Resources for Innovation in the Era of Global Networks

by Manuel Castells

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*Prof. Castells' speech was made in Spanish. What follows is the **transcription of the recorded English simultaneous translation** of his presentation. This has inevitably caused some small inaccuracies due to deficient sound quality in some parts of the tape. The author is not responsible for these transcription problems.*

Good afternoon, or good morning, depending on your cultural background. I would like to tell you how grateful and honoured I feel to have been invited by the International Association of Science Parks to attend this conference.

The idea that I am going to put across to you during the forty minutes of this presentation is based on the fact that a significant transformation has taken place with regard to the importance of and the role played by Science and Technology Parks over the last ten years. This transformation is due to the creation of innovation networks and to economic development as the fundamental element in the process of globalisation, which also has to do with the innovative capacity of our societies. This is the general idea that I will try to expound in several stages; I will start with the best-known facts and then move onto much more controversial elements from the most recent data we have regarding regional development and technological innovation.

Firstly I would just like to remind you (it was mentioned a couple of times this morning) that technological and entrepreneurial innovation are the sources of productivity and competitiveness for companies, for regions and for nations, so ultimately these are sources of wealth, including cultural and social wealth. When we talk about innovation, and about social and cultural creativity, what we are doing is moving towards the source of production of our different forms and levels of living in our society. We can therefore say that this is no secondary element; and that we are at the source itself.

Innovation, however, does not take place in an isolated manner; it takes place in social, economic and cultural organisations, which are the milieu for the innovation process; these innovation milieus are fundamentally characterised by their synergies, and synergy, I think, is always found at the base of productivity and innovation. We know that in a synergy two plus two equals five, and that is what makes it possible for society to make progress.

But how do you set up innovation, innovative actions that are capable of producing a synergy? Well, this is the basis of all economic and social developments. But it so happens that innovation milieus are territorially focused; they also have a localised structure, as demonstrated by research work carried out over the last few years.

There seems to be a paradox in the era of telecommunications, and innovation is increasingly focusing on certain territorial areas. We have many theories that we analysed from an empirical point of view in the eighties. As a result of academic research undertaken parallel to the process, we have, on the one hand, the innovation milieu theory that we generated in an independent manner based on a conversation between *(… inaudible…)*, the French economist, Peter Hall and myself. We also have the theory of industrial innovation means, which relates to some of our work, although it was proposed in an autonomous manner by Roberto *(… inaudible…)* in Italy and by Aldrin Scott in Southern California. At the same time, Michael Porter also proposed his 'industrial clusters' theory in the field of innovation. A parallel theoretical effort was carried out by Brian Arthur at Stanford University. So, this is the empirical and theoretical base that has been used for analysis as regards territorial innovation means.

On the basis of these theories, in the early 90's Peter Hall and myself carried out a study that had to do with the main centres of technological innovation and in particular with technology and innovation around the world. I think some of you may be familiar with the book we published on this matter. The outcome of this research (and let me underline that it was field research and that we went to many countries) was relatively surprising and somewhat complex for many technology and science parks. That is because all over the world science parks, as far as essentials are concerned, are in major metropolitan areas, which already had a tradition of technology and innovation and where entrepreneurs have been very innovative over the last decades or over the last few centuries. In Europe, the greatest concentration of technological innovation in quantitative terms, with many people working in the IT industry, is the Paris region. And the second most important area is the region of London and the south of England, with most innovation being concentrated from Oxford to Sussex. In this regard what we saw is that in the constitution of means of innovation, cultural activity, as well as scientific and university concentration, played an essential role. In the last three years new studies have also been carried out that point in the same direction. Two or three years ago Peter Hall published his wonderful book *Cities in Civilisation*, which has not yet been released in Spanish. In that book, going back over the history of Athens to Silicon Valley and Tokyo, he shows how urban culture, metropolitan culture is the fundamental element for creativity and innovation that has been present throughout history and is also present now in our information age. In a recent book published less than one year ago, called *The New Geography*, C…, a North American analyst, proved that at this point in time in the United States innovation is focused in large cities, particularly in large cities that are also culturally dynamic and that are capable of attracting innovation, much more so than in the metropolitan suburbs where microelectronics were born or where the computing industry or the IT industry was born. C…'s rationale is that the basis for innovation, and the basis for the added value that it generates, has to do with innovative people, highly trained people, highly skilled people who enjoy living in places like San Francisco, for example.

The major boom of the Internet industry in the US over the last two years has been in New York. There are two fundamental centres: one is San Francisco, but the other one is New York. The main reason for this is that New York is still the most interesting,

the most innovative, and the most creative city of the US. So, people who want to express their creativity go to New York. And once they're in NY, they find the funding needed to do what they want to do, which is what adds further value to innovation.

This means that in this particular context, Science and Technology Parks (STPs) are undergoing a certain degree of transformation. About twenty years ago or so STPs played a very positive role because institutions and businesses recognised the existence of a new economic development model based on science, technology and information, on new sources of productivity and on the relationship between R&D and production. So they did away with the former industrial model that was losing dynamism, although we must admit that it too was based on the relationship that existed between science and business. Remember what happened with the chemical industry in Germany at the end of the nineteenth century: it was also based on that specific relationship.

Let us say that what science and technology parks did was to organise. They were much more specific with respect to the effort of linking industries to new economies twenty years ago. Together with this innovative, institutional and entrepreneurial effort, many technology parks also frequently set up volunteer projects and sometimes ideological operations that had to do with modernising actions. In certain instances these were operations that only had to do with real estate speculation, but which looked as though they had to do with technological modernisation processes. Sometimes leading multinational corporations were attracted, but with very little technological innovation and very little connections with the regional productive structures. Occasionally, these operations had to do with the generation of employment and the productive relaunching of backward areas. There were not necessarily innovation means. There were some exceptions, of course, in particular when they connected to global innovation networks, as occurred with Hsinchu Park in Taiwan, or when they were based on university research centres, or whenever they got in touch with companies that focused on innovation. However, most of these operations involved industrial decentralisation. And in particular there was something that we discussed with Peter Hall, namely the Technopole programme in Japan, which was very interesting to the extent that it did provide for regional development. It also allowed… *(inaudible)* for example, to become a much more developed area compared to its former situation. But in any case, none of these operations ever set up autonomous innovation means at an international level.

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Tape 2

… *(inaudible)* in South Korea, or Cartuja '93 in Spain. This does not mean, however, that Technology Parks are no longer valid at present. I think they are valid, but on the basis of a new economic and technological development strategy, based on the creation of global innovation networks. Please allow me, ladies and gentlemen, to go

back to the origins and to remind you about the constitutional elements of the paradigmatic renovation means of the new economy. Let us refer specifically to Silicon Valley. From the lessons learnt there I will try to develop an analytical model that is much more far-reaching. In general terms, we all know what Silicon Valley has been all about, so I will only give you the main points that have to do with why that means of innovation was set up. At present it is still a dynamic means of innovation and is the one that generates the highest levels of value in the information industry worldwide. Then we will see how Silicon Valley has changed over the years. We will see the changes that have taken place in the dynamics and structure of the innovation system.

Silicon Valley was set up in the 50's and 60's based on the territorial distribution of what have always been the essential factors of the production system, namely raw materials, labour and capital. But raw materials, labour and capital have to be specific. Materials are first: there has to be knowledge and information in connection with new information technology. As you know, this raw material was based on migration from the East Coast of the United States to the West. These people set up companies around Stanford University and thanks to the dissemination work carried out by the engineers working for those companies, this raw material, in other words, knowledge, was eventually sent to other neighbouring companies.

Then we have specific work, the work that was done by the major or leading universities that existed in the area, universities which until the 60's did not have any realistic capability for training electronic engineers or computer engineers and so on. As a result of certain university policies and of the policy that was approved by the State of California in the case of Berkeley, they decided to multiply their engineering and IT programmes. In 1960 MIT and Harvard had twice as many engineers in IT and microelectronics as Berkley and Stanford, but in the 70's Berkeley and Stamford had four times as many as MIT and Harvard.

There are other universities in the field, including one people in Europe do not know much about. I am referring to the University of Santa Clara, a leading university in the field of technology, privately run by the Jesuits. It is one of the oldest universities and one of the leaders in the field of training innovative people.

Above all, there is also specific capital. What sort of capital am I referring to? I am referring to two types of funding: one that is not really 'capital', it is really just funding. In other words it is money that does not work as capital, which initially was very important but is no longer. This was the funding provided by markets, and normally supported by the Secretary of Defence in the United States. Due to military competitiveness this is no longer important, but it was decisive in the late 60's and early 70's. The other, which is the issue of Silicon Valley, is funding which has to do with the creation of a strong venture capital industry, which was and still is the essential basis for innovation in Silicon Valley.

Thus we have a specific raw material, advanced knowledge, specific labour, specific work and a high level of university training programmes, as well as specific capital, together with military funding that might not be returned, and venture capital which

could easily be lose money but which also had extraordinary possibilities of obtaining very high profits. From that moment, social networks were created for innovators, very flexible people who could move very quickly from one company to another. Though this circulation they disseminated knowledge, and eventually there were about 10,000 innovative companies in the Silicon Valley area and in the extension that reaches the Bay of San Francisco.

Once this was set up, once these means existed independently of the universities that had generated them and of the Ministry of Defence, they became a global point of attraction for talent. This is fundamental. This talent was attracted from all parts of the US and from all over the world, based on two key elements: cultural openness and institutional flexibility. Institutional flexibility, for example, in relation to immigration laws that meant the North American high-tech industry was entitled to add 250,000 special visas for high technology per year. And cultural openness, the ease for social and cultural integration in a multi-ethnic community that attracted people from all over the world without discriminating anyone. It is not that there is no racism in the US, but simply that it is of no use in California, because it would be a full-time job to hate everybody who is from a different country or culture or race. Therefore people get used to it, they get used to living with different people. This process was repeated in successive waves of innovation, initially with microelectronics, then with the personal computer, then with the software revolution, and finally with the internet. At present, it is happening with nano-technology, genetic engineering and the fusion of the two technologies around bioelectronics. In the 80's, Richard Gordon put forward Silicon Valley as a global network for innovation, where Silicon Valley was a fundamental pole or node, as we say in more analytical terms. Silicon Valley was established based on networks of companies and subsidiaries that were articulated around Silicon Valley itself and the rest of the world. Taiwan or Bangalore, for example, are articulated in Silicon Valley; they form part of the same system. We cannot think about Silicon Valley without thinking about Taiwan. We cannot think about the development of software in Silicon Valley without thinking about Bangalore.

A colleague of mine at Berkeley and … *(inaudible)* completed a study last year, which I think is going to be very significant when it is published, on immigrant entrepreneurs in Silicon Valley. I have christened it 'Hotel California'. In other words, to what degree does the development of Silicon Valley depend on the capacity to attract brain talent from all over the world? More than a third of the high-tech companies created in the 90's in Silicon Valley have a CEO that is Chinese or Indian. If we add Mexico, Russia, Israel and Brazil, and some minor areas such as Europe, 40% of innovative companies in Silicon Valley have a CEO who not only is not from Silicon Valley, but are not even from the United States.

This could sound like the famous 'brain drain'; stealing brains from the rest of the world. But what …*(inaudible)*showed in her very detailed study is just the opposite. Networks have been created by the people studying in the US or in California, or who came to invest or to work and stayed. Once they have their residence in the US, once their life and work is insured, they set up a company and then go back to their country of origin and set up other companies and generate the same system. They live

between the two societies, giving them much greater economic and technical leeway. They disseminate companies in Bangalore, for example, in India or in China, not just in Taiwan but in China mainland as well. They develop networks through which a system is set up, one that is not brain drain but rather a brain circulation, which is totally different.

What does this tell us? Let me just add another element before getting to the analytical reasoning. At Berkeley over the last two years, we have also started a territorial study of the Internet industry, as regards the production of the Internet as well as the production of content for the Internet. One of my students, M ... is, I hope, completing a doctoral thesis on the first world map (which you can see on the website because we are working with open sources and everything is published immediately), the first world map with a representative sample of 4% of internet domains, the dotcoms, dotsomethings or other. This world map shows companies that produce content for the Internet or companies that disseminate the content based on an Internet domain. It shows that the Internet, both with respect to production and to usage, is the most highly concentrated industry in the world. It is the most highly concentrated in terms of countries, in countries in terms of regions, in regions in terms of metropolitan areas, in metropolitan areas in terms of cities and in cities in terms of specific neighbourhoods in those cities. The largest concentration of Internet domains in the world is in New York city. It is not San Francisco, the first is New York, the second is Los Angeles, the third is the area of San Francisco, fourth is London. Los Angeles, if we exclude porn websites and domains, goes down to third place. Fundamentally, this shows that in New York, for example, 80% is concentrated in the centre and extreme end of Manhattan and especially around the so-called Silicon Alley area.

So, look at the paradox. An industry that is based on the ubiquitousness of the network, on the production of content, is the most highly concentrated in the world. What is this due to? Firstly, to the fact that since one can be located anywhere with telecommunications capacity, being at innovation centres, connecting with everyone and disseminating information to everyone favours concentration. This centralisation depends on the specific areas and activities one needs to connect to. Secondly, if we are in an information economy, the Internet is going to be linked, above all, to the capacity of disseminating information to places that generate the most information. And what are those places? Those places are the major metropolitan areas. Thirdly, the capacity to generate synergies, of being among the innovators, of creating innovation means is reproduced in the Internet. This is what Picasso discovered in the 20's by emigrating to Paris in order to be among those that painted. He left a much more interesting city, Barcelona. But if he had not been in Paris he would not have gone beyond the Blue Phase. The same thing happened with our national heroes, with Antonio Banderas, etc. If they do not go to Hollywood, they will not meet Madonna. And if they do not meet Madonna, they will not get anywhere. So, the fundamental issue here is that we are not inventing anything new. The territorial and social articulation of the means of innovation as still the mechanism through which synergies are generated, therefore innovation, therefore value. There is something I would like to add about the Internet.

What Z... *(inaudible)* empirically shows in his thesis is that companies concentrate because they are totally dependent on venture capital, on venture capital companies. And these companies are completely concentrated. Why? Because they too are networks that are set up based on specific knowledge and personal confidence. In the year 2000, when the dotcoms and the new economy fell, venture capital in the US, in terms of volume, went down by 2% of invested capital. But in the San Francisco area it went up by 10%. Why? Because people who know made use of the crisis to put their stakes on new projects that they knew would be able to work. The specific knowledge of an industry that is so territorially and socially concentrated allows for innovation and the financing of innovation.

Why then are global innovation networks being set up that go beyond the localisation of the innovation means? First of all, because it is technologically possible. The existence of the Internet, the existence of computer networks and of advanced telecommunications makes it possible to set up a network working on a real-time basis through different locations.

Secondly, because there is a global integrated transport system and a global service system for companies enabling them to operate both in Paris or Kuala Lumpur in the same way as in New York or as in Silicon Valley.

Thirdly, because what is needed most, as has been said this morning in several presentations, is the talent and the capacity to innovate technologically and in business. This is the fundamental issue.   In other words, most of the technology needed today to innovate, unlike when the technology parks were created, is in the network. The technology is obtained from the network, but we have to know what technology we need to look for, what for, and based on that technology what new innovation systems can be generated. This is a matter of talent, and not money or financing capacity. Today with talent and entrepreneurial capability, money can be and is made. But with money and no talent, money is lost.   The contrary is happening: companies that finance spend their time scanning the world to see where they can invest, not in traditional businesses but in new sources of innovation. Therefore, this talent and this technological innovation capacity are fundamental. They look for it wherever it is and connect to it. This means that advanced technological sectors are growing much faster than the supply of talent for technology and innovation.

Fourthly, the need to flexibly adapt to the requirements of the market in a global economy requires innovation that is linked to distribution or retail markets by a strategy that in the business or retail world is known as a 'customer strategy', a strategy that has adapted to the needs of each market and to the needs of each institution. Environmental regulations, legislation, contacts with the administration… all this requires specific knowledge. This specific knowledge requires global business networks connected to each local context. But this connection needs to maintain a relationship with the other nodes in the network in the rest of the planet.

Fifth, technological innovation today is increasingly based on open source systems. Communication and co-operation of knowledge is what brings about innovation. The idea that is being developed more and more is that innovation is generated through open co-operation, and competition is carried out by applying the innovation developed on a co-operative basis. Co-operation to innovate, competition in the application. Let us say that Microsoft is dead; not Microsoft the company, but Microsoft the model. But Bill Gates, who is very clever, is quickly moving to the other model. Today IBM is open (and nobody has ever been more closed than IBM in the technological world). IBM does Apache, IBM commercialises open source products, and develops applications around this. Why? Because IBM has understood that the business lies in services and applications, and that open sources and co-operation are needed for development. No company can buy thousands of high-level programmers by exchanging information. If the model has moved to networks, there are conditions required to take part in those networks. Not everybody can get in, it is not just a matter of connecting.

The first condition, however, is to connect, to have the technological ability to connect in a given territory in terms of telecommunications, transport and financial markets. Secondly, in this territory, in order to connect to the networks, it is necessary to have human resources that are capable of processing and managing the information, as well as the sources for those human resources, such as universities. Without serious universities there is no possibility of connecting to innovation networks. Thirdly, to enter a value network, one has to be capable of providing something to the innovation network, something which will make the other nodes of the network be interested in the connection. What is of interest is not low cost, de-regulation or flexibility. These are favourable conditions for the implementation of companies once the essential issue is ensured.

And what is the essential issue? The essential issue is the creation of value, and creation of value is the capacity for innovation. Innovative territorial nodes connect to the network. Those that are not innovative are disconnected by the network. The more innovative, the greater the participation in the networks. The participation network increases its value as a function of the number of nodes and the capability to create synergies at each node. Therefore, the new territorial innovation model is based on innovation means connected into global networks through which capital and talent circulates, through which markets are opened and human resources are incorporated. As an empirical illustration, I can give you an analysis based on this model carried out by the Finnish Institute, an empirical study on information technology and technology industry clusters in Europe. It shows that the information technology industries in Europe are once again the most highly concentrated of all industries, and that in certain territories this concentration is cumulative. The five most highly concentrated regions, with the highest localisation rate, are Stockholm, Isle de France, the Dutch area around Utrecht, … *(inaudible) …,* and the so-called … *(inaudible)*… area around greater Helsinki.

This shows that these areas have concentrated internally, and at the same time are the most highly articulated at the level of the global economy. In this context science

and technology parks can be key elements in the constitution and development of territorial innovation means, and thus sources of wealth and regional development. However, they are only to the extent that they develop around global innovation networks, and they develop only to the extent that they can offer innovation. This innovation can be offered through a combination of three fundamental processes: firstly, the endogenous generation of technological and entrepreneurial innovation through universities and/or dynamic companies; secondly, attraction or retention of major companies that are not isolated enclaves but which transfer technology and also disseminate the new business model, the new networked organisational model to the companies in their environment. A clear case is Nokia, in the area of Helsinki, Tampere and, I would also say as far as I know, Ericksson in Stockholm; and there is a possibility of Nokia doing so at the Parque Tecnológico de Andalucía in Málaga. And thirdly, the attraction of innovative talent, which responds fundamentally to two factors.

One is the existence of a metropolitan culture, not quality of life that is very subjective, but personal enrichment and educational and developmental opportunities for children, which is fundamental.   The other is the existence of a local and regional structure of venture capital. Innovators go where they can continue to be innovative and where somebody can finance their innovation.

All this makes it difficult to carry out experiments in completely isolated regions through wishful thinking. But this does not mean that only major cities can be innovation centres. In Europe, for example, fast transport means that the notion of metropolitan areas has been enormously extended, and many medium-sized cities actually become nodes that are linked to the major metropolitan areas. In any case, the essential point is the connection between a territorial innovation means capable of creating internal synergy and a global innovation network capable of amplifying this synergy into a second derivative. Innovation means that are territorially concentrated, that operate as a node in a co-operative global network to produce synergies: this is the new geography of wealth and poverty in the information area.

Thank you very much for your attention.