# Virtual Innovation Environment



**Nicos Komninos**
*Aristotle University, Greece*

## INTRODUCTION

Major new trends of our era emerge from the spread of information society and the increasing role of innovation as source of competitive advantage, development, and wealth. Innovation, however, is a tricky issue. We do not dispose adequate theories for predicting innovation in different sectors of industry and services, though we have plenty of tools and methods which assist and facilitate innovation in product development, process reorganization, and quality improvement. We tend to compensate the lack of theory about radical innovation (none can tell what the next big thing will be in an industry sector) with environments of innovation enabling the use of tools, instruments, and methods: financial tools, institutional tools, communication and information tools, creativity tools, and others.

The rise of the information society opened new possibilities in the creation of environments of innovation. Digital tools and virtual (digital) innovation environments may assist organizations in learning and practicing innovation. They offer new forms of government (digital this time), online or offline, for mastering the complex processes of technological development and innovation. These virtual environments are important for companies, research institutions, technology intermediary organizations, and the public administration involved in innovation and research and development (R&D) management as well.

## BACKGROUND: ENVIRONMENTS OF INNOVATION

Newer theories of innovation attribute an important role to the external environment of innovation embedded in networks and systems, communities, clusters, and regions, affecting the processes of innovation. Interactions within communities and regional or national innovation systems, combinations of roles and skills, communication channels, functional and spatial bonds bridging separate knowledge fields, are ingredients of participatory processes that result in new products and technologies (Cooke & Morgan, 1997).

Brokering theories assert that innovation derives from the synthesis of various fields of research and technology. Hargadon (2003) argues that innovation is a collaborative process in which knowledge and insights from different fields of science and technology are combined and create something new. A critical factor in achieving a new combination of unrelated knowledge is the human community in which different skills and competences are pooled together.

Nonaka and Tackeuchi (1995) describe innovation as tacit knowledge being transformed into explicit knowledge. They place great emphasis on this transformation of knowledge and explain the enormous organizational effort which is needed for this conversion of atypical and personalized knowledge into explicit, modeled know-how, and engineering. Dealing with innovation and tacit knowledge, Morgan (2001) goes one step further arguing that tacit knowledge is embedded in individuals and organizational routines which have location-specific dimensions and tend to cluster. Tacit knowledge is spatially "sticky" and despite the growth of knowledge management tools, is not easily communicated other than through personal interaction. Clustering becomes inevitable in innovative practices, not from the viewpoint of minimizing transaction costs, but in order to materialize the innovative behavior.

Evolutionary theories also assert that innovation springs from externalities, knowledge asymmetries, market imperfections, and institutions that select and manage the flow of knowledge. Learning, both as acquisition and use of existing knowledge and creation of new knowledge, is the key process. A different cognitive space is created in each organization composed of nodes and networks. The external environment has a decisive role also. Nelson and Winters (1982) explain that genetic processes to innovation are regulated by a "selection environment" which switches on-off the flow between ideas and products. Nations and regions through systems of innovation provide this selection and regulatory environment, bridging knowledge, competences, and resources from different actors, and screening of ideas and technologies through competent or funding organizations (Nelson, 1993).

A common understanding has been achieved, which attributes a major role to the environment of innovation,

pointing out at an "open innovation" paradigm (Chesbrough, 2003) in which valuable ideas, knowledge, and skills come from outside the organization. Innovation is an "environmental condition" (Komninos, 2002); it is less an individual achievement than the joint effort of communities of people working together, interacting, and sharing common goals and visions.

## THE FUTURE: VIRTUAL ENVIRONMENT OF INNOVATION

Human ingenuity recently added a new dimension to the physical and institutional environments of innovation: a digital or virtual dimension. The rise of the information society and the Internet brought into existence various fora for digital gathering, communication, and interaction, which strengthen the contribution of agglomerations and communities to innovation processes (Table 1). Henceforth innovative environments are constituted by more complex combinations among physical, institutional, and digital spaces.

A series of IT applications, systems, and digital tools are used to create virtual environments. Most are based on conventional information technologies and Internet based communication platforms. The core of solutions is on knowledge management and guidance of the innovation process rather than sophisticated telecommunications; services and knowledge management tools predominate over bandwidth. Some major categories are the following.

- **Business and Regional Intelligence:** For every organization attempting to develop a new product, it is important to know what the weaknesses are in the products it already manufactures, how customers evaluate those products, what new competing products are available and what their features are, what the expected consumer behavior trends are, and what opportunities spring from technologies already put in place. Gathering, organizing and utilizing this information can be made both easier and can be supported by using cutting-edge IT tools and employing information available on the Internet (Pawar & Sharda, 1997). Applications developed for business and regional intelligence purposes seek to facilitate information management. Their architecture combines targeted information collection, processing tools, and information dissemination to the end user (Back, 2002)
- **Virtual Communities and Clusters:** Virtual communities play a role in innovation similar to physical communities in terms of communication, socialization, and learning (Henri & Pudelko, 2003). The usual way for a virtual community to be created is with respect to a network of people sharing the same ideas or objectives. Two situations are possible. A physical-virtual situation in which the virtual extends the cooperation bonds of a physical commu-

*Table 1. Components of virtual innovation environment*

| Objective | Type of function | Type of online tool |
|---|---|---|
| Information | Learn about | Web pages; e-learning; online libraries; online databases; portals; online newsletters; blogs; digital cities |
| | Search/find | Search engines; semantic Web tools |
| | Consulting | Online technology transfer; online R&D; virtual brokering; market and technology watch; observatories |
| Communication | Communication | Electronic mail; telepresence; alerts |
| | Discussion | Discussion forum; e-communities |
| | Make a demand; give an order | Electronic exchange; e-auctions; e-commerce; virtual clusters |
| Problem-solving | Knowledge processing | Online creativity tools; online mind tools |
| | Guide a process | Digital roadmaps; online innovation management tools |
| | Turn knowledge into product | Product innovation and design tools; virtual engineering; online survey tools; virtual customer applications |

nity. In this case, most practices of the community remain in the physical space, while part of the communication and learning is transferred to the digital space. Second, a virtual-virtual situation is one in which the virtual community exists independently from the geographical gathering of people, though the members of the virtual community may meet occasionally, communicate and cooperate in physical space. In this virtual-virtual situation, the social bond is weaker, as are the emergence of intention, and the creation of identity. Virtual communities also take the form of virtual clusters. In a virtual cluster, each enterprise adds value by exchanging knowledge with other members. Internet technologies allow for increased real-time interaction, e-learning, and technology transfer, which in turn are translated into improved products and services and a reduction in transaction costs, as well (Passiante & Secundo, 2002)

- **Online Innovation Tools:** This is probably the most important component in the virtual innovation environment and includes tools and applications for solving typical knowledge management and innovation development problems. These tools can be broken down into sub-groups depending on the internal problem-solving mechanism:
  1. Roadmap tools which lead the user to problem resolution step-by-step, for instance through the stages of new product development or a spin-off company creation
  2. Dedicated tools which may assist in specific problems (i.e., drafting a business plan, benchmarking the performance of an organization, undertaking a technology audit, which rely on an input-output structure, data input and automatic result generation)
  3. Learning tools which present a problem and an overview of the methods that could be used to solve it, best practice from the past, bibliographical references and documentation
- **Web-Based Promotion Platforms:** These applications support awareness-raising on products and services, marketing, advertising, and e-commerce. They are based on a combination of Web applications, databases, and multimedia. Major categories of promotion platforms are: (1) corporate Web sites, which promote a business or organization's products or services, (2) "department stores" which group services and products from numerous suppliers together, (3) government Web sites informing citizens about the services provided by the public administration, and (4) digital cities which promote a territorial entity together with its products and services. Digital cities offer an exceptionally important promotion platform, yet underutilized. Their architecture includes numerous layers: 2-D and 3-D images of the physical space of cities and regions, infrastructure and services, products organized into databases, navigation applications, online service markets, as well as user communication interfaces where information, images and applications are synthesized (Ishida, 2000).

## CONCLUSION

The central question about the virtual innovation environment relates to how it functions. The question is what does this environment have to offer innovation processes? What innovation functions are made easier or accelerated in the digital space?

The key to these questions lies in understanding innovation as a collective knowledge process. Knowledge is at the very epicenter of innovation. This gives the digital space a tremendous power since its exclusive ability is to manage information and knowledge. Innovation processes taking place in digital spaces complement the creative processes that occur in physical and institutional spaces. Digital spaces are primarily instrumental spaces. They facilitate the extension of networks and learning, allowing organizations to be engaged in R&D and deploy their technology capabilities, while the use of digital tools and services is improving problem-solving capabilities and know-how in individuals and institutions.

The most direct impact of the digital environment on knowledge-innovation systems relates to learning processes that are transformed and bolstered by e-learning applications. E-learning may develop on different ontological levels, at individual, team, organization, inter-organization level, and from different perspectives as well, the cognitive perspective aiming to change the structures of the learning system, the cultural perspective dealing with human behavior, and the action perspective rooted in experimental learning (Passiante & Secundo, 2002). The true power of e-learning in the field of innovation is that it enables non-conventional knowledge processes to occur either between producers and customers or between producers, suppliers, and subcontractors.

A second field of impact relates to knowledge brokering networks. Within every innovation system there is a continuous exchange and transfer of knowledge going on. By far the greater part of this network activity relates to knowledge transfer and exchange. Knowledge is the most important connective substance in knowledge brokering networks, an intangible asset

which is "traded" through partnerships and collaboration. Via multi-level virtual networks the digital environment offers new options for exchanging knowledge and communicating in real time. Virtual networking applications, such as virtual customer, virtual cluster, virtual technology exchange, virtual order placing, virtual follow-up of processes, and so forth. have greatly amplified the ability of firms to exchange knowledge, cooperate and innovate. The Internet enables the creation of multiple virtual environments and platforms for collaboration allowing firms to tap into customer and supplier knowledge through virtual knowledge brokering (Verona, Prandelli, & Sawhney, 2003).

A third field which is dramatically affected by virtual spaces relates to human resource skills. The development of digital tools and online problem solving applications is an amazing achievement. Online tools allow even the most remote worker to significantly improve his/her skills and problem solving capabilities, and within a short period of time to acquire skills disproportionate to the time he or she invested in learning them. Online tools differ from e-learning applications since they are more targeted, but primarily because they help in solving a problem without requiring detailed understanding of it. As is the case with all tools, their use does not involve understanding of how they operate. Offline/online problem solving tools are available for all types of innovation, but primarily for market and technology watch, technology transfer, new product development, and optimization of supply chains.

## REFERENCES


Back, T. (2002). Adaptive business intelligence based on evolution strategies: Some application examples of self-adaptive software. *Information Sciences—An International Journal, 148*, 113-121.

Chesbrough, H. (2003). *Open innovation. The new imperative for creating and profiting from technology*. Boston: Harvard Business School Press.

Cooke, P., & Morgan, K. (1997). *The associational economy: Firms regions and innovation.* Oxford, UK: Oxford University Press.

Hargadon, A. (2003). *How breakthroughs happen: The surprising truth about how companies innovate*. Boston: Harvard Business School Press.

Henri, F., & Pudelko, B. (2003). Understanding and analyzing activity and learning in virtual communities. *Journal of Computer Assisted Learning*, *19*, 474-487.

Ishida, T. (2000). Understanding digital cities. In T. Ishida & K. Isbister (Eds.), *Digital cities: Experiences, technologies, and future perspectives, lecture notes in computer science*. Springer-Verlag.

Komninos, N. (2002). *Intelligent cities: Innovation, knowledge systems, and digital spaces*. London; New York: Spon Press.

Morgan, K. (2001, September 20-23). *The exaggerated death of geography: Localised learning, innovation, and uneven development*. Paper presented to The Future of Innovation Studies Conference. The Eindhoven Centre for Innovation Studies, Eindhoven University of Technology.

Nelson, R. S., & Winters, S. D. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Harvard University Press.

Nelson, R. S. (1993). *National innovation systems: A comparative analysis*. New York; Oxford, UK: Oxford University Press.

Nonaka, I., & Takeuchi, H. (1995) *The knowledge-creating company*. Oxford, UK: Oxford University Press.

Passiante, G., & Secundo, G. (2002, August 27-31). *From geographical innovation clusters towards virtual innovation clusters: The innovation virtual system.* Paper presented in the 42nd ERSA Congress, From Industry to Advanced Services—Perspectives of European Metropolitan Region, Dortmund.

Pawar, B. S., & Sharda, R. (1997). Obtaining business intelligence on the Internet. *Long Range Planning*, *30*(1), 110-121.

Verona, G., Prandelli, E., & Sawhney, M. (2003). Innovation and virtual customer environments: Towards virtual knowledge brokering. Paper presented at the *AOM Conference*, Seattle.


## KEY TERMS

**Cluster:** Network of production of interdependent companies, knowledge-producing agents, and intermediary funding and consulting organizations.

**Digital Cities:** A platform of digital community networks and information spaces using the city metaphor to exchange information and communicate.

**E-Learning:** Delivery via the Web of individualized, dynamic, and digital learning content, aiding knowledge

transfer and recombination within communities of knowledge and innovation.

**Innovation:** The act of starting something for the first time; introducing something new; the creation of a new device or process resulting from study and experimentation. A typical division is between product, process, and organization innovations. *Product innovation* is linked to the improvement or renewal of products being phased out; *process innovations* relate to the use of more advanced production technologies; *organizational innovations* introduce more efficient cost arrangement by reorganizing the entire supply chain and producer-supplier relations.

**Systems of Innovation:** Technological innovation advances through the interaction of multiple actors, between component and system producers, universities and industries, technology transfer organizations and brokers, venture capital and government funding institutions, which form national or regional networks, communities, and systems.

**Virtual Clusters:** Systems of suppliers, distributors, service providers, and clients that use internetworking technologies as the principal way of cooperating and competing.

**Virtual Communities:** A network of people assembled around a topic of common interest, or goal communicating over the Internet.