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

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ABSTRACT

The dissemination of knowledge in industrial districts (ID) and clusters has often been linked to the presence 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 of codified knowledge in these economic 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 in ID of combinations/hybridizations of both types of knowledge, which we have named *locational-translational* knowledge. This third type of knowledge might explain the continuity of ID's contextual advantages even in presence of higher doses of codified knowledge. Nevertheless, a complete explanation requires 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.

The referred agents emerge when we consider an ID as a knowledge system. This evolutionary system adopts a particular morphology at each stage of the district life-cycle, emerging new models of absorption, combination, and dissemination of external knowledge. In concrete, we distinguish, as successive 'knowledge translators' in ID, the *impannatore*, the *cappofiliera* firm, the *mid-open*

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innovation process and, recently, the formal knowledge from research oriented institutions such as the above referred (*virtual districts*).

Although the district can change, it does not imply a generalized change. Some mature ID experience difficulties related to their strength and suitability. In particular, we notice several constraints, such as the size of the 'district's creative market', which might 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.

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), since 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 conceptualization, scholars have emphasized the role of tacit knowledge: it allows boosting the economic performance of ID because its knowledge is contextual and its diffusion and learning mainly happens inside the ID, restricting its adoption by outsiders.

This explanation, succinctly exposed, is frequently adopted by Marshall's followers, although its consistency has apparently eroded after the intense changes in technology and other sources of innovation developed for the last decades. Even the ID specialized in mature sectors, like some Italian and Spanish traditional districts, have evolved towards new technologies and management expertise, breaking the former, narrow relationship among products, tools and producers. For instance, we consider that the irruption of electronics since the 60s and 70s, the alternatives opened by new materials or processes, the access to new and increasingly complex markets with specific niches have overflowed the boundaries of the conventional tacit knowledge.

To overcome the contradictions between tacit knowledge and the current characteristics of modern innovations, we have reconsidered the knowledge of industrial districts. In this way, we propose a new knowledge modality –which we have named *Locational-Translational Knowledge (LK)* - that enables to combine tacit and codified knowledge, explaining how the ID has evolved through the time preserving, to some extent, their usual features and competitive

strength in this field. The LK might explain how districts have overcome the district knowledge paradox: i.e., the presence of higher doses of codified knowledge and, simultaneously, the persistence of its knowledge advantages.

Nevertheless, even such knowledge faces up to limits at the present. The speed of technological change, the new logistics needed, the disappearance of competitive devaluations in the Euro-area and the considerable competition from Asian countries suppose deep challenges for most ID. Before this complex 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, -that we have denominated *Locational-Traslational Knowledge* (LK)-, to explain the peculiar innovative capacity of ID. Likewise, this Section analyses ID as a knowledge system and its implications. Section 4 explains the dynamic evolution of ID distinguishing several possible models. Section 5 concludes.

2. The knowledge in industrial districts

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

However, in our opinion, there is a cost when, because of the communication facilities, there is a saturation of information for the user which requires to incur some intermediaries costs, like information analysts and documentalists. Besides, even in this case, the users face a 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 tasks necessary to avoid ‘information noise’. 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) confront the neoclassical position. For Nelson & Winter, firms are a reservoir of specific knowledge. As a result, differences among them will appear. An additional and powerful consequence will be the presence of unbalances in the long term, because firms do not introduce innovations with similar synchrony, intensity and diffusion or absorption degree. Coherently with these arguments, it should be accepted the appearance 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 of creativity and 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 useful criteria for its understanding².

Types of knowledge

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

&1. The isolation of at least a concept or model with sufficient entity to provide with an explanatory meaning, subjective and inter-subjective, to a concrete phenomena, either by itself (non 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; b) they try to reach a subjective (individual) and inter-subjective (common) explanatory meaning, whatever the means used; c) as a consequence, at least two different subjects should understand the knowledge content (a process of minimum socialization of the knowledge is required to accept it); and d) the concepts and models can be modified o recombined so that they extend or modify the previous ones –making possible to develop 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, whose origin is at least one expert community; these concepts and models should

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

³ In the framework of innovation.

⁴ The definition excludes the creativity achieved by literature and fine arts, although recognizing its powerful influence on innovation. For example, the Bauhaus culture atmosphere and conceptual developments, the current multimedia or the comic industry.

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 codified knowledge by means of technology facilities. However, there exist several cognitive phases that modulate its effective diffusion, against the neoclassical mainstream assumptions. Firstly, the transmission of a piece of knowledge does not necessarily imply its complete understanding; secondly, the understanding of a piece of CK does not imply its adequate verification; third, the verification does not guarantee the recognition, because the creation or transformation of a code, generally accepted for an expert or epistemological community, requires a previous process of socialization. Then, three are 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 contrast of the code; and the phase of recognition or socialization, which depends on the spread of the approval.

On the other hand, there are phenomena and actions of difficult or impossible codification. Such a fact restricts the use of codified knowledge, suggesting the use of the tacit one (TK)⁵⁶. However, the reception and scope of this type of knowledge in the economic field has not been easy. In fact it has stimulated many reflections in the literature.

Without going deep into the controversy, we should remember the seminal contribution of Polany (1974; 1983) as the main source on TK. Ulterior works on this issue (Nelson & Winter, 1982), have followed the path opened by Polany. On applying this approach to industrial districts, we can notice that they may achieve competitive advantages, more intense and persistent when greater the generation and diffusion of the localized knowledge is and greater the capacity of district firms to transform it into innovations. In the same way, a wide spectrum of literature on the relationship between territory and knowledge has emerged⁷.

⁵ The seminal reference to tacit knowledge 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 the 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) and 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, uncoded 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 examples on this issue.

Despite the increasing relevance granted to tacit knowledge in the economics and management fields, its use has remained imprecise because of the broad range of meanings included: 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 (concepts and models):

& 3.1. That are created by an expert community in absence, for the time t, of a code generally recognized and accepted by other expert communities; or

& 3.2. That are just transmissible by means of certain codes whose use, in the time t, allows a lesser consumption of cognitive resources than the codified knowledge.

Three nuances to clarify the definition: a) Unlike codified knowledge, the TK only appears, develops (and eventually disappears) inside an expert community, unless at the time t+1 its codification allows a reduction of the cognitive resources used –and logically, a reduction of the economic costs related to. b) It is a type of knowledge diffused by means of concepts and models of reduced or null external visibility, mainly through people proximity. Nevertheless, it may be diffused by several supports of restricted circulation and, consequently, of limited recognition for people not belonging to the expert community; c) It is a type 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 features of ID, the author identifies a knowledge of peculiar diffusion. As he 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,

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

but internal to the whole district, which contribute to explain the potential superiority of the district firms over the firms diffusely located⁹.

After this initial contribution, the TK takes root in several Italian authors: for instance, with some differences, in Brusco (2008), Maccabelli (1997), Corò (1997)¹⁰, and 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 tacit knowledge 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 proceeds from Japanese big firms. The authors apply to the Italian ID similar explanations originally used to understand the management of 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 and vice versa. These processes broke down in four phases, according to Nonaka's theory: TK socialization, TK externalization, CK combination and CK internalization¹¹.

Now, we cannot analyze in detail the use of the 'SACI' model to explain the knowledge in ID. Nevertheless, we point out that the above mimicry is not properly justified by Becattini and Rullani. Besides, the links and the shades required to fit both economic phenomena are not explicit, despite the fact that, implicitly, they suggest that the transformations of knowledge in districts and big Japanese company coincide. In our opinion, this proximity is rather improbable because the latter is hierarchical, imposes homogeneous routines, is used to hold relationships with worldwide knowledge sources and propels an active, persistent and controlled strategy of innovation. Second, these companies enjoy a better access to financial

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.

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" in 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 used by Becattini and Rullani coincide with the theory of Nonaka. Close to Becattini and Rullani approaches are, in some aspects, Sforzi (2000) and Corò (1997).

resources and other privileged relationships than ID firms. Such aspects do not seem easily reproducible in the 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 advance another step for understanding how knowledge works in ID if we link the concepts of district, knowledge and system. In this way, Antoldi (2006a) looks at ID as a cognitive system, with creation processes of tacit and codified knowledge influenced by learning mechanisms that work in firms and territory; a system where proximity contributes to 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 tacit and codified knowledge. In the same way, Bonaccorsi (2005) considers ID useful as 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 new meanings of the local knowledge.

3 The knowledge in industrial districts and the *Locational-Translational Knowledge (LK)*

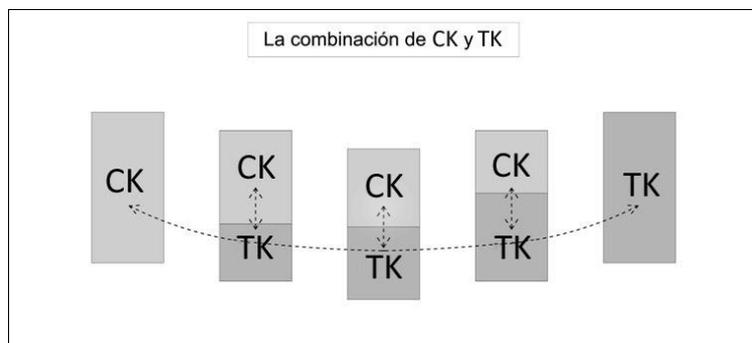
The previous contributions quoted identified tacit knowledge with the typical ID knowledge. In past decades it was quite appropriate to defend this position because this type of knowledge was often linked to handicraft firms, mainly SMEs, and it was the basis for the generation and dissemination of new knowledge in ID. However, the subsequent changes induced in most of ID by technological innovations do not allow keeping the tacit knowledge as the main knowledge resource of the district nowadays. Since the 60s and 70s another type of localised knowledge seems to appear –or to develop more intensely-, combined with pieces of external codified knowledge 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 its own innovations. This process has helped to renew the ID knowledge as well as the ID economic vivacity and entrepreneurial dynamism¹².

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,

The relationship between tacit and codified knowledge has resulted in contributions of a new knowledge achieved after the integration, fusion or hybridization of knowledge pieces from both initial resources. These processes work along a continuum (Nonaka, 1995; 2009; Malerba, 2000; Hakansson, 2007), and they have made feasible an effective transmission of the 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.

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. Applied to ID, it means that the knowledge of ID does not remain static and that its components can mutually interact, producing hybrid knowledge. The internal composition of knowledge pieces modifies as time elapses, either in the way forward the left (greater relative contents of tacit), or forward the opposite way (more contents of codified)¹³.

Graphic 1. The combination of CK and TK



Source: Our own elaboration

The transmission and effective absorption of new KL in districts might require an inter-personal relationship between transmitter and receiver that facilitates the complete capture of the new knowledge and the convergence of their respective cognitive conditions. For the ID firm, conferences, technical contacts, organization of trade fairs, workshops, or formal and

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).

informal meetings can provide the adequate frame for the communication of district actors, in order to syntonize their respective cognitions so that the understanding of each CK/TK 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 contents as consequence of the above mentioned processes of 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 codified knowledge 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.

At this point, we think that the new concept of knowledge needs more explanation for linking it to definitions of Section 2: a) Some LK can achieve diverse codification levels, but such a code, at least in the time t, is of limited acceptance and diffusion, built *ad hoc* for an expert community to facilitate the cognitive accessibility of their members; b) The LK generated and kept by an expert community makes also possible the translation of new knowledge pieces into other easily accessible to district firms with knowledge resources below average; 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 the district to improve its innovative diversity.

Consequently, LK does not mean a mere sequence of mutual conversions between tacit and codified knowledge CK (Nonaka 1995; Becattini 1993) neither the birth of a simple tacit knowledge articulation: we witness a new knowledge that incorporates variable and integrated doses of codification and tacitness.

Expanded reproduction of district's knowledge

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 probably more 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 is required. On the other hand, we consider that TK contributes to the *effective* transmission of CK as it shows the usual stages of researchers at laboratories and universities to meet their colleagues: a practice that seems necessary to absorb their work in detail.

As in other knowledge modalities, the LK face the negative consequences caused for its obsolescence. To reduce its impact, we suggest that in ID exists a process of expanded reproduction of knowledge. Such a process starts, in the short term, when the flows of knowledge and information inputs supply a new knowledge and information return or feedback after their use in the production process. Thus, the pre-existing stock of knowledge increases, making easier the finding of incremental innovations. The new knowledge might be considered as the 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 ‘in-house’ to the process or the product. This knowledge incorporates into the existing knowledge stock to improve either the process efficiency or the product quality and diversity of the firm.

Nevertheless, in the medium and long term, ID needs to expand the innovative advantage of their firms before external competition. For obtaining an enlarged knowledge now it requires an expansion of the positive factors that stimulate the development of LK so they may neutralize the negative ones. The **Table 1** lists positive and negative factors, although this it is not the moment for a detailed discussion on them.

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	Existence of efficient and learning mechanisms for the transmission and enlargement of KL (vocational schools, clubs of workers, trust relationships)
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. 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 districts. To illustrate the evolution, we turn to stylized models, analysed by the literature.

Our aim is to show a synthetic view of the birth and transformation of district morphologies¹⁵. According to the previous Section, we can visualize the production as a process of cognitive experimentation that jointly includes 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 other district agents.

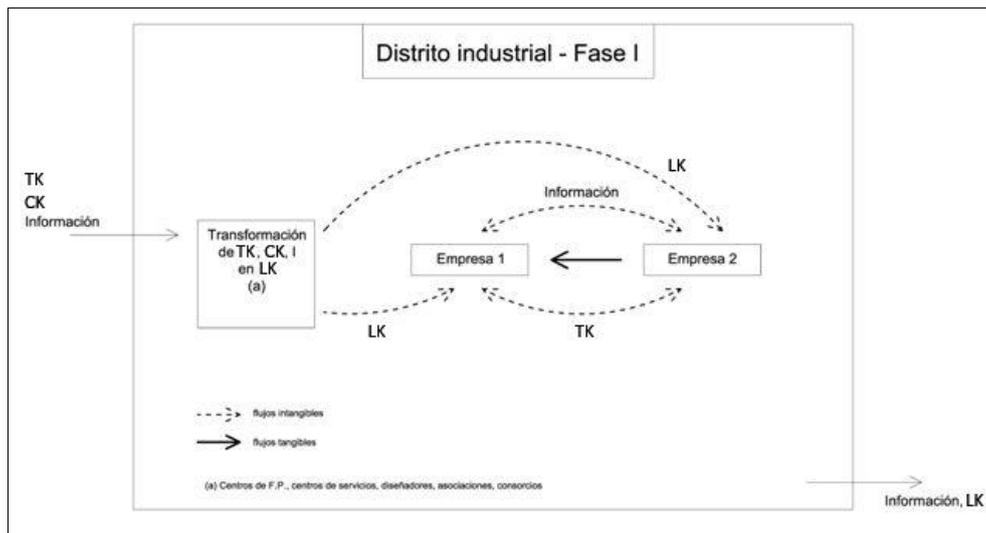
Our first model (Graphic 2) assumes that an ID is integrated by n firms, none exerting a hierarchical role. The coordination of the vertical relationships of production among the ID firms and external market is the result of an articulated process headed by an agent like the *impanatore*, which is present 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, from outside sources, flows of tacit and codified knowledge as well as information (I). The respective inputs are processed by at least an ID institution: the same *impanatore*, training centres, advanced service centres for firms, designers or consortiums, among others.

The correspondent agent sends out the LK resulting from the fusion/hybridization of tacit and codified knowledge to the firms. In turn, these exchange the tacit knowledge and the information necessary to adjust their respective links in the chain value. It must be noticed that the ID, globally considered, works as a knowledge and information importer and, simultaneously, it exports information, tacit and codified knowledge, either endowed in the emigrant human capital or partially transmitted to some consolidated purchasers and suppliers external to the district¹⁶. The intensity of both internal and external streams depends on the district openness.

Graphic 2. Industrial District Type 1

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.

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



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 current coordination of the chain value logistics, but an adjustment, harmonization and synchronization of different sights, which are achieved by working on the ground and with a dense relationship with other district agents. In this frame, to be an expert in the district language (for instance, technical although informal jargon) is not enough to link firms placed in 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 district actors to guarantee the same understanding of the new knowledge introduced.

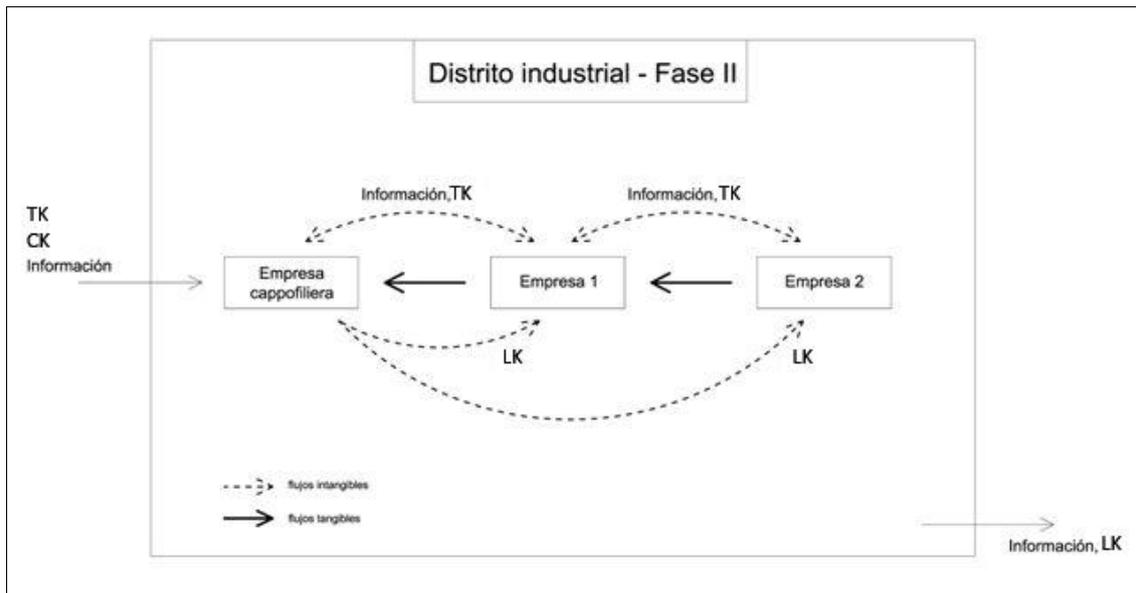
According to the technological and market imperatives, the process impels the emergence of new translators which will extend the pre-existing basis of designers, *peritti*, training teachers, etc. throughout the district sector of specialization. In a later moment, the district transformation achieves a new phase (**Graphic 3**). The position of LK changes. Now, its absorption and diffusion correspond to a final firm or *cappofiliera*, in charge of coordinating the companies integrated in the productive chain. Simultaneously, these firms go on their mutual interchange of information and tacit knowledge. Nevertheless, some of the latter flows into the *cappofiliera* that may use it to feedback its own LK stock¹⁷. About this point, 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

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).

which constitute a sort of fixed asset... This also happens, obviously, in the networks of firms that do not 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 displays 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 the *cappofiliera* processes of learning, absorption and implementation of the new knowledge. From the *cappofiliera*, the knowledge spreads, with or without limitations, to supply other chain value firms. From the ID, the LK and the information floods outside, endowed in the final goods, along with the skills and know-how of emigrant qualified workers.

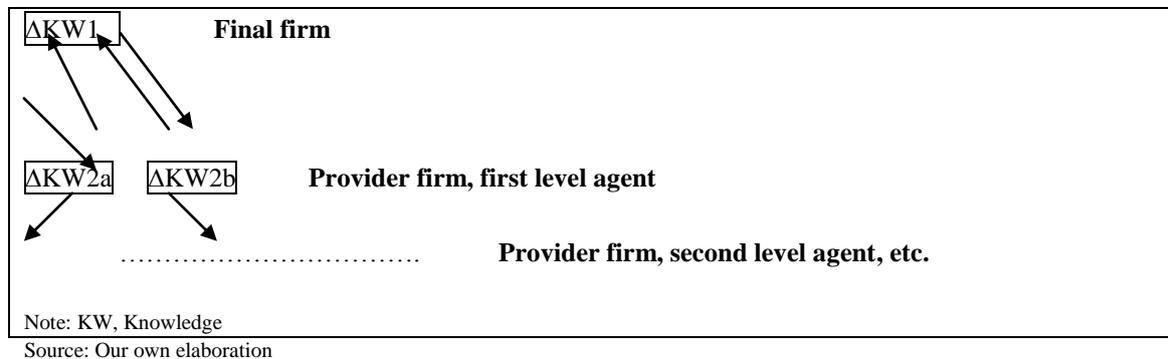
The change pointed out in the **Graphic 3** contributes to recognize the ID learning capacity for *deconstructing* the codified and tacit knowledge to transform them into LK. However, some districts do not access to this new phase of transition, -from the 'handicraft management' of the *impanatore*, to a formal and structured relationship that demands quality, price, fixed period for delivery, environment duties and opening to the learning. The cause may be a knowledge shortage. It depends on the effective absorption of the new pieces of knowledge assimilated and diffused by the *cappofiliera* and its knowledge competence to capture the specialization advances and radical innovations developed outside the ID. If it is not the case, the LK accumulated in the cluster becomes obsolete.

A partially different model emerges when this centralized/hierarchical model loses efficiency as source of LK and driving belt of new knowledge. Such a result may appear if the hierarchy is as intense as to disincentive the introduction and development of new knowledge in the most specialized suppliers. If they display innovative strategies, it should be a chance, for the final or main firm, to remove old inertias and set up a lighter hierarchy, closer to the coordination than to the centralization, as a way to impel the concerns of suppliers on innovations and to spread a symbiotic culture.

Nevertheless, the economic relevance of the suppliers usually differs. In such a case, the final firm could try an allocation of tasks, through a multilevel model, for stimulating a

more vivid creation of knowledge. In this model some suppliers are, likewise, the coordinators of complementary productive phases, as summarized in **Graphic 3**.

Graphic 3. Industrial District Type III



The above graphic displays that the final firm transfers part of its initial control on the productive process to some suppliers through a hierarchy variably distributed. The geometry of *mid-open innovation process* enables to encourage the creation of knowledge among ID suppliers by means of new relational morphologies. This type of organization helps to explain the growing prominence of suppliers of intermediate goods in some districts.

On the other hand, the investment in new firms by national or international companies may reinforce the evolutionary trajectory of ID. However, the creative knowledge can not be always a goal of these firms if they reject a symbiotic relationship in favour of a broad use of knowledge advantages already generated -i.e., a saprophytic relationship¹⁸.

In current times of particular competitive intensity, even the evolutionary morphologies of ID deals with several knowledge advantages and disadvantages, gathered in **Table 1**. To achieve a positive balance, avoiding an ID decline, we think that the generation of new knowledge cannot just depend on the district agents: the ID needs the rooting of innovation processes, regularly developed -innovation processes capable of importing, translating and absorbing growing doses of codified knowledge.

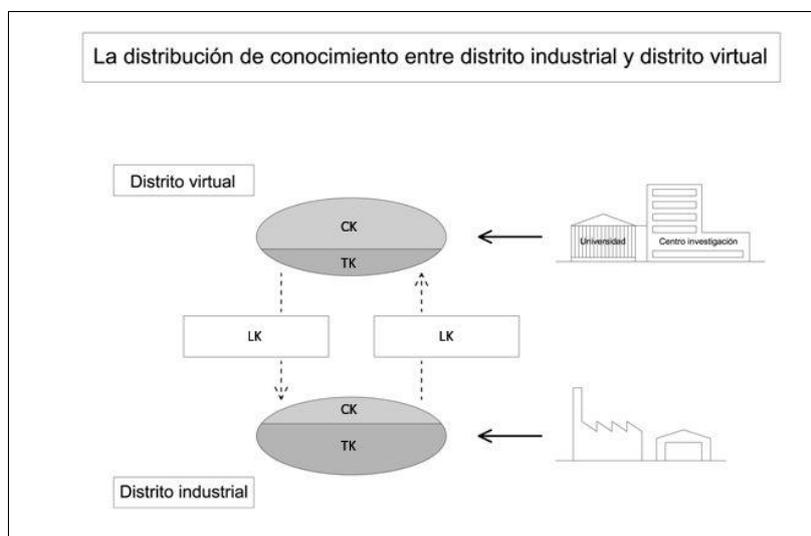
The opening of ID to external knowledge resources leads to consider the access of districts to universities, research centres, firms specialised in applied knowledge and the setting up of technological consortiums. The choice of these knowledge sources is a consequence of their power to overcome some district limitations, mainly those linked to the size of its market

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).

of creative work, the changes in the organization and commercialization of goods, and the financial consistency of SMEs. Nevertheless, a mimetic imitation of external experiences does not always work if the local culture is scorned. To this respect, a sporadic relationship among district firms and the above-mentioned institutions does not necessarily generates an efficient collaboration, because of differences or antagonisms between the university and firm cultures, as it is often the case in Spain and Italy.

Faced up to this cognitive distance, it seems convenient to implement a new relationship model that enables a mutual empathy, a sense of community by sharing missions, routines and opinions and the identification of 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 target. In turn, the relationships to maximize the exchanges of LK need to work in both ways, as **Graphic 4** displays. To get this aim, a desirable condition might be the presence of knowledge translators and what, as analogy, we may call a ‘virtual district of knowledge’.

Graphic 4. Industrial District Type IV



Source: Our own elaboration

5. Conclusions.

The paper reviews some interpretations about the industrial district (ID) knowledge, discussing its similarity with tacit knowledge and other contributions that, on the other hand, propose to identify the district knowledge with imported models applied to big organizations. Likewise, it points out the limitations of tacit and codified knowledge to explain the generation, absorption, diffusion, and reproduction of the district knowledge. This is why we

suggest the inclusion, at least from the perspective of innovative firms, of a new type of knowledge: the *Locational-Translational Knowledge* (LK). The LK is the result of merging/hybridizing pieces of tacit and codified knowledge. Its content includes combinations of scientific, technical and handicraft languages located in a concrete place and time. The LK finds in districts an adequate *milieu* for its development, facilitating a crossbreeding between tacit and codified that restricts the cognitive isolation of ID.

In particular, the paper analyses the industrial district as a system, trying to explain its knowledge behaviour. In this frame, the interactions among the district agents, either directly or by means of spillovers, acquire a singular relevance because they provide inputs which may stimulate, slow down or destroy the knowledge district. On the other hand, the understanding of an ID as a knowledge system leads to consider the enlarged knowledge reproduction as a key mechanism to understand its regeneration and resistance before obsolescence processes. In the short term, the enlarged reproduction of knowledge benefits from the joint production of goods/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. However, when the time horizon extends beyond the short term, the enlarged knowledge reproduction might require an import of external knowledge as well as the rise of the district innovation level through changes in its human capital composition: a set of actions to make possible an active neutralization of the knowledge obsolescence and the losses of the progressive functionality of the knowledge stock.

The paper emphasizes the process of ID evolution as a way to overcome the understanding of ID as a static or a timeless economic phenomenon. On this matter, we attempt to explain the evolution of the knowledge district, 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 within *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 district firms does not guarantee a spontaneous, fluid and robust connection between both agents. Consequently, we suggest the weakening of cognitive and cultural barriers by means of *translators* in charge of supporting their mutual relationships and knowledge comprehension.

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