The Influence of Information Technology on Spatial Development

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ABSTRACT

We live in an era of rapid change moving towards the information / knowledge / network society. *e*City, *e*Region, *e*Country, *e*Europe and the like are targets of many authorities round the world. One of the driving forces of this development is the new information and communication technology, ICT. This technology has progressed rapidly during the last 20 years and the pace of development of new tools and applications is intense.

The microprocessor, personal computer, mobile phone, e-mail, Internet, WWW and a number of software are good examples of ICT. The use of these tools is growing continuously and at a fast rate. The productivity of industries and effectiveness of services have increased. Civil society has found new ways of networking. Individuals have easy access to information around the world. Mobile and wireless communication is becoming commonplace.

One aspect of ICT has been rarely discussed and that is: will ICT influence spatial development. During the agrarian era rural areas were the focus of life, during the industrial era urbanisation took place. Railways and roads shaped spatial structures. Modern telecommunications can be seen not only as a new way to behave but also as new kind of traffic. Thus it can be predicted that ICT, as an essential element of information society will reshape in the long run current regional, urban and rural structures and create new spatial forms for urban and rural life.

Although there is still only little empirical evidence about new spatial development tendencies, a number of scientists have described these phenomena and predicted that essential changes in the structures of cities and regions will take place. The basic principal reason for this development is the change in the meaning of space, place, distance and time as the determinants of location factors. Space and place are not affected by distance and time factors in the same way than before. ICT gives more freedom for location and the specific features of place will play an important role in selecting locations of activities. ICT will also change the traditional ways running businesses in industry, services and other organisations as well as in everyday life. These developments will also have spatial consequences. The conventional and virtual worlds will function at the same time.

ICT will have both centralising and decentralising effects, it will influence production and services, location of offices and housing, foster *e*work, have impact on traffic etc. It is still difficult to perceive how these new technologies will affect spatial structures. It is definite that changes are taking place all the time and we are just at the beginning of this evolution.

For spatial planning change is always an opportunity. Spatial planning in general and land use planning in particular are important tools to guide the development also in the future. Therefore land use planners should be aware of these development tendencies and be prepared for the new challenges they are facing. What is needed is a new way of thinking and new planning applications based on new knowledge about the spatial impacts of ICT. Planners have to work for their own city and region and benefit from the opportunities new technologies provide. Winners are those who will understand the emerging new spatial order.

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1. INTRODUCTION

The history of a country, region or local area indicates clearly that the development of new means of transportation and respective networks have had a great impact on the spatial formation of the area concerned alongside with economic and societal progress. The quality and diversity of transportation networks and services have been and are important location factors for many industries and activities. It is therefore only natural that watercourses and harbours, railroads, roads, streets and airports are important elements in all land use planning. Through land use planning it has been possible to regulate traffic flows and take into account special transportation needs when defining the locations of activities. Traffic planning has been a significant part of land use planning.

We live in an era of rapid change moving towards the information / knowledge / network society. *e*City, *e*Region, *e*Country, *e*Europe and the like are targets of many authorities round the world. One of the driving forces of this development is the new information and communication technology, ICT. Modern telecommunications can be seen not only as a new way to behave but also as a new form of traffic. ICT should therefore be taken into account also in land use planning.

The impact of the development of the information society and especially the impact of information and communication technology on the structures of cities and regions is now a question which should be widely discussed by land use planners. Until now this discussion has been very modest. One reason for this is probably simply the fact, as Moss (2000) argues, that we do not understand how these technologies will shape the growth of cities and regions. This is understandable. Modern information and communication technology is a newcomer and the application of this technology is still in the early stages, although rapidly increasing.

If land use planners could foresee what spatial consequences will follow from the applications of ICT, now would be the best time to influence this development in terms of land use planning. Before we are able to do so we have to obtain new knowledge about these development forces and create new concepts for land use planning. Old methods will probably not work in the new situation.

In the following chapters some of the possible spatial consequences of the application of ICT will be discussed and some ideas for land use planning suggested. Before that a short review of the development of ICT will be presented.

2. THE DEVELOPMENT OF INFORMATION AND COMMUNICATION TECHNOLOGY

2.1 Information technology

The history of information technology begins at about 3000 BC when Abacus was developed in Asia. The next step took nearly 5000 years when Blaise Pascal invented the calculator in 1642. The following important year was 1833 when Charles Babbage designed the automatic calculating machine. Mr Babbage is called the creator of the computer.

After the Second World War the development of information technology has been very rapid. In 1946 the first high-speed electronic computer ENIAC was taken to service. In the following year, 1947, the transistor was invented and the integrated circuit in 1959. A big step forward was the invention of the microprocessor in 1971. It was in practice a computer on a silicon chip.

Computers were at first used only by big companies. The development of the personal computers began in 1975. Five years later came the laptops. The computing capacity and speed of microprocessors has doubled every 18 months. The CD and DVD technologies provide better handling possibilities. Separate data, text, voice and picture information are integrated into a multimedia product.

Along with the development of computers new software was created. In the near future it is expected that computers will understand spoken language and translate it into other languages. Artificial intelligence and other new ways to use computers are under development.

The number of computers has increased continuously. For example, in Finland there were 25 computers per 100 people in 1995. In 2000 the respective figure was 57.

2.2 Communication Technology

The history of communication technology, according to some, began with the use of carrier pigeons in Greece in 700 BC. The telegraph was introduced in 1837, the telephone in 1876, the radio in 1895 and the television in the 1920s. 1947 was an important year when Claude Shannon created a mathematical theory, which was the basis for modern digital communications. During the 1960s the first satellite telecommunications were developed. In 1966 a fibre optic was used in the transmission of telephone signals for the first time.

The year 1969 saw the beginning of the Internet era when the development of ARPANET began. The first satellite of the Global Positioning System, GPS, was launched in 1978. The concept of the world wide web, WWW, was introduced in 1989 and the Mosaic programme in 1993. These developments were important for the diffusion of the Internet. The Internet is a tool to obtain all kinds of information, to establish networks, to send messages, the tool for e-commerce etc.

The Nordic Mobile Telephone, NMT, system was introduced in Scandinavia in 1981. Ten years later came the second generation of mobile phones, the Global System for Mobile Communications, GSM. It was a digital system. Now the G 2.5 system phones are available. Probably in 2002 the third generation phones are introduced when the Universal Mobile Telecommunications System, UMTS, is promised to be ready for use. Mobile phones provide wireless connections to other phones, Internet and different types of services. You can send messages, text and data as well as fax. Soon also a digital camera is included to phones. Modern mobile phones will be multimedia tools and provide wireless connections where operators have networks in place. As an example of the extent of the use of mobile phones, it is estimated that in 2001 some 200 billion text messages will be sent in the GSM networks.

The diffusion of the Internet and mobile phones is growing all the time and fast. The number of Internet users was under 20 million in 1995. In late 2000 they were over 400 million and it is estimated that in 2005 the number will be over 1 billion. The number of mobile phones was 11 million in 1990, 480 million in 1999 and estimated at 919 million in 2001. All these figures increase rapidly. Internet and mobile phones will change communications systems in a way that is difficult to predict. Wireless connections and communications will have a great impact on human life.

The impact of the introduction of digital television is now difficult to predict. Probably it will become a good tool also for two-way communications.

2.3 General Remarks

The new and continuously developing information and communication technology has given and will give a growing number of people access to a great variety of information sources at low cost and great speed. New tools also provide opportunities for networking and sending different types of information to anybody who is connected. Wireless multimedia is the next target.

According to Molitor (2001) the telecommunications industry will face more technological change in next five years than in the past 95 years. He predicts that the most important changes will originate from the development of optical transmission, satellite communications, wireless and mobile communications devices, broadband digital technologies and Internet resources.

3. INFLUENCE OF INFORMATION AND COMMUNICATION TECHNOLOGY ON SPATIAL CHANGE

In the following discussion on the impact of ICT on spatial change it is important to note that the experiences in the use of the modern ICT are from a short time period. It is therefore difficult to find out clear signals about its spatial impacts. Mostly there are opinions about possible consequences.

A good starting point for this discussion is to notice the change in the meaning of space, place, distance and time as the determinants of location factors. In many cases distance will

no longer be a problem when one can transmit information via telecommunications networks. The same applies to time. All transmissions will take place at once. Wireless communications will allow the making of connections at any place where the service is offered. Space and place are thus not any more affected by distance and time factors in the same way than before. Instead new determinants will emerge.

Probably the best known concept of the changing role of space, place, distance and time in information age are suggested by Castells (1996) when he introduces the concepts of "space of flows and timeless time". Earlier Masuda (1981) and Naisbitt (1984) had suggested in principle the same ideas when speaking of information space which is connected by electronics. Many scientists, like Mitchell (1999) and Kotkin (2000), suggest that the importance of place will remain but the importance of distance will decline. ICT gives more freedom for location and therefore the specific features of place will play an important role in selecting locations for activities. Another general observation regarding the spatial consequences of ICT is the fact that this technology will change the traditional ways of running businesses in industry, services and other organisations as well as in everyday life.

The application of ICT means that now and in the future we will have both the conventional, physical settings and the virtual world functioning at the same time complementing rather than replacing each other.

3.1 Centralisation or Decentralisation

Most scientists suggest that ICT will have both a centralising and decentralising effect. The outcome depends on how the new technology is applied. Castells (2001) argues that especially the Internet will foster the role of big cities in the locations of industries and services. The basic reason for metropolitan concentration is the innovative milieu the big cities have.

Mitchell (1999), and Weiner and Brown (1997) suggest that the differences between cities and peripheral areas will diminish because services will be available also in rural areas, and many people will move to live in those areas because of a better environment and also cheaper housing. Weiner and Brown call this new type of area "rurbania".

Graham and Marvin (2001) and some others warn us of the danger of the development of dual cities where there will be distinctive, separate areas for the affluent and the poor as is already the case in many big cities.

3.2 Influence of ICT on Production and Service

The automation of industrial processes was the first application of ICT. It led in many cases to the reduction of labour. Subsequently ICT has been used in the structural reforms of production. Mass production has often been replaced by customised production. Enterprises are restructured into network companies. This has led to the relocation of production to cheaper places. However, new technology has also provided new opportunities for old and small industries to compete by networking with other companies and thus strengthening their posi-

tions. Marketing of products has also benefited from this new tool and in this sense a remote location is not a big problem.

Industries that develop ICT have special requirements for location. The vicinity of universities, qualified labour and good housing are some of the location factors identified in many studies. This means that the ICT industries are not easily spread but rather concentrated to selected cities. Companies producing devices are normally globally structured and have plants on different continents. This does not necessary apply to the software industry because they can deliver their products via the Internet.

The spatial impact of ICT on services is more diversified compared to production. Electronic banking is a good example. For example in Finland most financial transactions are made with computers or mobile phones. A great number of branch offices have been closed. Electronic commerce is mostly used by businesses. It is also becoming more common for ordinary people especially as regards buying and selling intangible products, like flight tickets, music, insurance etc. When buying goods you need to have a good delivery system.

Public services is an area where ICT provides limitless possibilities. Central and local authorities are now offering a lot of information about their services, in many cases online two-way communications are made available for citizens. Libraries offer on-line services. Virtual education and telemedicine are developing fast.

In many cases services provided via ICT will improve the service standard especially in small communities and rural areas. It will also save time and travelling costs. The location of services will not be as important as earlier. It is good to remember that we are just at the beginning of this development. New technology and new services will make everything easier in the future.

3.3 ICT, Location of Offices and *e*work

The application of ICT has influenced certain kinds of office work. The first phenomenon was probably the establishment of so called " back offices", when some of the office activities were relocated from central offices to cheaper places and away from the city centre. "Call centres" are now a very common new type of office where services which can be given by phone or e-mail or via Internet are located to places of low cost labour and cheap office premises.

Airports are also becoming places of many offices and also some production facilities. Good and fast connections attract special enterprises to these locations. Terminals themselves provide good, office standard network connections to passengers.

In Finland central government is considering possibilities to locate service providers outside the Helsinki area. The idea is part of the new regional policy.

Toffler (1980) introduced the concept of "The Electronic Cottage" and expected that a number of people will start to work at home provided they have good connections. At that time

there were people who argued that people need face to face contacts in the work. At the moment the reality is between these estimates. According to a study carried out by the EU (Korte, W.B. and Garais, K, 2001) only some people telework fulltime. In 1999 in ten EU countries 6 % from the labour force carried out telework but not every day of the week. They estimate that the number of teleworkers will grow to 10,5 % of the total workforce by 2005.

ICT brings about flexibility to work. More people have also established their own businesses and work from home. An important phenomenon is shown by "24/7" when activities are functioning 24 hours a day and seven days in a week. It is the result partly from the changing working habits and partly from a global working environment. How it will affect spatial order is a good question.

3.4 Spatial Impact of Wireless Communications

There is yet little experience about the impact of wireless communications on spatial structures. Wireless communication brings a new dimension to human interaction. Even now and more so in the future, people are not dependent on location when communicating. Anywhere and any time is the slogan. New services are offered all the time. It is, however, difficult to predict how quickly people will learn to apply these new possibilities. The success of the text messaging function on the mobile phones was a big surprise for everybody. Probably many people need time to become experienced in the use of new tools. No doubt wireless communication will make life easier in many ways both in work and free time. It will subsequently have a great impact on the behaviour of people. Therefore it is important to follow what spatial consequences wireless communication will bring along.

3.5 Spatial Impact of ICT on Housing

Until now the location of the work place has determined very much the location of home. As ICT gives more freedom for the location of work places, it is easy to predict that it will do the same for location of housing. The evidence is still modest. It would be understandable if people who have "mobile work" would choose the location of their homes according to personal preference of the housing environment. People who work mostly via the Internet may locate to far-away places because of special requirements.

Some scientists have suggested (Mitchell, 1999, Moss and Townsend, 2000) that the separation of work and home will disappear along with the development of ICT. This will be true at least to some people.

3.6 Impacts of ICT on Traffic

It is easy to foresee that electronic communication will reduce traffic. This will be the case in e-commerce, at least as regards intangible products. In some cases the seller will bring the goods to the buyer if they are not posted. Services provided via the Internet will clearly reduce traffic. Teleworking will reduce traffic, as well as video conferencing. E-mails have replaced some of the traditional postal services.

When virtual functions and wireless communication are reducing traffic more scattered housing can increase commuting. Also new way of living may also cause new traffic demands. So the impacts of ITC may both increase and reduce traffic.

4. IMPACTS OF ICT ON LAND USE PLANNING

The points above indicate that the application of ICT will have some spatial consequences, although the signals are still weak but relevant. Many scientists predict that essential changes in the structures of cities and regions will take place. For spatial planning change is always an opportunity. One can use change to reach accepted goals and at same time try to soften or eliminate negative development trends. Therefore it is now high time to discuss how land use planners should meet and handle these new challenges.

The first point is the ICT infrastructure. Traditionally the development of transportation networks was a task for public authorities. Now more and more private enterprises are also involved in providing services. In the case of ICT all infrastructure investments are normally privately implemented. Actions should be profitable. Some governments in Europe have even auctioned the rights to build the third generation mobile phone, UMTS, networks. The situation was just the opposite compared to the construction of roads. As a result there is a risk that the building of the network will take longer than expected. Economic development in the whole of Europe will therefore be affected by the possible delay.

In some countries governments consider to finance the building of a broadband connection to everybody. The idea behind this is to promote the development of the Internet and also to safeguard easy access and connectivity. In any case it is clear that the future of regions, cities and even rural areas very much depends on the quality of the ICT infrastructure they will have.

In the planning of regional and local physical structures it is important to notice the changes in production, marketing and delivery. The created ICT networks will be essential elements of these structures. Virtuality will also be a new key function. When the importance of place still matters, it is essential to find the success factors of each place. Some places may have at the same time both a local and global influence area. The diversified life will offer plenty of opportunities. Traditional planning principles should also be tested. As an example, the separation of work and housing areas should no longer be a practice.

Mitchell (1999) concludes his book “e-topia” by presenting some arguments on future of city planning. Now it is possible to create ´ “e-topias”- lean, green cities that work smarter not harder´. His five planning principles are as follows: 1. Dematerialization, 2. Demobilization, 3. Mass customization, 4. Intelligent operation and 5. Soft transformation.

In general scientists do not declare any places to be winners or losers because of ICT. Instead, all will have to work for their own city and region and benefit from the opportunities new technologies provide. Spatial planning in general and land use planning especially are important tools to guide the development also in the future. What is needed is a new way of

thinking and new planning applications based on new knowledge of spatial impacts of ICT. Winners are those who will understand the emerging new spatial order.

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