

Passiante, Giuseppina; Secundo, Giustina

Conference Paper

From geographical innovation clusters towards virtual innovation clusters: The innovation virtual system

42nd Congress of the European Regional Science Association: "From Industry to Advanced Services - Perspectives of European Metropolitan Regions", August 27th - 31st, 2002, Dortmund, Germany

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Passiante, Giuseppina; Secundo, Giustina (2002) : From geographical innovation clusters towards virtual innovation clusters: The innovation virtual system, 42nd Congress of the European Regional Science Association: "From Industry to Advanced Services - Perspectives of European Metropolitan Regions", August 27th - 31st, 2002, Dortmund, Germany

This Version is available at:

<http://hdl.handle.net/10419/115731>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

42th ERSA Congress
From Industry to Advanced Services - Perspectives of European Metropolitan Regions
University of Dortmund (Germany), 27-31 August 2002

*From geographical innovation clusters towards virtual innovation clusters:
the Innovation Virtual System*

Theme: Innovation and New Technologies

Authors:

Prof. Giuseppina Passiante Department of Innovation Engineering, Faculty of Engineering, University of Lecce, via per Monteroni, zip code: 73100, (LE) Italy, phone: +39 0832 320210
telefax: +39 0832 320211 e-mail: passiant@ingle01.unile.it

Dr. Giustina Secundo e-Business Management School – ISUFI, University of Lecce, via per Monteroni, zip code: 73100, (LE) Italy, phone: +39 0832 421220
telefax: +39 0832 323796 e-mail: giusy.secundo@isufi.unile.it

*From geographical innovation clusters towards virtual innovation clusters:
the Innovation Virtual System*

Abstract:

The opportunities of the new economic landscape have determined radical changes in the organizational structures of the firms, till the creation of new virtual clusterization forms, that is distinct systems of suppliers, distributors, service providers and clients that use the “internetworking technologies” as a principal way for co-operating and competing.

These “virtual clusterization forms” that have been also defined as “e-business communities” or “b-web communities” (Tapscott, Lowy & Ticoll 2000), are here defined as “virtual clusters”.

In a virtual cluster (VC), each enterprise adds one or more distinct aspects of product/service value to the value of the network, by exchanging digital knowledge with other members. Recent studies, focused on VCs, highlight that the VC enabling factors may be identified in ICTs ubiquity (increasingly wireless) and bandwidth robustness, that allow firms to access real-time what they need and to co-ordinate their intra and inter-firm activities, creating value both by offering innovative and personalized products/services and by cutting transaction costs. (Davin and Botkin 1994) (Rayport and Sviokla 1995).

This paper focuses on these VCs innovation processes, in order to make some comparisons between the traditional geographical innovation clusters and the emerging virtual innovation clusters.

A model of the VCs global virtual learning environment, here conceived as a system of innovation, defined as “Innovation Virtual System” (IVS). IVS is here interpreted as a new way of projecting the traditional systems of innovation into a global scale.

1 Introduction

Recently, industrial clusters have been defined as “networks of production of strongly interdependent firms (including specialised suppliers) knowledge producing agents (universities, research institutes, engineering companies), institutions (brokers, consultants), linked to each other in a value adding production chain” (OECD Focus Group 1999).

This definition sums up a lot of different theoretical approaches to industrial cluster, that have represented them in terms of (Steiner 1998):

- concentrated forms of economic activities with strong connections to the knowledge infrastructure (knowledge clusters);
- vertical production chains of rather narrowly defined branches, where subsequent stages of production form the core of clusters (for example textile clusters with the different stages manufacturing: tailoring, design and cutter);
- sectorial concentrations at different levels of aggregation (for example automotive or electronic clusters);
- collections of firms with a common basic technology (biotechnology clusters);
- common demand or needs (for example eco-clusters).

All the theoretical approaches emphasise the linkages and interdependences existing between actors in the network of production that realise products/services and create innovations.

These linkages and interdependences concern:

- dynamic interconnections existing between a clusters industrial structure, its corporate organisations, its local institutions and culture (Saxenian 1996). Industrial sectors include the social division of labour, the extent and nature of links between customer, suppliers and competitors in a particular sector or complex of related sectors. Corporate organisation refers to hierarchical or horizontal co-ordination, centralisation or decentralisation and specialisation of tasks within the firm. Local institutions and culture contribute to create and sustain regular patterns of social interactions in a region. In the Saxenianan approach, the three dimensions are viewed as closely interconnected, and their feedback mechanisms contribute both to create industrial cluster, and to increase the innovation rate of the regional economies where they are located.
- interactions among four elements of a territorial system (Porter 1999):
 - the nature of local firm strategy, structure, and rivalry;

- factor conditions, or the basic endowments or conditions on which local firms seek to compete, including both tangible asset (as physical infrastructure) and intangible assets (such as information, logical systems, university research institute);
- demand conditions or the nature of local demand;
- the presence of related and supporting industries, including suppliers and successful competitors, that create business infrastructure and spur innovation and spin off industries.

This paper focuses on the analysis of the shift from geographic towards virtual industrial clusters. More specifically, the target issue is the changes that are happening in the mechanisms of learning exchanges existing between the agents of a cluster, and the consequent impact on their innovative behaviours.

A particular attention is devoted to the emerging global learning environment, driven by the virtual ness concept.

The issues discussed in this chapter are organised in three sections:

- the first section is focused on some specific features of the learning process that boost innovation in geographic cluster.
- the second section is devoted to a presentations of the emerging virtual cluster phenomena
- the third is focused on a model of the learning processes that are developed in Virtual cluster and on the learning environment they are generating.

Finally some conclusions are remarked, that emphasize the changed role of proximity in supporting Virtual cluster process and the emergence of the new global learning environment, that we have called “Virtual Innovation System”.

2 Some stylised facts of the learning processes in geographic clusters

The strategic role of learning is related to its capacity to boost innovation that in turn increases the competitiveness of clusters (Porter 1999). The process that proceeds from knowledge towards innovation is illustrated in fig 1.

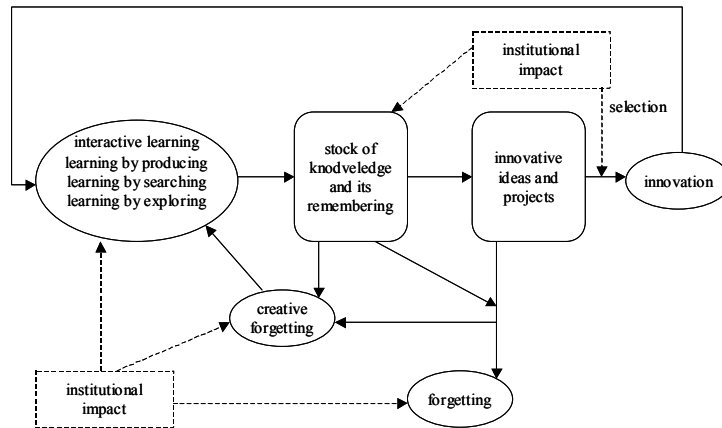


Fig. 1: The relationship between learning, growth of knowledge and innovation. (source: Bjorn Johnson, 1992 in National Innovation System, Lundvall, 1992)

As shown in fig 1, the process is not an automatic process, but a “selection mechanism” working on a set of innovative items and project generated. Moreover, luck and coincidental combinations of creativity influence each step from learning to innovation. The flow of learning, remembering and forgetting and the selection mechanism are all shaped by institutional factors. Finally the innovation process continually changes the condition for interactive learning (Bjorn Johnson, 1992 in National Innovation System, Lundvall, 1992)

In this view, the word « learning », assumes multiple meanings, merging individual and collective capacities: it means education, the acquirement of information, of skills or, the comprehension. As usual, the concept « to learn » is considered both as a process (learning process) and a result (to reach a state of knowledge).

For the purpose of this paper, “Learning” is defined as the acquisition and use of existing knowledge and /or creation of new knowledge with the purpose of improving economic performance. Strictly speaking, only individuals possess the ability to create knowledge. However organisations provide a context within which individuals learning take places (Marshall 1965).

Raising on this concept of learning, recent approaches have emphasized the role of geographic cluster as Learning Networks (LN), i.e. structures that have been established in order to increase the participants’ knowledge and innovative capability, and give organizations the opportunity to benchmark themselves to other organizations and also to support the self-directed learning of their employees (Bessant and Tsekouras 2001).

Networks assume different configurations, from simple organisations as simple as two tin cans tied together with a string, towards complicated structures as the Internet. Their ability

to distribute, store, assemble, or modify information is also known as their intelligence (Sawhney and Parikh 2001).

Learning network emphasizes the potential value of learning together (Bessant and Tsekouras 2001) for the purpose of increasing Knowledge base; in this case, learning network can be interpreted as “Knowledge Based Network” (Lundvall 1994) some of which are local while others cross national boundaries.

Lindholm (1997) categorizes three different processes through which learning can take place in a Network:

- *Transfer of knowledge*: Knowledge to be transferred refers to the knowledge available at any point in time within a firm, for example within people’s minds (specialist knowledge and the knowledge of how to use knowledge), or in form of company culture, routines and norms. Knowledge transfer can be discussed for all types of knowledge subject to transfer, irrespective of the value it constitutes to firms. In most cases knowledge transfer is a prerequisite for learning. Inter-organisational knowledge transfer therefore is closely related to inter-organisational learning: the high degree of specialisation among firms requires that firms complement own capabilities with those of other firms (Richardson 1972).
- *Creation of new knowledge*: or at least substantial transformation of existing knowledge. This process involves the dynamic conversion of tacit knowledge in explicit knowledge mutually complementary, that interacts and interchange with each other. Four modes of such knowledge conversions-socialization, externalisation, combination and internalisation- the SECI process, may be derived by Nonaka and Takeuchi (1995) from their studies of knowledge creation process in Japanese firms.
- *Retrieval of knowledge*: this process involves the retrieval of knowledge that has been generated within each partner of the learning network and its internalisation within the firms so that they can use it in other areas of operation.

Each learning process generates and improves the knowledge assets of an organisation (Nonaka, Toyama, and Konno 2001):

- *Transfer of knowledge* improves Conceptual knowledge asset and systemic knowledge asset. Conceptual knowledge assets consist of explicit knowledge articulated via images, symbols and language. As they have tangible forms, brand equity and concepts or designs perceived by members of organisation, are example of this type of knowledge assets. Systemic knowledge assets consist of systematized

and packaged explicit knowledge, such as manuals, technologies, product specifications that can be easily transferred.

- *Creation of new knowledge* improves experiential knowledge assets and routine knowledge assets. A routine knowledge asset is tacit knowledge routinized and embedded in actions and practices. Know-how, organisational routines and organisational culture in carrying out daily business of organisation are example of routine knowledge asset. Experiential knowledge asset consists of shared tacit knowledge, which is built through shared, hands-on experience among the members of organisation; Skills, emotional knowledge, energetic knowledge, rhythmic knowledge and know how, that are acquired by individuals in experience at work are example of experiential knowledge assets.
- *Retrieval of knowledge* improves mainly only systemic knowledge assets.

<i>Knowledge assets</i>	
<i>Knowledge transfer</i>	Systemic Knowledge assets Conceptual Knowledge assets
<i>Knowledge creation</i>	Routine knowledge assets Experiential Knowledge assets
<i>Knowledge retrieval</i>	Systemic Knowledge assets

Tab1. Knowledge assets generated by learning processes

These processes require the creation of conditions that make the learning processes possible; more especially the process of transformation/production of knowledge develop in interactive space where collective action became the foundation of organisational learning process.

The traditional approaches of the geographic clusters have generally related this context to the social capital and knowledge spillovers that develops in a geographic area. Indeed, they pointed out the role of the geographic context in enhancing the opportunities of organisations to learn together.

Useful insights are offered by some seminal approaches that are mainly focused on the learning processes of the partners of the industrial clusters. The non-exhaustive list includes:

- the Marshall-based approaches, that highlight the role of the local social capital, as mainly pointed out by the “industrial districts” approach;
- the evolutionary approach, that points out the role of the local knowledge spillovers and collective learning processes, mainly developed in the “milieu innovateur” approach.

Marshall explains the development of concentrations of specialised industries in certain localities through the existence of positive externalities in agglomerations of interrelated firms and industries.

The externalities are generated by three factors: knowledge spillovers between firms, specialised inputs and services from supporting industries, a geographically pooled labour market for specialised skills. The knowledge spillovers existing within a systems of interdependent economic entities both influence specialisation patterns in production and contribute to the growth of the overall system, generating knowledge spillovers for innovation and growth in other parts of the system.

In the 1980s several studies have rediscovered and updated Marshall's work, pointing out the role of local interdependent economic entities in generating innovation processes: here we refer mainly to the literature relating to industrial districts. Indeed, the industrial districts literature points out that these network organisations do not merely represent economies of scale, but concern the system or learning and organising via untreated interdependencies. Networks are generally based on strategic agreements, where firms know the results expected from the co-operation: they are the results of a dynamic interdependence between the productive features of the firms and the social features of the population, mediated by the local social culture and prevailing institutions.

In this view, the region is considered a network of co-operative partnerships that continues the Marshallian lesson of positive externalities, and is identified as a set of localised links of knowledge, geographically concentrated and relatively self-contained: then the region is not simply considered the scenario where the action takes place, it is considered the action itself, that generates innovations (Storper 1997).

The evolutionary theory points out that innovation, as engine of productivity growth, springs from information asymmetries and market imperfections. Knowledge accumulation and learning mechanisms are considered then as the key referring points of these approaches.

The evolutionary theories suggest that a neural-net model of innovation is probably the most useful approach for interpreting knowledge accumulation and learning processes (Ziman 1991). The patterns of nodes and connections in these cognitive spaces are not similar in different organisations or local systems: in each different organisation and local system the learning engine lies in the particular configuration or pattern of ideas, techniques

and commodities, and the specialised items of knowledge linking them. The learning capability of these transversal networks becomes their capacity to transform (De la Mothe and Paquet 1998). The relationships between market and non-market organisations and institutions generate a context that Nelson and Winter define as “selection environment”, that is at the core of the processes of innovation, learning and discovery, and of the process of diffusion of technical and organisational innovations. In the evolutionary approaches, the selection environment forms what is called “the relevant milieu” (internal and external, broader or narrower) that explains industrial clusters as innovation networks or as local and regional systems of innovation.

Learning process remains a social cognitive process, requiring interactions that come from the geographical closeness, that generates not only maximal probability of learning by learning (i.e. of developing new capabilities), not only through a greater density of situated cognition-driven interactions (Kirat and Lung 1995). In this sense, it is much less relevant the spatial interactions per se than the mix of situated culture and institutions that characterises the context and facilitates communications, cumulative information exchanges and community learning.

Indeed, in both the Marshall-based and the evolutionary approaches geographic proximity plays a strategic role, since it provides the firms of the cluster for the knowledge needed for innovation. Whereas information is considered as transferable resource across distances, it is assumed that the transfer of knowledge needs communications and repeated interactions, facilitated by face-to-face interactions, which permits reciprocal exchanges, negotiations and deep communication during the complex process of innovation.

The emerging electronically networked world economy is creating a new economic landscape that highlights a shift from geographical industrial cluster to virtual cluster, driven by digital innovation. The industrial clusters that are emerging in the Web-based world of business point out a new competitive space where “How you do business” is more relevant than “where you do business”.

3 The emerging phenomenon of The Virtual clusters and the Virtual clusters learning processes.

The opportunities of the new digital economy landscape is determining radical changes in the organizational structures of the firms, till the creation of new virtual clusterisation firms, that is distinct systems of suppliers, distributors, service providers and clients that use the “internetworking technologies” as a principal way for co-operating and competing.

These “virtual clusterisation firms” that have been also defined as “e-business communities” or “b-web communities”, are here defined as “virtual cluster” (Tapscott, Ticoll and Lowy 2000).

Recent empirical studies highlight some common features of a VC:

- Internet Infrastructure (Tapscott, Ticoll and Lowy 2000), to lower transaction costs: the internetworking technologies are changing the traditional Coase’s trade-off. According to Coase’s law: “a firm will tend to expand until the costs of organising an extra transaction within the firm becomes equal to the cost of carrying out the some transaction on the open market” (Coase 1937). The Internetworking technologies, and their related virtual business models, have lowered the minimum threshold value that makes advantageous the outsourcing process, since they allow reducing all the components of a transaction cost.
- Five class of participants (Tapscott, Ticoll. and Lowy 2000):
 - Customers, who receive and contribute to the value of the VC;
 - Context Providers, that support the interface between customers and suppliers. A context provider leads the value realisation and rule-making activities of a VC;
 - Content provider, who designs, makes and delivers the VC product/services;
 - Commerce service providers, that supply transactions and financial management, security and privacy, information and knowledge management, logistics and delivery services;
 - Infrastructure providers, that allow the necessary Internetworking infrastructure;
- Customer centrality (Reicheld and Schefter 2000). In VCs the gap between producers and consumers is blurring. As highly customized products and services replace mass production, producers must create specific products that are imbued with the knowledge requirements, and tastes of individual customers. In VCs, consumers become involved in the actual design process. This perspective of blending production and consumption is reminiscent of the notion of “prosumption” suggested by Alvin Toffler.

- Rules and standard (Tapscott, Ticoll. and Lowy 2000): VC participants know and adhere to the rules of engagement of their community.

A VC is the result of an integration process of different “core competencies” owned by each single partner, supported by the necessity to face the risks, costs and complexity of innovation. The final structure of a VC is then similar to a "hub and spoke" configuration (an example is shown in figure 2) that consists of many different nodes, interconnected by a web of linkages (transactions/relationships) (Passiante and Andriani 2000).

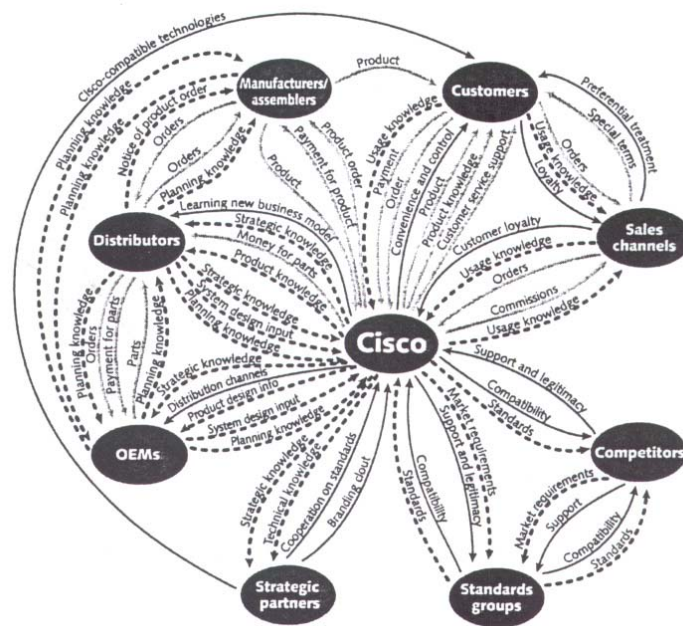


Fig. 2: A topology of a virtual cluster (source: Tapscott, Ticoll. and Lowy 2000)

Each VC’s node takes the shape of an “Internet worked Enterprise (IE)”, internally connected via Intranet, with suppliers and customers via business-to-business networks and with other organisations, business homes and consumers via public Internet. Links include (Passiante and Andriani 2000):

- upstream transactions with suppliers, using Extranet solutions for managing, coordinating suppliers, or managing the supply chain;
- downstream transactions with distributors and clients, allowing users to access information about credits, sell reports, products/services or to monitor transactions and orders or to get financial information ;
- horizontal transactions with competitors or other institutions, where the target is co-ordinating hardware/software manufacturers, venture capitalist and marketing information systems.

This configuration allows the IE to behave as a “sense and respond” organization. Indeed, the unpredictable, discontinuous change is an unavoidable consequence of doing businesses in VCs. This environments demands fast and sometimes instantaneous response, and as a result many companies are fragmenting themselves into smaller units in order to respond in real time. In this ever-evolving environment, business leaders need to be able to change and adopt new business models instantaneously. Organizations embrace not only adaptive mindsets, as in the geographic clusters, but also adaptive business platform. These platforms allow to deliver a “Sense and Respond Enterprise”, as defined by Evans and Wurster (1997), also known as an “event driven organization”.

3.1 The VC's learning processes

In a recent book (Passiante 2002) the IEs learning processes have been grouped in:

- *Learning processes from markets*, related to the understanding user needs and the involvement of the lead users, that increase the likelihood of the success of a new product/service; These processes are synthesised in creating on-line communities, on-line forums, newsgroups, discussion groups, for monitoring the satisfaction level of customers, and for getting information about the opportunities of improving its products/services; e-mails, to take suddenly information about dislikes and inefficiencies in the services offered, and to give customers announcements concerning new products and delivery systems.
- *Learning processes through alliances* with suppliers, competitors and other sources of knowledge. These processes are related to (Passiante 2002):
 - subcontracting, that is short term relationships concerning the outsourcing of non-core activities, that allow to reduce costs, risk and lead time, but generally reduce the performance and quality level of the final product;
 - technology licensing, that is fixed term relationships aimed at exploiting the intellectual property of other firms/organizations, in return for payment of a fee and royalty based on sales;
 - strategic alliances, that is flexible agreements between two or more firms, to co-develop a new technology a product;
 - joint ventures, that is long-term relation ships to develop a new technology, a new product or to enter in a new market. Joint ventures allow integrating the know-how

of the single partners and to get managers that are full-time enjoyed in the innovation process.

These IE learning processes are based on the use of Information and Communication Technologies; VCs learning processes are then a meso-level manifestation of individual learning processes, of specific learning sessions and of particular knowledge assets of the simple IEs that are commonly defined as e-learning processes.

Following Drucker (2000), e-learning is a delivery of individualized, comprehensive, dynamic learning content in real time, aiding the development of communities of knowledge, linking learner and teacher.

The true power of e-learning lies not in the anyone, anyplace, anytime model, but rather in its potential to provide the right information to the right people at the right times and places. Web based integrated learning systems are revolutionizing e-learning processes by enabling personalized, interactive, just in time, current, and user centric learning tools (M. Keegan 2000).

According to Rosenberg (2001) an *e-learning* process has the following characteristics:

- is networked, which makes it capable of instant updating, storage, retrieval, distribution and sharing of instruction or information; in this way customers, suppliers, partner in a virtual cluster can access to update learning content;
- is delivered to end users via computers using standard internet technologies, that create a standard platform for delivery; the access is every time and every place for each firms.
- It focuses on the broadest view of learning – learning solutions that go beyond the traditional paradigm of training. This modality supports knowledge creation process at individual, organisational and inter-organisational level according to ontological level of Nonaka.

Recent studies have highlighted the lack of theoretical framework suitable for representing the e-learning processes that develop in a virtual cluster. Some of them, refer mainly to the problem of how learning may be transferred from individuals to an inter organisation level. Other approaches highlights the lack of models that include the various learning types, such as single loop and double loop learning or the learning phases along which learning occurs. In order to give a first contribute to this issues, we present in this paper an integrated model of the inter organisational learning processes that develop in a VC, also taking into account their complexity and scope of these processes, as emerged during an empirical research that

we have carried on 34 case studies (see Passiante and Andriani for details of the empirical research).

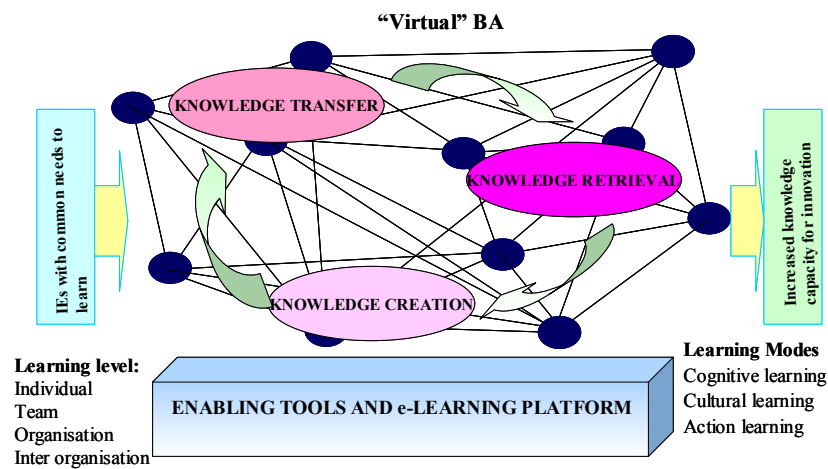


Fig. 3: An integrated model of Vc e-learning processes

The constitutive elements of the integrated model, as shown in Fig 3., may be identified in:

- “IEs with common need to learn” are the IEs belonging to the VC with common need to learn together in order to foster their innovation role; they represent the inputs of the model;
- “Increased knowledge capacity for innovation” is the knowledge developed during the learning process and is the output of the model;
- “The virtual BA” represent the virtual learning environment of the IEs;
- The engine of the model, given by the three phases of the learning processes that develop in the VCs;
- Enabling tools and e-learning systems is the ICT platform that enables the three phases of the learning processes; here, we define *Learning tools* an instrument or intervention, designed to support one or more of the learning process phases involving the various dimensions of inter organisational learning. (Pawlowsky, Forslin, Reinhardt 2001). These tools are all intentional interventions that are directed at decreasing possible barriers, or inhibiting factors, between the learning processes. Moreover, the tools offer an integrated and holistic way of dealing with tacit and explicit knowledge, aimed to facilitating the creation of new knowledge.

An overall description of the tools and e-learning platform is shown in Tab. 2, that includes the following functionalities:

ENABLING TOOLS and e-LEARNING PLATFORM FUNCTIONALITIES						
INTER ORGANISATIONAL LEARNING PROCESSES		User Functionalities	Creation and assembly of content and activities	Content and activity management	Development and management of individuals and communities	Manager and administrator functionalities
	Knowledge Transfer	<p>Portal-based access to a variety of content, activities, communities and tools, based on user profile.</p> <p>Wireless and other alternative access.</p>	Powerful search capabilities across structure, content and metadata.	<p>Workflow, lifecycle, process automation and security functions applied to the validation and publishing of content.</p> <p>Integration of external content, portals, etc.</p>	<p>Integration of tools for virtual meetings, virtual workspaces, virtual classrooms, discussions, group scheduling, etc.</p> <p>Peer-to-peer information sharing</p>	Monitoring and reporting for “people managers,” training coordinators, knowledge or content managers, etc.
	Knowledge Creation	User-configurable proactive agents which monitor sources and repositories to automatically alert users to relevant new information	Object-oriented content and activity creation and/or integration with leading XML and other authoring tools.	<p>Automatic indexing of unstructured content, automatic categorization to a taxonomy and automatic creation of taxonomies to provide content in context.</p> <p>Link management capabilities for maintaining relationships among elements.</p>	Management of individuals, competencies, expertise, temporary and permanent groups/communities.	
	Knowledge retrieval	<p>Powerful search capabilities across structure, content and metadata.</p> <p>Dynamic delivery/access to specific content, activities and communities based on profiles, assessment or other data, or queries;</p>	<p>Easy importing of external or existing content.</p> <p>Publishing to any number of devices, including Web.</p>	A relational or object-oriented repository (support for multiple repositories also desirable) of content and activities, which allows granular storage of XML content and all other formats, with descriptive and category metadata to facilitate retrieval.	Features to allow users to rate content, provide alternatives and comments.	Management of resources and facilities for training, meetings, etc.

Tab 2. Correspondence between learning processes and e-learning platform functionalities

- User functionalities
- Creation and assembly of content and activities
- Content and activity management Development and management of individuals and communities
- Manager and administrator functionalities.

Each of these functionalities enables specific processes of knowledge transfer, knowledge creation and knowledge retrieval.

The characteristics of the platform presented above do not necessarily promote any specific learning type, because they depend on how the sources of knowledge are used within the organisation. These tools can be regarded as navigation instruments in the cognitive knowledge base of each organisation of the VC; they therefore especially promote single loop learning rather than double loop learning, or the adoption of implicit knowledge. The most important thing to keep in mind, when using these tools, is that they are not applied for their own sake. The idea is to make internal knowledge at each organisation visible and access external sources of new knowledge through boundary spanning in the entire space where VCs learning processes take places.

Indeed different learning processes may develop:

- At different ontological levels: at individual, team, organisation, inter organisation level according to the ontological dimension of the theory of organisational knowledge creation of Nonaka;
- With different perspectives of the learning models: The cognitive perspective, based on the theory of bounded rationality with the major attempt to change the cognitive structures of the learning system. The cultural perspective is based on the human behaviour concepts. Finally, the action perspective is rooted in experiential learning concept (Reinhardt 2000).

Our integrated model and the categorisation of the e-learning platform functionalities may help in the representation of VC learning mechanism, marking that the usefulness of the single tools depends not only on the characteristics of the tools but also to a high degree on the culture of organisation, on leadership styles, and on the organization's structural features.

4 The Virtual Innovation System

The above model of the e-learning process in a virtual cluster, allow to get the pervasiveness of innovation in a VC: innovation becomes ubiquitous in every industry, in every place and in every firm, and transcends local, regional and national borders. Virtualness contribute to generate dynamic external economies through which complementarities of knowledge and competencies or organisational and technological connections may accelerate collective learning processes, enabling innovative capabilities. The concept of Virtual Innovation System (VIS) was introduced in a previous paper (Romano and Passiante 1997) as a new unit of analysis useful to describe the shift of the learning environment from geographical industrial clusters to virtual industrial clusters. The VIS dynamics points out at a global scale the well known stylised facts of the innovation literature:

- innovation as a non-linear process, network shaped and dynamized in a fundamental way by a complex multi-dialogue which weaves the various partners together (De la Mothe and Paquet 1998);
- innovation as first and foremost new practical knowledge, generated by capabilities/absorptive capacities of the organisations (Langlois and Robertson 1985);
- the strategic choice that strikes a balance between exploitation of existing resources and exploration of new possibilities and opportunities, in a rapid evolving, surprise generating context (Mertins, Heisig and Vorbeck 2001) ;
- knowledge creation related to a balance between communality and diversity of knowledge, between coherence and mutual learning, between exploitation and exploration (Marengo 1993);
- learning and discovery related to the interactive mechanism with the context environment through which selection occurs. This innovation mechanism “both provides the source of differential fitness –firms whose R&D turns up more profitable processes of production or products that grow relative to their competitors- and also tends to bind them together as a community” (Dosi and Nelson 1994);

The VIS may be then represent the global context where the IEs and the VCs develop the dynamics that characterises a new virtual “Ba” concept (Nonaka, Toyama and Konno, 2001)

More specifically some particular characteristics “Ba” seems to be more suitable to understand the VCs learning environment, characterised as a VIS. Indeed, Ba has some further similar characteristics to the VIS:

- it is not related necessarily to a physical space: it is a concept that unifies a physical space (a place), a virtual space (an e-mail service) and a mental space (shared ideas);
- it develops at different ontological levels: individuals form a Ba (a group) and again groups form the Ba of an organisation; the interactions that develop at different ontological levels amplify the knowledge creation processes of the organisations;
- it acts as an autonomous, self-sufficient unit, that may connect to others Ba for expanding knowledge; relationships among Ba partners are not predetermined, but Ba is the result of organic interactions among its participants, based on a knowledge vision, rather than a mechanistic planning;
- it has to be energised: knowledge participants need some necessary conditions, such as:
 - autonomy, that increases the commitment of individuals to create new knowledge, and may be the source of unexpected knowledge;
 - creative chaos, that encourages people to transcend existing boundaries to define and solve problems;
 - intentional overlapping of information about business activities, to support a sharing of tacit knowledge and the definition of the single members role;
 - diversity, in order to deal with the challenges of the complexity and the variety of the environment;
 - trust and commitment, since interactions among individuals participating in a Ba or between different Ba has to be supported by trustful sharing of knowledge and continuous exchanges between all units of the Ba.

The characteristics of a VIS, suggest analysing VCs in a link space, rather than in a geographical space (Romano, Passiante and Elia 2001). More specifically, it suggests to re-think the role of geographical space in generating opportunities to access more effectively and efficiently to information and knowledge, considered the key determinants of the innovation process. Traditional models relate these opportunities to a physical notion of distance and connectivity (Janelle and Hodge 2001) that allows people, firms and institutions to access all the resources they need to innovate, prosper and compete.

5 Toward a conclusion: a comparison between geographical and Virtual Cluster Learning processes.

Internet is reducing the importance of geographical location for determining interactions patterns, since activities have become more person-based rather than place-based.

In this paper we focus mainly on the issues concerning the learning processes that develop in a “virtual” way, that integrate the traditional “face-to-face” learning processes. More specifically, we present a model of these new e-learning processes, showing how they support innovations even between actors that are not co-located.

Our model allows to analyse the learning processes that develop in the more complex forms of organisation that are emerging, which bypass spatial relations, embed traditional places in broader networks of linkages beyond the traditional physical space.

In this view, the geographic notion of space has been replaced by a new virtual space, that parallels the behavioural setting and rules of the physical space with some that are based on electronic linkages between computers, allowed by shared hardware/software and by protocols for communications. Activities in the physical space and virtual space are highly integrated: indeed virtual interactions have become both a substitute and a complement of physical interactions.

Thus, it is emerging a new, more generalised concept of proximity, related to a new concept of virtual distance, calculated as inversely proportional to the number of hyperlink connections between two points (web sites, organisations on so on). The geographically accessibility is being replaced by an information/knowledge accessibility, that can be measured by new parameters, such as (Dodge 2001);

- Delays in response time among a set of dispersed computers, known as network latency;
- deliverability, related to the problem of data being lost in transit and having to be resent;
- availability of the network and servers, that is generally assessed by the amount of downtime.

References

- Bessant J., Tsekouras G., 'Developing Learning Networks', Springer-Verlag London Limited, (2001).
- Coase R. H., 'The nature of the firm', *Economica* **Vol. 4 No. 4** (1937).
- Davis S. and Botkin J., 'The coming of knowledge-based business', *Harvard Business Review* **Septembre-October** (1994).
- de la Mothe J. and Paquet G., 'Local and Regional Systems of Innovation as learning socio-economies', in de la Mothe J. and Paquet G.. (ed.) *Local and Regional Systems of Innovation* (Kluwer Academic Publisher, Norvell, MA, USA, 1998), 1–26.
- Dodge M., 'Accessibility to information within the Internet: how can it be measured and mapped?', in Janelle D.G. and Hodge D. C (ed.) *Information, place, and cyberspace – issues in accessibility* (Springer Press, New York, 2001).
- Dosi G. and Nelson R. R., 'An introduction to evolutionary theories in economics', *Journal of evolutionary economics* **Vol. 4 No. 3** (1994).
- Drucker, P. (2000). Need to Know: Integrating e-Learning with High Velocity Value Chains. A Delphi Group White Paper.
<http://www.delphigroup.com/pubs/whitepapers/20001213-e-learning-wp.pdf>.
- Evans P. and Wurster T. S., 'Strategy and the new economics of information', *Harvard Business Review* **September-October** (1997).
- Janelle D.G. and Hodge D. C., 'Information, place, cyberspace and accessibility', in Janelle D.G. and Hodge D. C (ed.) *Information, place, and cyberspace – issues in accessibility* (Springer Press, New York, 2001).
- Keegan M., 'eLearning, the engine of the knowledge economy', *Morgan Keegan&Co., Inc*, (2000)
- Kirat T. and Lung Y., 'Innovations et proximités: le territoire, lieu de déploiement des processus d'aptissage', in Lazaric N. and Monnier J. M. (ed.) (1995) 206-227.
- Langlois R. N. and Robertson P. L. A., *Firms, markets and economic change* (Routledge, London, 1995).
- Lindholm N. 'Learning Processes in International Joint Ventures in China', *Advances in Chinese Industrial Studies*, 5 (1997), 139-54.
- Lundvall B., 'The social dimension of the learning economy', *DRUID working paper No 96* - (1996).
- Lundvall B., 'A national system of innovation', *Pinter N.Y* - (1992).

- Lundvall B. and Johnson B., 'The learning economy', *Journal of Industry Studies* n.1 (1994), 23-42.
- Marengo L., 'Knowledge distribution and coordination in organisations: on some social aspects of the exploitation vs exploration trade-off', *Revue internationale de systématique* **Vol. 7 n. 5** (1993).
- Marshall A., 'Principles of Economics', *London: Macmillan*, (1965).
- Mertins K., Heisig P. and Vorbeck J., *Knowledge management- best practices in Europe*, (Springer, Berlin, 2001).
- Nonaka I., Toyama R. and Konno N. 'SECI, Ba and leadership: a unified model of Dynamic knowledge creation', in Nonaka I. And Teece D.(eds) *Managing industrial knowledge* (Sage Publications, London, 2001), 13–43.
- OECD. *Boosting innovation.. The cluster approach* (OECD, Paris, 1999).
- Porter M. E., 'Clusters and competitions', in Porter M. (ed.) *On competition* (Harvard University Press, London, 1999).
- Passiante G. "Industrial Cluster in the net economy: empirical evidence and some theoretical approaches" in Passiante G., Elia V., Massari T., *Digital innovation*, *Imperial College Press*, 2002 (forecoming)
- Passiante G. and Andriani P., 'Modelling the learning environment of the virtual knowledge networks: some empirical evidence', *International Journal of Innovation Management* **Vol. 4 n. 1** (2000), 1-31.
- Pawlowsky P., Forslin J., Reinhardt R., Practices and tools of Organisational Learning, in Hanbook of Organisational Learning and knowledge, *Oxford University Press*, 2001, 775-793
- Rayport J. F.. and Sviokla J. J., 'Exploiting the virtual value chain', *Harvard Business Review* **November-December** (1995).
- Reicheld F. F. and Schefter P., 'E-loyalty', *Harvard Business Review* **July- August** (2000).
- Reinhardt R., 'Knowledge Management: linking theory with Practices', in Knowledge and Management, classic and contemporary work, *MIT Press*, 2000,187-221.
- Richardson, G.B. (1972): 'The Organisation of Industry', *The Economic Journal*, 82, 2: 883-896.
- Romano A, Passiante G and Elia V., 'New sources of clustering in the Digital Economy', *Journal of Small Business & Enterprise Development* **Vol. 8 n. 1** (2001).
- Rosenberg M., 'e-Learning', *Mc Graw-Hill*,2001.

Sawhney M. and Parikh D., 'Where value lives in a networked world', *Harvard Business Review* **January** (2001).

Saxenian A. (ed.), *Regional Advantage Culture and Competition in Silicon Valley and Route 128* (Harvard University Press, London, 1996).

Steiner M., 'The discrete charm of clusters: an introduction', in Steiner M. (ed.) *Clusters and Regional Specialization* (J H L DEWHURST, 1998).

Storper M., *The Regional World* (The Guildford Press, New York, 1997).

Tapscott D., Ticoll D. and Lowy A., *Digital Capital* (Nicholas Brealey Publishing, London, 2000).

Ziman J., 'A neural net model of innovation', *Science and Public Policy* **Vol. 18 n.1** (1991), 65-75.