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The diffusion of knowledge in industrial districts and clusters

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TITLE OF COMMUNICATION: The diffusion of knowledge in industrial districts and clusters

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ABSTRACT

The dissemination of knowledge in industrial districts (ID) and clusters has often been linked to the existence of a specific tacit knowledge. Thus, the companies belonging to the ID's specialization sector might sustain a distinctive competitive advantage against isolated firms.

However, the technological changes in recent decades, and the presence of ID whose technological intensity has dramatically increased in the same period, suggest the existence and the need of codified knowledge in these agglomerations. As a result of a decline of tacit knowledge, the economic performance of ID could move backwards, since it would be easier for competitor firms, located in non district areas, to imitate and reproduce their contextual knowledge.

The paper discusses the above assumptions, suggesting the existence of combinations/hybridizations of both types of knowledge in ID, which we have named *locational-translational* knowledge. This third type of knowledge could explain the continuity of ID's contextual advantages even in presence of higher doses of codified knowledge. The explanation would require the presence of agents acting as interfaces able to absorb new pieces of codified knowledge, in order to combine them with local knowledge, thus fitting the specific needs of ID.

However, this possible way can experiment some difficulties. Concretely, we argue the existence of several constraints, such as the size of a 'district's creative market' in the ID, which may need its opening to knowledge imported from academic institutions and other formal research centers, in contrast with the apparent autarky or isolation suggested by the tacit knowledge.

Finally, an analysis of the ID evolution has enable to appreciate that the process of absorption, combination and dissemination of external knowledge has existed throughout the ID life cycle although supported, at each stage, by different institutional agents: the *impannatore*, the *cappofiliera* firm, the *mid-open innovation process* and, lastly, the formal knowledge from research oriented institutions such as the above referred (*virtual districts*).

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1. Introduction

Knowledge has burst into economics with a strong presence for the last decades, as source of economic growth, either as productivity trigger, or as an instigator of *destructive creativity*.

The paper analyses the knowledge of industrial districts (ID), as this factor has been highlighted as a source of better economic performance of these agglomerations. In the origin of this assumption we can find the seminal work of Marshall (1920), where the metaphor of industrial atmosphere suggests the formation of technological spillovers in ID. For developing this preliminary way, scholars have emphasized the role of tacit knowledge: it permits to boost the economic performance of ID because its knowledge is contextual and it can just be diffused and learned inside the ID, refusing its adoption or imitation by outsiders.

This explanation has been generally adopted by Marshall's followers, although its consistency has apparently eroded after the intense changes in technology and other sources of innovation which have happened for the last decades. Even ID specialized in mature sectors, like some Italian and Spanish traditional ID, have evolved toward new technologies and management expertise, breaking the narrow relationship between product, tools and producer. We consider that the irruption of electronics since the sixties and seventies, the options opened by new materials or processes, the access to new and increasingly complex markets as well as specific niches we consider that have overflowed the features and skills of conventional tacit knowledge.

To overcome the contradictions between tacit knowledge and current requisites of modern innovations, we have reconsidered ID knowledge, proposing a new modality –which we have named *Locational-Translational Knowledge*– that enables to combine tacit and codified knowledge and to explain how the ID has evolved through the time preserving, to some extent, their usual properties and competitive strength. Nevertheless, we have warned about the limits of this type of knowledge at the present. The speed of technological change, the new logistics required, the disappearance in the Euro-area of competitive devaluations and the considerable competition from Asian countries suppose deep challenges for most ID. Given this situation it will probably be inevitable to reinforce the presence in ID of wider, permanent and newer knowledge sources as well as 'translators' able to link ID needs with S&T advances.

The paper is organized as follows: Section 2 synthesizes the contributions of knowledge to economics, with a particular focus on ID knowledge. Section 3 explains why it seems necessary to insert a new type of knowledge, which we have denominated *Locational-Translational Knowledge* (LK), to explain the peculiar innovative capacity of ID. Likewise, this

Section looks at ID as a knowledge system. Section 4 explains the functional evolution of ID distinguishing several possible models. Section 5 concludes.

2. The knowledge in the industrial district

Knowledge analysis, in neoclassical economics, identified knowledge just with codified knowledge. This was understood as similar to information and equally accessible to all firms (Arrow, 1962) despite previous contributions by Hayek, against the latter point (1945). To reinforce their positions, ulterior neoclassical authors stressed the role of new information technologies, which allows the transmission of information practically at zero cost. Moreover, the use of a piece of knowledge did not prevent its utilization by others users and, consequently, it could be considered as a quasi-public good.

However, in our opinion, there is a cost when, because of the transmission economies, there is a saturation of information for the user that requires to incur in some intermediaries costs, like information analysts and documentalists. Besides, even in this case, users confront a possible paradox: how to be sure about the relevant information existing in the time $t+1$, when their predefined preferences correspond to a previous time t . Therefore, it is not possible to fix an efficient price to pay the intermediary tasks. Such a paradox is similar, in some aspects, to that present in transactions of pieces of knowledge of economic value (Maskell, 1999a).

Other contributions, coming from the evolutionary economics (Nelson & Winter, 1982) and the literature on knowledge management in organizations (Nonaka, 1991; 1994; Nonaka & Takeuchi, 1995) confronted the neoclassical position. For Nelson & Winter, firms are a reservoir of specific knowledge. As a logical result, differences will appear among them. An additional and powerful consequence will be the usual presence, in the long term, of unbalances because of the innovation does not spread among the firms with similar synchrony, intensity and diffusion or absorption degree. Coherently with these arguments, it should be accepted the existence of spatial inequalities. A recent work by Florida (2003) also remarks the uneven distribution of talent and creativity. This circumstance leads to think, again, whether some areas enjoy idiosyncratic characteristics that enable them to be fertile matrixes for the innovation.

The previous arguments lead us to distinguish knowledge from data and information: data constitute the raw material of information, while the latter just offers a systematized presentation of data, according to criteria useful for its understanding².

² However, although the information is different from knowledge, we believe that a part is addressed to classify it (systematization and standardization codes) and how to use it (modification code).

Types of knowledge

One problem that emerges in the knowledge analysis³ lays in its vagueness. To palliate this, we depart from some previous work definitions. Concretely, we define knowledge⁴ as:

&1. The isolation of at least a concept or model with sufficient entity to provide an explanatory meaning, subjective and inter-subjective, to a concrete phenomena, either by itself (no combined knowledge) or by means of pre-existing knowledge pieces (combined knowledge).

Therefore, a piece of knowledge should meet certain properties: a) the concepts and models should be transferrable, because they try to reach an inter-subjective explanatory meaning, whatever the means used, in order to find an inter-subjective explanatory meaning; b) at least one different subject should understand its content (minimum socialization of the knowledge); and c) the concepts and models can be modified o recombined so that they extend or modify the previous ones –making possible a way to access to an enlarged reproduction of knowledge.

Secondly, we define the codified knowledge (CK) as:

&2. The pieces of knowledge which give support to concepts and models created, reflected and transmitted, by means of codes, at least by an expert community; these concepts and models should be capable of understanding, verification and consequent general recognition by at least one different expert community.

This definition does not exclude the physical transmission of CK by means of technology facilities. However, there exist several cognitive phases that modulate the effective diffusion of CK, in contrast to the neoclassical mainstream. This is based on several arguments: the transmission of a piece of knowledge does not necessarily imply its complete understanding; the understanding of a piece of CK does not imply its adequate verification; the verification does not guarantee the recognition because the creation or the transformation of a code, generally accepted for an expert or epistemological community, requires a previous process of socialization. Three are then the phases that a piece of knowledge should successfully pass: the understanding, which depends on the receptor's formation and the novelty of the knowledge; the phase of approval, which depends on the understanding and the code contrast; and the phase of recognition or socialization, which depends on the spread of approval.

³ From a economic innovation perspective.

⁴ We exclude, from the definition, the creativity achieved through literature and fine arts, although recognizing its powerful influence on innovation. For example, the Bauhaus culture atmosphere and conceptual development, the current multimedia or the comic industry.

On the other hand, there are phenomena and actions of difficult or impossible codification; a fact that restricts the use of CK, suggesting the use of tacit knowledge (TK)⁵⁶. The reception and scope of this type of knowledge in economics has not been easy. In fact it has provoked abundant reflections in the literature.

Without going deep into the controversy, we should remember the seminal contribution of Polany (1974; 1983) as the main source about TK. Ulterior works on this issue, as that by Nelson & Winter (1982), have followed the path opened by Polany. On applying this approach to our case, we can notice that ID achieve competitive advantages, more intense and persistent when greater the generation and diffusion of the localized knowledge is and greater the capacity of ID firms to transform it in innovations. In the same way we can find a wide spectrum of literature on the relationship between territory and knowledge⁷.

Despite the increasing relevance granted to knowledge in economic research, its use remains imprecise because it includes a broad range: from the knowledge related to people psychomotor activity to the 'dialectal' or 'contextual' knowledge. This fact drives us to define the tacit knowledge, at least from the perspective of innovation, as:

&3. The pieces of knowledge:

& 3.1. Created by an expert community in absence, for the time t, of a code generally accepted by other expert communities and able to disseminate it; or

& 3.2. Just transmissible by means of codes whose use, in the time t, permits less consumption of cognitive resources than the use of CK.

According to this definition: a) Unlike CK, the TK creates, develops (and eventually disappears) only inside an expert community, unless at the time t+1 its codification permits a reduction of the economic resources consumed; b) It is a type of knowledge diffused by means of concepts and models of reduced or null outside visibility, mainly through people proximity. Nevertheless, it can be diffused by several supports of restricted circulation and, consequently,

⁵ The seminal reference to KT in economics is mainly related to the well-known quotation of Polany 'I shall reconsider human knowledge by starting from the fact that we can know more than we can tell' (Polany, 1983). In literature on innovation we find a wide reception of TK and a rich set of discussions about it (for example, in *Industrial & Corporate Change*, among authors like Ancori (2000), Cowan (2000), Johnson (2002), Nightingale (2003), Balconi (2007).

⁶ According to Dosi (1988), 'Tacitness refers to those elements of knowledge, insight and so on, that individuals have, which are ill-defined, uncodified and unpublished, which they themselves can not fully express and which differ from person to person, but which may to some significant degree be shared by collaborators and colleagues who have a common experience' (Fischer (2006b, p. 98).

⁷ Research on *high-tech* areas in USA (Saxenian, 1994), *milieux innovateurs* (Camagni, 1994; 2006), *learning-regions* and *learning economies* (Lundvall, 1994; Asheim, 1996; 1999; Maskell, 1999), clusters (Porter, 1991; 1998); 2000; Breschi, 2005b); Asheim, 2006b); Borrás, 2008), regional systems of innovations (Braczyk, 1998; Cooke, 2002; 2004), are some recent examples on this issue.

of limited recognition for people that don't belong to the expert community; c) It is a kind of knowledge that often uses the intuition as well as metaphors and analogies⁸.

The reception of knowledge in the research on industrial district

Departing from the previous knowledge modalities, we can now inquire into its presence in ID theory. The route starts from the well-known contribution by Marshall (1920) since, among the characteristics of ID, a knowledge of peculiar diffusion appears. As Marshall says:

*When an industry has thus chosen a locality for itself, it is likely to stay there long: so great are the advantages which people following the same skilled trade get from near neighbourhood to one another. **The mysteries of the trade become no mysteries; but are as it were in the air** and children learn many of them unconsciously. Good work is rightly appreciated, inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed: **if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further new ideas*** (Marshall, 1920, Par. IV.X.7. Bold added).

This knowledge of Marshallian origin has been translated into the current economic language by means of the concept of economic externalities: economies external to each firm, but internal to the whole district, which contribute to explain the potential superiority of the ID firms over firms diffusely located⁹.

Since this initial contribution, the stress on TK takes root in several Italian authors. For instance, although with some nuances, in Brusco (2008), Maccabelli (1997), Corò (1997)¹⁰, Marchi (2008a). Becattini (1994) also remarks the relevance of TK: while machinery and equipment, manuals, or organizational models are endowed with CK, it is not the case for the sediment of TK settled in ID.

On the other hand, Becattini and Rullani (1993; 1998) try to explain how knowledge works in ID. They follow Nonaka (1995), adopting most of his contribution; in particular, the Nonaka model core, i.e., the 'SACI', despite its cultural and economic framework, that of Japanese big firms. The authors extend to the Italian ID the similar changes experimented by knowledge in great organizations. In this respect they hold that modern industrial civilization is ruled by conversion processes of tacit/contextual knowledge in codified/explicit knowledge

⁸ It should be noticed that TK, although widely found in ID or in firms, can also be a result of scientific activity. The scientific creativity resides in TK (Håkansson, 2007). Even in the fields of highest scientific level it does exist some knowledge achieved through learning-by-doing processes (Foray, 2004).

⁹ As Becattini says, 'É questo dunque che, quando riesce a interagire col sapere tacito rilevante (cioè col sapere scientifico-tecnico che, unito al sapere tacito di un sistema locale, produce beni o servizi che si collocano sul mercato globale), **conferisce uno specifico vantaggio competitivo** a un determinato sistema produttivo locale' (Becattini, 1994, p. 85, bold added).

¹⁰ Nevertheless, he also suggests that it is necessary a broader codification for accessing to some resources external to ID firm.

and vice versa. Processes broken down in the four phases, according to Nonaka's theory: TK socialization, TK externalization, CK combination and CK internalization¹¹.

We cannot analyze in detail the use of the 'SACI' model to explain the knowledge in ID. Nevertheless, we must declare our surprise because this mimicry is not properly justified. Besides, the links and the shades needed to fit both economic phenomena do not appear, despite the fact that an implicit coincidence, of both the Italian district and the big Japanese company, is suggested. This proximity is rather improbable because the latter is strictly hierarchical, imposes homogeneous routines, is used to hold relationships with knowledge sources worldwide and propels an innovative, active, persistent and controlled strategy. In second place, these companies enjoy a better access to financial resources and other privileged relationships than ID firms. Such aspects do not seem easily reproducible in ID framework. However, we agree with the general views of the preceding authors about ID as a place of connections between TC and CK, as we point out in the next Section.

The industrial district as cognitive system

We can achieve a new step for understanding how knowledge works in ID linking the concepts of district, knowledge and system. Antoldi (2006a) looks at ID as a cognitive system, with knowledge creation processes of TK and CK influenced by learning mechanisms in the firms and in the territory; a system where proximity contributes the imitation processes among the firms through learning and workers mobility. However, he warns of risks if local knowledge turns to be auto-referential, giving raise to lock-in problems. Schianove (2008) also holds that ID is similar to a cognitive system able to elaborate complex information and to activate conversion processes between TK and CK. In the same way, Bonaccorsi (2005) considers ID is useful as an economic concept because the territory is a cognitive system that forms part of a spatial context which enables to sediment languages, shared experiences and collective identities; a set of characteristics that drives to an easier understanding of the meaning of the local new knowledge.

¹¹ The *socialization of TK* is achieved through the sharing of the experience consolidated in the production field; the phase of *externalization of TK*, through metaphors, analogies and mental models in order to finally achieve the encoding of contextual knowledge; the *combination of explicit knowledge* consists of the transfer, accumulation and manipulation of encoded information to turn it into a language of easy communication; and the *internalization of explicit knowledge* lies in the concrete processes of "fare" of the district, with the production of new TK and CK: i.e., the use of science and technology, together with the TK, to obtain specific products and the emission of new knowledge through the *cognitive spiral*. All terms in italics coincide with the theory of Nonaka. Close to Becattini and Rullani approaches are, in some aspects, Sforzi (2000) and Corò (1997).

3 The knowledge in ID and the *Locational-Traslational Knowledge* (LK)

The previous contributions quoted identify TK with the typical ID knowledge. In past decades it was quite appropriate to defend this position because TK was often linked to handicraft firms, mainly SMEs, and was the basis for the generation and diffusion of new knowledge in ID. However, the posterior changes induced in most of ID by technological innovations don't permit to keep TK nowadays as their main knowledge source. From our point of view, since then another type of localised knowledge has appeared –or developed more intensely–, combined with pieces of external CK unknown in the district. The pieces of knowledge resulting from these combinations have allowed ID the absorption of innovations provided by other agents and the development of own innovations. This process has helped to renew the ID knowledge as well as the ID economic vivacity and entrepreneurial dynamism¹².

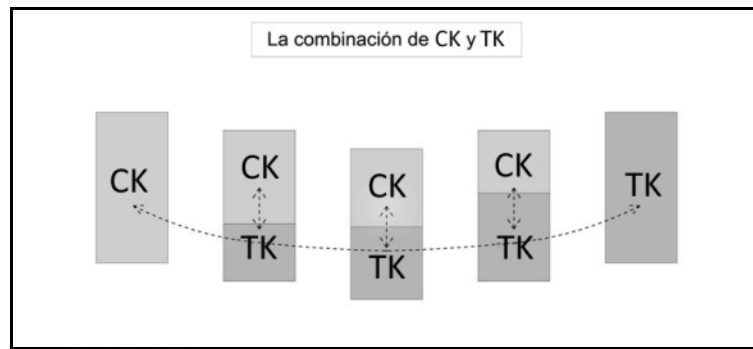
The relationship between TK and CK has resulted in combinations of new knowledge by means of integration, fusion or hybridization, along a continuum, (Nonaka, 1995; 2009; Malerba, 2000; Hakansson, 2007), of pieces from both knowledge types. This process has made feasible an effective transmission of this new knowledge, i.e., its understanding, acceptance and reproduction. In fact, the usual distinction used to differentiate both types of knowledge is artificial because most of the knowledge is a combination of TK and CK (Rooney, 2003; Buesa, 2007), achieved by a dynamic and inter-active complementarity between them.

To this respect, the **Graphic 1** shows the pieces of knowledge as rectangles CK/CT, i.e., as integrated modules of both types of knowledge. If we applied it to ID, it means that the knowledge of ID doesn't remain static and that its components can mutually interact, producing hybrid knowledge. The internal composition of knowledge pieces modifies as time passes, either in the way forward the left (greater relative contents of TK), or forward the opposite way (CK)¹³.

¹² As Becattini (1993) states: 'A relation of mutual integration must be established between contextual and transferable knowledge; this relation, as it has to adapt abstract knowledge to the specificities of different contexts, will inevitably reach to a crisis point. The conversion circuit that codifies and decodifies the knowledge, relating the global to the local, realises a complex process of 'versatile integration'...These capacities belong to the advanced technologies and organisations. But the process in a more and more important and no secondary way, will have to be granted by the exchange of ideas and by personalised communications...carried out in local systems...**among men and groups that have developed a special capacity to act creatively as mediators between abstractive codes and local experience contexts**' (p. 58, bold added).

¹³ To this respect, Fischer (2006) points out that in many cases a knowledge piece can locate anywhere between the completely tacit and the completely codified. Likewise, he states that a certain type of knowledge can be codified when consolidates and, on the other hand, that its incorporation to specific goods and services can reintroduce some tacitness (p. 119).

Graphic 1. The combination of CK and TK



Source: Our own elaboration

The transmission and effective absorption of new combinations of knowledge in ID might require an inter-personal relationship between transmitter and receiver that facilitates the complete capture of the new knowledge contents and the convergence of cognitive conditions. For the ID firm, conferences, technical contacts, organization of trade fairs, workshops, formal and informal meetings can provide the adequate frame for the communication of ID actors, in order to syntonize their respective cognitions so that the understanding of each CK/CK combination becomes coincident¹⁴.

The combinations of CK/TK found in a specific time and place constitute the so called *Locational-Translational Knowledge* (LK); a type of knowledge which acquires its peculiar contents as consequence of the above mentioned fusions and hybridizations. These combinations create some particular codes that are the result of integrating the pre-existing technical and handicraft knowledge into new pieces of CK imported to and adapted by the ID firms. A knowledge which is *Locational* because it is possible to identify its presence in a specific place and, simultaneously, is *Translational*, because it makes possible the fusion/hybridization of pieces of knowledge, tacit or codified in nature, which coincide in a concrete time and locus.

We think that what we have said needs qualifying. So, linked to definitions of Section 2: a) Some LK can achieve diverse codification levels, but such a code, at least in the instant t, is of limited acceptance and diffusion, built *ad hoc* for an expert community to facilitate the

¹⁴ This practice can be also found in the scientific field. Concretely, the contrast of a wrong hypothesis usually remains in the specific locus of the concerned researcher. Fischer (2006) even states that the knowledge closer to the science boundaries is more probably tacit, that most of essential knowledge is specialised and remains as tacit among researchers or engineers. Likewise, he points out that, among the non codified skills, one especially relevant is the acquisition and effective use of knowledge. For Buesa (2007), the more complex a product is, the more KT it requires. On the other hand, we consider that TK contributes to the *effective* transmission of CK as it shows the usual stages of researchers in laboratories and universities to meet their colleagues: a practice that seems necessary to absorb in detail their work.

cognitive accessibility of their members; b) The LK generated and kept by an expert community makes also possible the translation of new knowledge pieces on transforming them in other easily accessible to the ID firms with below average of knowledge resources; c) The LK differs from the previous pieces of TK and CK that have contributed to its generation. It is a creative synthesis among knowledge pieces that, even existing previously, drive to original functions that enable ID to improve its innovative diversity.

Consequently, LK means neither a sequence of mutual conversions between TK and CK (Nonaka 1995; Becattini 1993) nor the birth of a simple TK articulation: we witness a new knowledge that incorporates variable and integrated doses of codification and tacitness.

Expanded reproduction of district's knowledge

As in other knowledge modalities, the LK faces the negative consequences derived from its obsolescence. To reduce its impact, we suggest that in ID a process of expanded reproduction of knowledge exists. Such a process starts, in the short term, when the flows of knowledge and information inputs supply a new knowledge and information return after their use in the production process. Thus, the pre-existing stock increases, making easier the finding of incremental innovations. The new knowledge could be considered then as a result of a joint production process (Becattini & Rullani 1993; Becattini 2003) in which the output includes the good or service produced and a new knowledge generated from the expertise or from some slight changes applied to the process or the product. This knowledge incorporates into the previous stock of the firm to improve either the process efficiency or the product quality and diversity.

Nevertheless, in the medium and long term, ID needs to maintain or expand the innovative advantage of their firms over external firms. For obtaining an enlarged knowledge in this case, it requires an expansion of the positive factors that stimulate the development of LW so they neutralize the negative factors. On this matter, the **Table 1** lists positive and negative factors, although this it is not the moment for their detailed discussion.

Table 1. Some factors with influence on the existence and reproduction of LK in ID	
General Factors	Particular factors of a specific territory
Codification cost of TK when possible	Quantity and composition of human capital in ID and its real utilization
Learning cost of the CK: When bigger, more probability to keep LK as less expansive option	Presence of qualified translators and their position in the firm and in ID
Degree of radical intensity in the new combinations of knowledge integrated in the LK: more intensity can provoke negative reactions in people or institutions if they cause a shock to established culture, influence economic interests of organizations or modify the power distribution in the letter	Existencia de mecanismos eficientes y aprendedores para la transmisión del LK (escuelas profesionales, clubes de trabajadores y técnicos, relaciones de confianza) y su ampliación, respectivamente
The increase of relationships among the firms o between firms and other organizations that enables the access to new flows of knowledge capable of enlarging LK	Incorporation to ID of new firms because of ID quality knowledge if they are willing to share enlargement processes of LK
Specialization sectors	Flexibility before an increase or reduction of hierarchy in the relationships of firms
Source: Our own elaboration	

4. The industrial district as a system of evolutionary knowledge

The ID evolves and a stimulus of this evolution is the systemic nature of its knowledge. To illustrate this evolution, we turn to stylized models, analysed by literature or shaped by recent research. Our aim is to show a synthetic view of the appearance and transformation of district morphologies¹⁵. According to the previous Section, we can visualize the production activity as a process of cognitive experimentation that includes, jointly, knowledge and goods or services. A joint production we can observe from inside as well as from outside the firm, because it also flows to the rest of the district, and even beyond that.

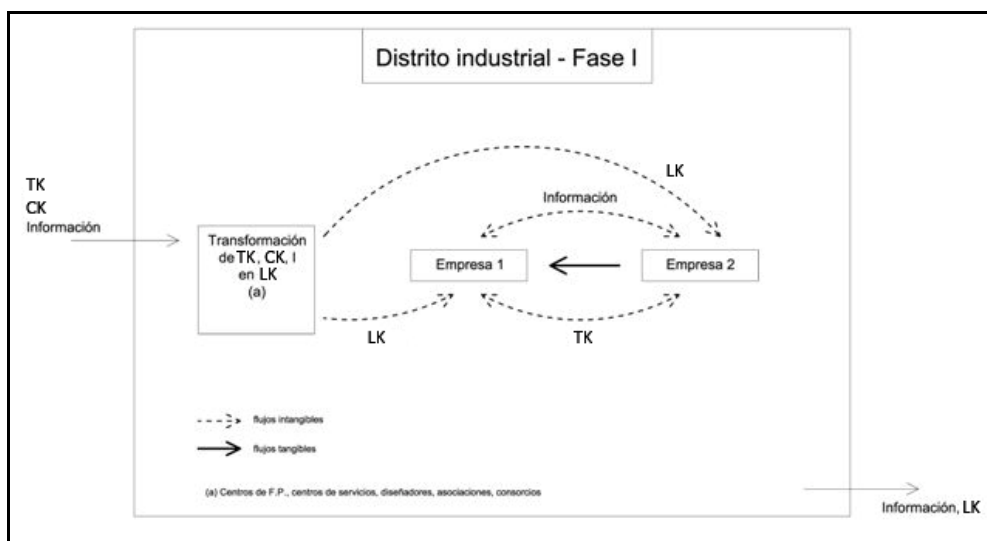
Our first model (Graphic 2), assume that ID is integrated by n firms, none exerting a hierarchical role. The coordination of the vertical relationships of production among the ID firms and external market is the result of an articulated process headed by an agent like the *impanatore*, that in present in some Italian ID (Becattini, 2000). With less functional scope, it could also be the case of the *mochilero*, in the Spanish footwear district of Elx (Cividanes, 2008). Anyway, in this model the ID receives flows of TK, CK and information (I), from outside sources. The respective inputs are processed by at least an ID institution: the same *impanatore*, training centres, advanced service centres for firms, designers or technological consortiums, among others.

The correspondent agent sends out the LK resulting from the fusion/hybridization of TK and CK toward the firms. In turn, these exchange the TK and the information necessary to

¹⁵ Although in our case the ID evolution turns around its condition of knowledge system, it does not mean that this dynamic process is not present in other characteristics utilized to explain the singularity of ID.

adjust their links in the chain value. It must be noticed that the ID, globally considered, works as knowledge and information importer and, simultaneously, exports information, TK and CK, either endowed in the emigrant human capital, or partially transmitted to some consolidated purchasers and suppliers external to the ID¹⁶. The intensity of both the internal and the external streams depends on the ID openness.

Graphic 2. Industrial District Type 1



Source: Our own elaboration

In this model it is the *impanatore* –or occasionally another district agent- who intervenes to articulate diverse TK segments through sticky pieces of knowledge, including some traces of CK. It is not a mere logistic coordination of the chain value, but an adjustment, harmonization and synchronization of different sights, which are achieved by working on the ground and with a dense relationship with other ID agents. In this frame, to be an expert in the ID language (for instance, technical language) is not enough to link firms that include several productive phases. In fact, the *impanatore* develops a double translation: first, importing and allocating new knowledge pieces from the market towards district actors that make up the productive process; second, among the ID actors to guarantee the same understanding of the new knowledge introduced.

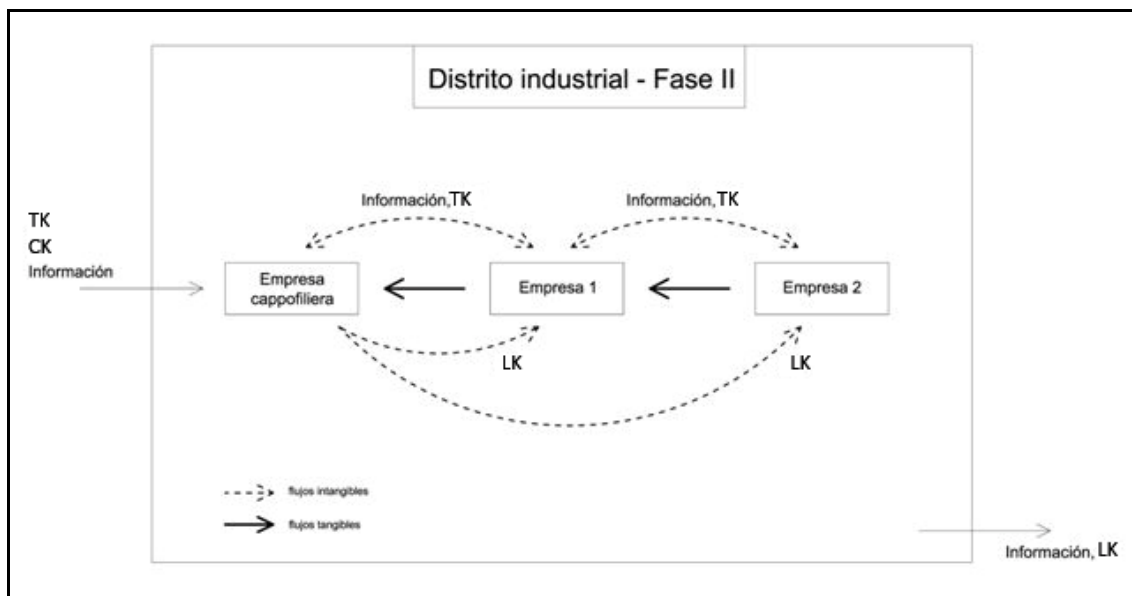
According to the technological and market imperatives –trademarks, trade distribution- the progress spreads to prevalent ID sectors impelling the emergence of new translators that extend the pre-existing basis composed of designers, *peritti*, training teachers, etc. The

¹⁶ Also Iammarino (2008) distinguishes two types of knowledge spillovers according their condition of enter-floods and exit-floods. For the author, the first group is positive while the second one can be positive or negative, depending on the point of view adopted: either the public goods or the knowledge owner.

following model suggests this ulterior phase of ID evolution (**Graphic 3**). A change appears in the role of LK applied to the production. Now, the absorption and diffusion of LK correspond to final firm or *cappofiliera*, in charge of coordinating the firms which are integrated in the productive chain. Simultaneously, these firms go on with their mutual interchange of information and TK. Nevertheless, some of this last knowledge ends in the *cappofiliera* which may use it to feed back its own LK stock¹⁷. On this issue, Becattini (1997) on replying Maccabelli (1997) holds that:

‘Between final firm and phase firm of a district does exist an intense interchange of remarks and information. It is a process that repeats over time, produces a technical language and typical behaviour rules which constitute a sort of fix asset... This also happens, obviously, in the networks of firms that don’t belong to the ID, but in this case some precariousness emerges because the links are just economic...inducing participants to ‘invest less’ in the building of linguistic capital and team behaviour’ (p. 263, own translation)

Graphic 3. Industrial District Type II



Source: Our own elaboration

Note: This graphic reflects the import of knowledge and information inputs endowed in productive inputs (machinery, raw materials, etc.) as well as, occasionally, inputs of extra-district CK (patent or other intellectual property licenses, consulting, training, etc.). These inputs access to *cappofiliera* processes of learning, absorption and implementation of new knowledge. From the *cappofiliera*, the knowledge spreads, with or without limitations, to supply firms. From the ID, the information floods endowed in the final goods leave along with LK and information of emigrant qualified workers.

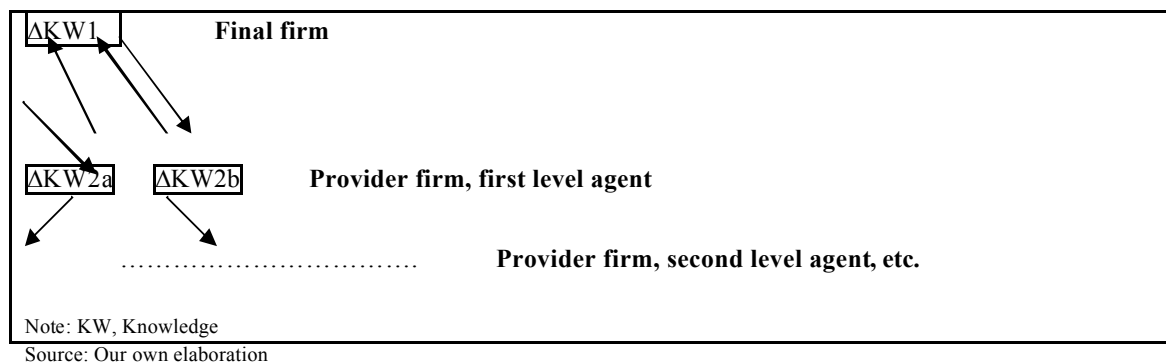
The change pointed out in the **Graphic 3** contributes to recognize the ID learning capacity for *deconstructing* the CK and the TK to transform them into LK. However some ID don't access to this new phase of transition, -from the 'handicraft management' of the

¹⁷ Paniccia (2009) also understands that, in the canonical type of industrial district, the links among the firms are dense and support two floods: goods (one or two ways) and intangibles (although in this case he just mentions a possible two way for the information).

impanatore, to the formal and structured relationships, subject to quality, price, specified period, environment respect, and opening to the learning. A knowledge shortage may be the cause. A shortage that depends on the effective absorption of the pieces of knowledge assimilated and diffused by the *cappofiliera*. On this matter, the knowledge resources capacity of this type of firm can be insufficient if, outside the ID, the specialization advances or a radical innovation becomes obsolete the stock of knowledge accumulated in the cluster.

A partially different model emerges when the efficiency of the learning centralization, the creation of LK and the diffusion of the new knowledge decrease in the final firm. Such a result may appear if the hierarchy is as intense as to disincentive the knowledge enlargement among the most specialized suppliers. If these suppliers have developed their own innovative skills, it should seem convenient, for the final or main firm, to set up a lighter hierarchy, closer to the coordination than to the centralization, accepting that, in this last case, suppliers can feel more concerned about the improvement of processes and products. Thus, the final firms would benefit from the innovative dynamism of their providers. However, it might happen that the inputs of the value chain differed over their importance in the productive process. In such a case, the final firm, for stimulating a more vivid knowledge creation, could try an allocation of tasks through a multilevel model, in which some suppliers were, likewise, the coordinators of complementary productive phases, as summarized in **Graphic 3**.

Graphic 3. Industrial District Type III



The above graphic above it is possible to deduce that the final firm transfers, part of its initial control over productive process to some suppliers, through a hierarchy variably distributed. This geometry of *mid-open innovation process* allows, using new relational morphologies, to impel the knowledge creation among ID suppliers. This type of organization contributes to explain the growing prominence of suppliers of intermediate goods in some ID. The investment in new firms by external companies seems to reinforce the evolutionary trajectory of ID. However, the creative knowledge can not be always a goal of the new firms if

they reject a symbiotic relationship in favour of a mere use of knowledge advantages already generated (saprophytic relationship)¹⁸.

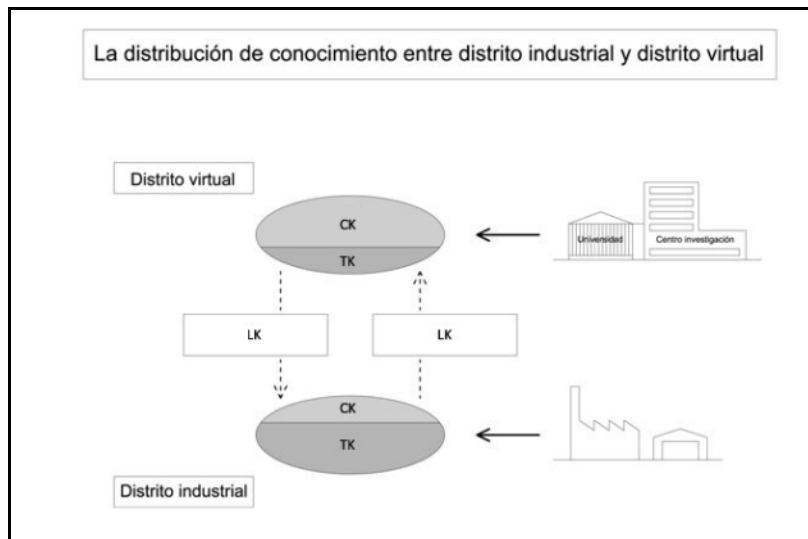
In current times, of particular competitive intensity, even the evolutionary morphologies of ID deals with many knowledge advantages and disadvantages, already synthesized in the **Table 1**. To achieve a positive balance, avoiding the ID decline, we think that the generation of new knowledge cannot just depend on the ID agents: it seems to need the rooting of innovation processes regularly developed -innovation processes capable of importing, translating and absorbing growing doses of CK.

The opening of ID to external knowledge resources leads to consider the access of districts to universities, research centres, firms specialised in applied knowledge and the set up of technological consortiums. The choice of these knowledge sources is a consequence of their power to overcome some district limitations, linked to the size of its creative work market, the changes in the organization and the commercialization of production, and the financial consistency of SMEs. Nevertheless, the mimetic imitation of external experiences doesn't work if the local culture is scorned. To this respect, a sporadic relationship between ID firms and the above-mentioned institutions does not necessarily generates an efficient collaboration because of differences or antagonisms between university and firm cultures, as it is the case in Spain and Italy.

Faced with this cognitive distance, it seems convenient to implement a new relationship model able to allow a mutual empathy, to share missions, routines and opinions and to identify the suitable incentives for stimulating the introduction of a more qualified human capital. Without this reciprocal 'discovery', the attainment of a robust cooperation emerges as a very complex goal. In turn, the relationships to maximize the exchanges of LK need to work in both ways, as pointed out in **Graphic 4**. To get this target, a desirable condition could be the presence of knowledge translators and what, as an analogy, we call 'virtual knowledge district'.

¹⁸ A concrete example is the ceramics district of Sassuolo where there exist 13 Spanish firms and other foreign companies. The aspects of ID more interesting for these firms are the relationship with machinery providers, designers, chemists, etc. as well as the presence of CERSAIE (employers association) and some complementary phases of the production process (Marchi, 2008).

Graphic 4. Industrial District Type IV



Source: Our own elaboration

5. Conclusions.

In this paper we review some interpretations about the ID knowledge, discussing its similarity with TK and other contributions that propose to identify the ID knowledge with models imported applied to great organizations. Likewise, we point out the insufficiency of TK and CK to explain the generation, absorption, diffusion, and reproduction of knowledge in ID. This is why we suggest the inclusion, at least from a firm innovation perspective, of a so called *Locational-Translational Knowledge* (LK), i.e., a type of knowledge which is the consequence of merging/hybridizing LK and CK. This new knowledge is the result of combinations of scientific, technical and handicraft languages located in a concrete place and time. The LK finds in ID an adequate milieu for its development, facilitating a crossbreeding of TK and CK that avoids a cognitive isolation of ID. Likewise, this type of knowledge supplies renovation and variety to ID firms and institutions.

In particular, we analyse ID as a system, in order to explain its knowledge behaviour. We accept that interactions among the district agents, either directly or by means of spillovers, acquire a singular relevance because they provide inputs which can stimulate, slow down or destroy the district's knowledge. On the other hand, the understanding of the ID, as a knowledge system, leads us to consider the enlarged knowledge reproduction as a key mechanism to understand its regeneration and resistance in front of obsolescence processes. In the short term, the enlarged knowledge reproduction benefits from a joint production of goods or services and the knowledge that emerges from the everyday scrutiny of the chain value. The firm assimilates this 'by-product' by means of successive feedbacks, increasing its probability

of finding incremental innovations. In our opinion, when the time horizon extends beyond the short term, the enlarged knowledge reproduction might require an import of external knowledge as well as a rise of the ID innovation level through changes in its human capital composition: a set of actions to make possible an active neutralization of the firm obsolescence and of the losses of progressive functionality in the stock of knowledge.

We emphasize the process of ID evolution as a way to go beyond the understanding of ID as a static or a timeless economic phenomenon. In this respect, we can remember the examples of Prato and Montebelluna. Both cases, although for different causes, are good examples to justify the evolutionary process followed by ID. On this matter, we attempt a wider understanding of ID evolution, limited to its knowledge, proposing some stylized models like the *impanatore*, the *cappofiliera* and the *flexible hierarchy or mid-open innovation process*. These models reveal the route of ID towards new morphologies that enable to reinforce their competitiveness. Nevertheless, the delicate economic conditions in many of the Spanish and Italian ID recommend a step beyond. In that respect, we suggest a future model characterized by a persistent relationship of LK with *virtual districts* composed of universities and public research centres, among other developers of new knowledge. Anyway, the existence of controversial priorities and incentives in research institutions and ID firms does not guarantee a spontaneous, fluid and robust connection between them. Consequently, we suggest the demolition of cognitive and cultural barriers by means of *translators* in charge of supporting the flood of translation and mutual relationships between the knowledge agents of ID and the *virtual districts*.

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