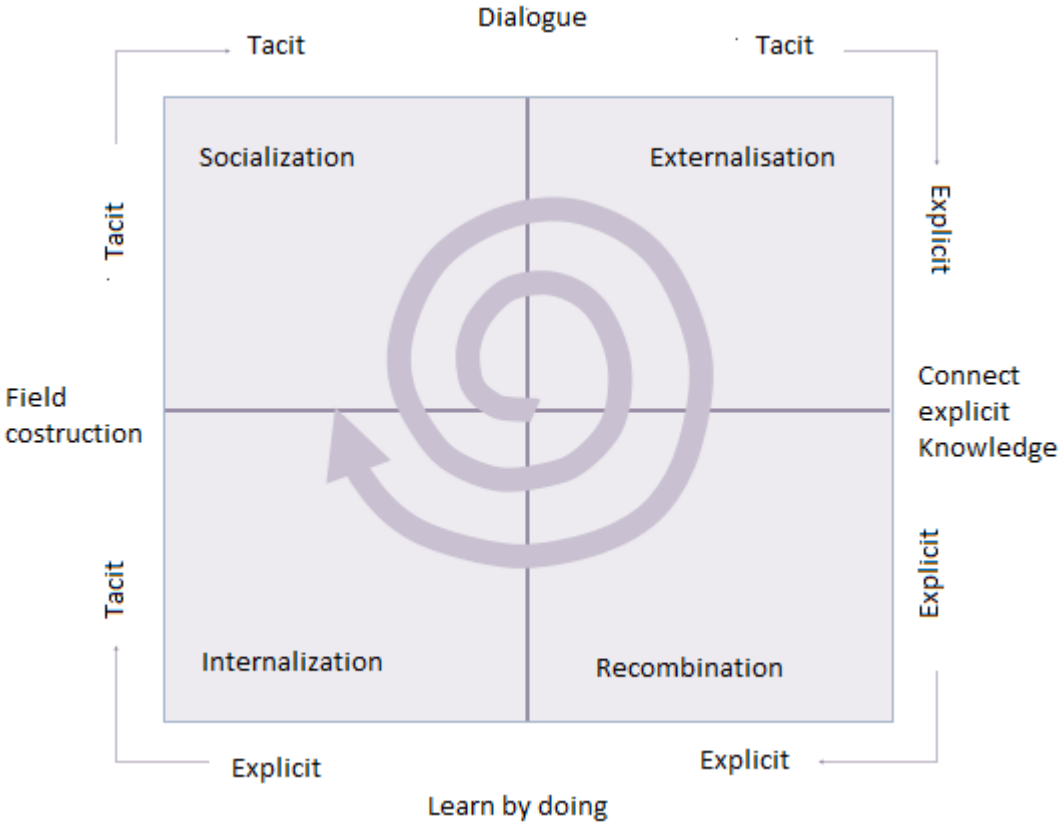

Fig. 4 Schema of Nonaka and Takeuchi on the interaction between tacit and explicit knowledge

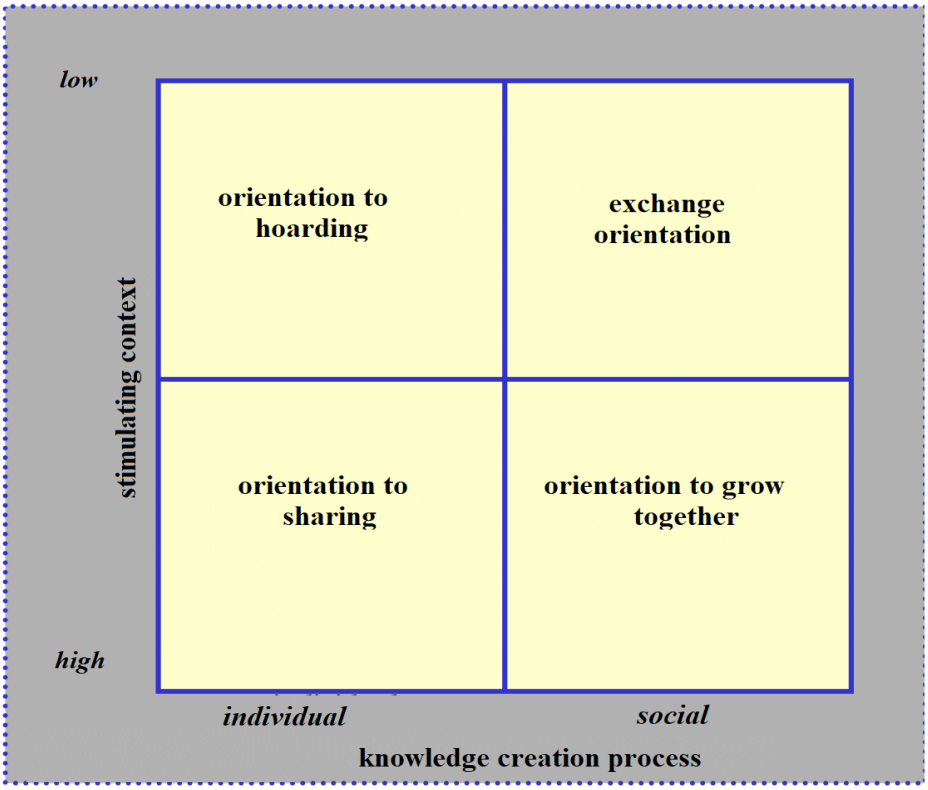

Fig. 5 Nonaka and Takeuchi's card for knowledge exchange

Explicit knowledge is used and internalized, allowing to develop but also to identify and create new tacit knowledge. Therefore, through a process of conversion knowledge is made transferable and communicable. Tacit knowledge is the true source of innovation, becoming a strategic value for the company. But to ensure that this process of conversion is carried out effectively, the social and organizational context of reference is of fundamental importance as it can facilitate or constrain this process.

Organisational contexts can therefore stimulate different attitudes (see Fig. 5):

1) attitude to the hoarding of knowledge: this concerns a context in which the creation and exchange of knowledge are not supported by any instrument but is entrusted to the individual competences of the agents present in the organisation, giving priority to an attitude to the hoarding of knowledge

2) attitude to the exchange of knowledge: this concerns a context in which individual competences are supported by instruments that facilitate the individual integration and formation of groups, giving priority to an attitude aimed at the exchange of knowledge, even if such knowledge is not integrated throughout the organisation.

3) common growth attitudes: this concerns a context in which there are instruments that facilitate processes of knowledge distribution and group association processes, favouring common growth attitudes.

4) attitudes of knowledge sharing: this concerns a context in which the application and internalisation of knowledge is stimulated, through individual and social growth processes. Developing attitudes of knowledge sharing.

As Nonaka and Takeuchi say, an organization must provide the necessary tools to convey and disseminate knowledge in a given context, both individually but also at an aggregate level among several organizations (as we will see with the prosumer model) in order to obtain competitive advantages so to stimulate innovation.

The process of creation and sharing can be represented graphically (see Fig. 6 where the learning level is a function of knowledge creation and sharing) as a succession of individual and social attitudes[15]:

[15] Cfr. L.Cavalli, *Ibidem*.

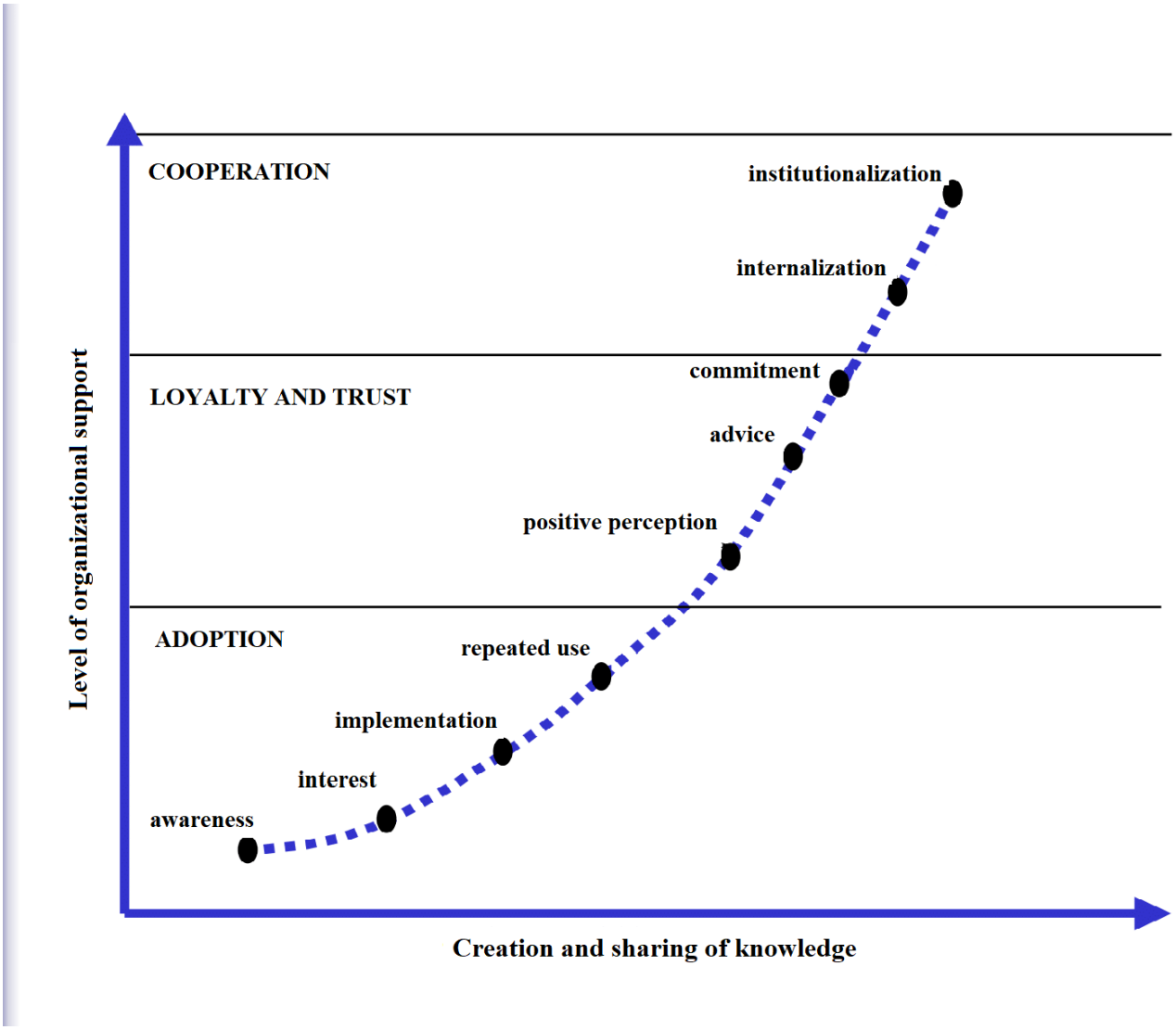

Fig.6 learning courve

Knowledge, however, does not only reside in individuals or organizations, but is also localized in hybrid organizational forms (NETWORKS AND INDUSTRIAL DISTRICTS) in which it is often concentrated [16].

Among all forms of knowledge, tacitness is the most relevant as a driver of innovation for all enterprises connected to each other within an industrial district, generating a competitive advantage among the companies that are part of it. In fact, in an area of extraordinary concentration of international know-how, it generates productive capacities, encouraging even large companies to concentrate in increasingly specialised and innovative districts, not only to exploit their network

[16] Cfr.F. Pompei , "Economi of Innovation", University of Perugia, (2017)

economies but also to exploit the intrinsic tacit knowledge that otherwise would not be transferable.

6. THE MODEL PROSUMER AS A KNOWLEDGE NETWORK

The fact that the model of Nonaka and Takeuchi provides that through a collaborative process tacit knowledge can be transformed into explicit by activating a cycle that creates new knowledge, allows us to state that, although this model is referred to a business context, it can be transferred to other macroeconomic contexts as it may be the case either of a group of companies collaborate among themselves or even producing and consuming a given set of goods/services as is in a *prosumer model*.

6.1 BUSINESS CLUSTERS

In general, business clusters are a group of companies interacting by generating new knowledge and/or sharing existing one with mutual benefit. According to Porter's [17] definition, business clusters are defined as "a geographic concentration of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions in particular competing/co-operating fields". Clusters have attracted a lot of interest in recent years as they are believed to have significantly improved learning processes. Before analysing the benefits associated with cluster formation, it is necessary to classify them into either horizontal or vertical. The first category concerns companies carrying out the same type of activities (which are, therefore, rival to each other), while the second category concerns companies carrying out different but complementary activities.

[17] M. E Porter. (1998), " Cluster and the New Economics of Competition", Harvard Business Review, 76(6), pp. 77-90

- *Horizontal dimension*: in this dimension, interconnected companies derive a considerable advantage from their ability to monitor, compare and learn from the mistakes made by others when carrying out that same activity. Therefore, in this dimension there is an increase in the creation of knowledge, which derives from monitoring, comparing, selecting and imitating the solutions and strategies adopted by the competitors [18].

- *Vertical dimension*: in this dimension companies are interconnected by input/output interactions, where suppliers and customers contribute to improve the capabilities of companies, thanks to an improvement due to a continuous learning by doing process. Interested companies are becoming increasingly specialised and efficient through a division of work. This is closely linked to the dissemination and growth of heterogeneous knowledge, thus reducing information asymmetries.

Companies may find it more advantageous to be part of a cluster to take advantage in accessing network knowledge generated by the interaction of companies already present in the cluster. A dynamic environment can become important not only for companies already present in the cluster but also for those who want to enter it by further improving the cluster through the contribution of new knowledge provided by new entrants.

As already said, clusters play a very important role in the process of knowledge diffusion and growth both in a macro and micro economic context. However, there is a further contribution made by Hakansson on the "economics network approach"[19], by integrating the relationships generated among e-learning, innovation and networking. He claims, in fact, that knowledge is multi-layered and this leads to two main consequences:

1) even if an enterprise specialises in a given sector, it must exceed the limits to acquire knowledge outside its specific field of competence.

[18] Cfr. A. Frasca, P. Morone, quaderno n.4/2007 " Innovazione, Network di impresa e conoscenza: quale ruolo per la geographical proximity?", pp 10

[19] Hakansson. H. (1987), "Industrial Technological Development: A Network Approach. London: Croom Helm

2) because of the heterogeneity of knowledge, each company must consider the contribution of a plurality of actors and institutions (both internal and external) each one of whom has an intrinsic knowledge.

As a matter of fact, his work pinpoints the importance of networking because it both enhances innovation processes based on using external resources and can acquire new knowledge through economic relations with other system players[20].

Above discussed theories and models provide a good basis for the formulation of new forms of learning and knowledge dissemination. This is the case of the prosumer model adopted of Master Up s.r.l. when designing and implementing the Virtual Education Community (VEC) activities of the members of ECTN (European Chemistry Thematic Network [21] an association of Higher Education Institution dealing with the harmonization of Molecular Science Education at European level.

The prosumer model adopted for this purpose leverages the networked used of both the EOL [22] (Exam On Line) knowledge evolution software and the libraries of Question and Answers (Q&A) produced by teams of experts of the Universities members of ECTN. This e-test machinery was developed by the VEC within different European Life Long Learning project managed by ECTN and was named EChemTest® a well consolidate brand at present. Out of the Q&As of the EChemTest® Libraries EOL extracts subsets to compose Self Evaluation Sessions (SES)s of e-tests. The SESs are administered for academic purposes under controlled conditions by the accredited Test Centers of the VEC managed by host ECTN member Universities. In this operational scheme the ECTN University running an e-test SES for the assessment of its own students is at the same time consumer of EChemTest® services for their educational activities and a producer of Q&As, e-learning materials and SESs.

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20 . A. Frasca, P. Morone, quaderno n. 4/2007“ Innovazione, Network di impresa e conoscenza: quale ruolo per la geographical proximity?”, pp 12

21 . A. Laganà, C. Manuali, N. Faginas Lago, O. Gervasi, S. Crocchianti, A. Riganelli and S. Schanze, From Computer Assisted to Grid Empowered Teaching and Learning *Activities* in Higher Level Chemistry Education in Innovative Methods of Teaching and Learning Chemistry in Higher Education, I. Eilks and B. Byers Ed. RSC PuPublishing 2009, pp 12 ISBN 978-1-84755-958-6 pp 123-153

22 .N. Faginas Lago, O. Gervasi, A. Laganà, S. Tasso, E. Varella, Tools *for e-Learning and e-Assessment: GLOREP and EOL* http://services.chm.unipg.it/ojs/index.php/virtlcomm/article/view/101

In EChemTest® Master Up s. r. l. provides the telematic tools and support to the ECTN members.

As far as producer functions other than the EChemTest® ones of particular importance are the services based on the use of the Learning Obiects (LO)s through the search and management engine made available on the distributed repository GLOREP (Grid Learning Object Repository Master-Up provides also the issuing of Proficiency Certificate and the publication of the scientific and didactic advancements of the VEC on VIRT&L-COMM. In this way, the knowledge cycle of the Nonaka and Takeuchi model will be fed and new knowledge will be produced and innovated.

As already mentioned EChemTest® collaborative activities have been established during a 20 years long series of ECTN European Life Long Learning projects started in 1996. Among the initial working groups a strong synergy was established with the Core Chemistry (Bologna, IT), Tuning Educational Structures (Dortmund, DE) and Multimedia in Chemistry Education and several committees were formed to transfer their outcomes into Q&A Libraries. As a result, it was quite obvious to leverage the existing the 13 European Test Centers (TC)s plus two no European ones activated at ECTN member Universities to build the EChemTest® Prosumer network on September 2015 when the last funded project EC2E2N2.

Despite the short time past since then the application of the prosumer model to EChemTest® it has already made significant progress.

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