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Urban Futures in the Era of the E-Economy

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URBAN FUTURES IN THE ERA OF THE E-ECONOMY

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Abstract
The wide use of information and communication technology leads to structural changes in our economy and society. The impacts of ICTs embrace not only a faster and denser communication but also a reorganisation of values 'chains, firms, labour relations and management structures. In this paper various actual and potential impacts on the function of cities are identifíed and discussed. This is based on a scan of the literature and empirical research of one particular value chain, i.e. that of financial services. Attention is given to customer driven production, customer services, desintermediation and re-intermediation, new e-firms and e-webs of firms, and flexibility of work places. A special focus is on different forms of knowledge and concomitant constraints in eiectronic communication. The paper concludes with a number of questions and some brief policy recommendations.

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1. Introduction

The use of information- and communication technology in commercial transactions has grown tremendously since the mid 1990s. Most transactions using electronic commerce have been in business-to-business commerce, but business-to-consumer commerce is likely to play an expanding role in the next coming years. Electronic commerce has grown quickly as a result of the application of e-mail and electronic data interchange (EDI), enabling users to substitute physical papers by electronic forms. However, it is the Internet and the World Wide Web that have allowed the stimulation of e-commerce.

An explanation of the popularity of Internet and e-commerce services can be found in network extemality theory (e.g. Katz and Shapiro 1985; Capello, 1994; Economides, 1996). The positive network effects include the ones of increasing returns and first-mover advantages. Increasing returns means that with each new subscription to the web, the network increases its user value. Subscription enables actors to carry out strategies at a world-wide level. First-mover advantages means that each actor that introduces an innovation on the web benefits from publicity and popularity of the name among consumers; this at the expense of followers suffering from large marketing costs. The growing use of Internet and e-commerce has also been approached from a transaction cost perspective. From this perspective the following critical transaction and co-ordination economies may be observed (e.g. Wigand, 1997): a faster and denser transmission of information in communication; a tighter connection in linkages within the firm, among firms and between firms and customers; a bringing together of customers and sellers in the electronic marketplace (e.g. electronic auctions); and a strategic use of networking in co-operation and competition.

The changes in society embrace more than just a faster and cheaper communication, with increasing intensity of transmission. With the growth of Internet and e-commerce, a new architecture of society is under way. The changes - although not all clear, because of complex interaction and contradictory trends - point to a transformation of the organisation of production (value chains), including the organisation of firms, management structures and labour relations (Dussart, 2000; Shapiro and Varian, 1999; Westland and Clark, 1999), with concomitant spatial impacts. In value chains, for example, old, physical intermediaries disappear from particular places while new electronic ones arise (van Geenhuizen and Nijkamp, 2001; Kenney and Curry, 200 1). There has been quite some speculation about the

spatial impacts of this transformation, in particular the impacts on cities, ranging from the death of cities to the rise of a few global command centres.

Against this background, this paper aims to uncover trends and potential developments in electronic communication in terms of connectivity of cities with global grids and in terms of serving the knowledge economy. Particular attention is given to emerging changes in the value chain and repercussions on cities as nodes and on related transport flow. The basis for unravelling the impacts of the e-economy on urban functions is a scan of the recent literature and an empirical study of a sector subject to strong influence of ICTs and e-economy, i.e. fmancial services (van Geenhuizen and Nijkamp, 2001). The results can be seen as what is named "educated guesses".

The paper is structured as follows. First, some scenarios on the future of cities are identified and discussed. Then there is an analysis of the connectivity of Dutch cities with advanced ICT infrastructure in order to identify urban differences in potentials for taking advantage from the e-economy. This is followed by a discussion of the state of the art in research on electronic communication of different types of knowledge, and an evaluation of the role of e-communication in serving the knowledge economy. In the next part the paper turns to a number of emerging adaptations in the value chain with important actual and potential implications for urban functions and transport flow, including an assessment of the uncertainty involved.

2. Future Urban Developments

New technological advances mean a challenge for our space-economy, including the cities. But it is as yet not clear which types of trends may be expected. To shed more light on the related uncertainties, many researchers resort to scenario analysis.

In the literature, one can observe two extreme scenario's and one moderate scenario for future urban development in the ICT era - or broader – era of the e-economy. In the first, extreme, scenario it is emphasised that modem ICTs enable to overcome barriers of space and time. Firms and households become footloose meaning a larger freedom in choosing their location. Homes as "electronic cottages" are (re)designed to be access nodes for households as consumers, workers, etc. In a situation named the "death of distance", place and location no longer matter and, as a consequence, large cities weaken their hold over economic and social

life (Cairncross, 1997). Urban meeting places, markets, entertainment, etc. will give way to virtual gathering, e-business, e-information exchange and entertainment (Mitchell, 1995). The basic hypothesis here is the ubiquitous access of firms and households to fast computer networks.

The other extreme scenario says that large cities strengthen their position at the expense of smaller ones. This scenario recognises the role of large corporations in decision making in the global economic system, as well as the fact that their specialised decision making - requiring face-to-face contact - may hinder any trend for spread. Most probably there are only a few of such "global urban command centres" in which highly qualified professional skills and tacit knowledge are produced and circulate (see e.g. Gillespie and Williams, 1988; Graham and Marvin, 1996; Sassen, 1999). ICTs help to extend the dominance of these cities by enabling action at a distance and remote control of activities in smaller towns and rural places. In addition, there are various generic arguments supporting agglomeration under the influence of ICTs. First, the use of ICTs has enabled flexible specialisation. This development has stimulated a spatial clustering of supplying firms due to the need to build and sustain trust and to transfer tacit knowledge. Secondly, many economic activities in cities are strongly interrelated with the here present knowledge workers (e.g. Duranton, 1999). Although distance seems to shrink under the influence of ICTs, the local linkages of these knowledge workers in the urban labour market are reinforced due to an increasing demand for the fast establishment of face-to-face contacts in high density knowledge transfer, both with customers and suppliers of services. A third argument in favour of agglomeration is derived from the institutional and social-cultural dimension of cities, which act as a kind of "glue" between firms and organisations making them perform better. It is plausible that the social-cultural dimension of cities acts as a counterbalance against the impersonal and straightforward nature of electronic communication.

In a third altemative of a more moderate nature the possibility of access of various selected medium-sized towns and smaller settlements to global decision-making networks is recognised. In this vision ICTs have no deterministic impacts but work through the way in which they are "constructed" in society in complex processes of institutional and personal interaction. Socio-economie actions can direct the application of the new technologies and change their impacts each time. The relation between the development of cities and the use of

ICTs therefore, seems complex and non-linear, leading to a variety of results in places and times (Graham and Marvin, 1996; Malecki and Gorman, 2001; Mitchell, 1999).

The issue of the future of cities is the more interesting because recent research has depicted various important emerging patterns. In Europe there is a genera1 trend for spatial dispersal (e.g. Groth, 2000; Lambooy, 1998). A so-called polycentric model seems emerging, with smaller towns and rural areas exhibiting a stronger employment growth than large cities. The relative stagnation of large cities may be attributed to certain agglomeration diseconomies here (Manshanden et al., 2000). In addition, in some cases we observe the rise of network cities. In The Netherlands, the northem wing of the Rimcity (including Amsterdam) seems to develop as a network city, not only connected through labour market relations, but also through business trips, shopping and other leisure trips (van der Laan, 2000). On a lower spatial scale there seems an employment increase at the edge of cities, whereas inner city areas tend to increase the function of living area. These pattems indicate the emergence of a growing diversity in density and function. The key issue in the context of the e-economy is whether the concomitant changes reinforce ongoing trends of spatial dispersal or weaken them.

3. Dutch Cities in Grids

This section explores the different position of Dutch cities as nodes in (inter)national ICT networks. To this purpose a few selected fiber-optic grids are analysed, i.e. EuroRings (KPN-Qwest), Surfnet 4/5, and CityRings (KPN) (Table 1). By considering the size of the cities connected with these grids it appears that Amsterdam, as the largest city, has the best connections. Dependent on the type of grid, Rotterdam is also in a favourable position. For example, EuroRings – grids around European agglomerations – connects both Amsterdam and Rotterdam with other European centres and, in the near future, with the largest cities in the US (using the Qwest grid) (KPN, 2000). Another example is Deutsche Telekom, that operates an intemational network in which most recently Amsterdam is included, aside from London, Paris and Brussels. Both grids represent intemational grids established in a period in which market demand determines the location of the connections, i.e. the largest cities.

A different intemational network is SURFnet. It connects universities and research centres in various parts of the world and offers the possibility to subscribe for large enterprises. In The Netherlands all four large cities are connected, aside from eight mostly medium-sized

university towns. To date, SURFnet4 is being replaced by SURFnet5, meaning a capacity increase by hundred, as well as access to new generations of Internet. In The Netherlands this network - named Gigaport – is heavily subsidised by the govemment in order to push The Netherlands intemationally. By making use of Gigaport, knowledge institutes and enterprises can participate in advanced research based on new broadband technologies that are not available somewhere else, like in research of fast, three dimensional simulation, intemational tele-consulting and data-mining. The third indicator used here to identify the position of cities in (inter)national grids, is CityRings (KPN), i.e. fiber-optic rings established around relatively large cities to increase transfer and connection capacity. All large cities and a considerable number of medium-sized towns in The Netherlands are connected in this way (85% of the twenty largest cities).

Table 1 **Position of 20 largest urban agglomerations in The Nederland in ICT networks (selected indicators) (1999/2000)**

Urban agglomeration according to size	EuroRings (KPN-Qwest)	SURFnet4/5	CityRings (KPN)
Largest city	100%	100%	100%
4 largest cities	50%	100%	100%
10 largest cities	20%	80%	100%
20 largest cities	10%	55%	85%

Bron: van Geenhuizen, 2000.

If we focus in on the intemationai position of Dutch cities based on various supply-side and demand-side indicators, it appears that only Amsterdam plays an important role. According to a ranking based on the price of services, choice of available connections and availability of the most advanced connections, Amsterdam is fifth in Europe, following London, Stockholm, Paris and Frankfurt (Graham 1999). According to an indicator conceming the use of Internet, however, Amsterdam is third in the world. Of the 50 most frequently used Internet routes Amsterdam is end-station of seven routes in the world, against nine each for London and New York (Abramson, 2000). As a node in Internet traffic Amsterdam thus holds a position in the top'of Europe.

Although the evidence is fragmentary, the conclusion may be drawn that there is no death of distance in terms of access to the fastest global grids. Nodes are only created there where the

potential market is largest due to sheer size of cities or specialised research functions. Thus, the urban hierarchy of our world is partly replicated by the current ICT developments.

4. Electronic Communication in a Knowledge Economy

Despite high-speed fiber-optic connections, there are a number of constraints in electronic communication. In this context it is common practice to distinguish between codified, and tacit knowledge. Contextual communication has been added as a separate class more recently (Bolisano and Scarso, 2000; Foray and Lundvall, 1996). Codified knowledge is based on objective facts understandable for all actors that know the language (codes) and consequently, it is transferable between different organisations. In contrast, tacit communication deals with subjective knowledge, like personal experience, ideas and specific routines. Much of this communication is by chance, such as during work, at lunch or coffee breaks. A basic requirement is that the persons involved understand each other by using similar conventions and routines in understanding, usually merely existing within one and the same organisation. A third form of communication is often not distinguished explicitly, i.e. contextual communication, but in view of constraints of electronic communication a distinction seems necessary (Bolisano and Scarso, 2000). Major points of difference with the previous forms are the aim of the communication, namely transfer (exchange) of new meanings and new interpretative frameworks. Concomitantly, there is a need to avoid predefined methods and outcomes etc., while the communication is basically a long term process of interactive learning. It seems that innovative segments of the value chain not only depend on tacit knowledge between similar organisations but also on contextual communication between different organisations, particularly because the latter enables "radical" innovations, by widening horizons and breaking with existing frames of references.

The crucial question is to what extent these three types of comrnunication can be carried out electronically and lead to sufficient cost advantages to be adopted on a large scale? Furthermore, is there substitution of face-to-face communication by electronic communication, or is there complementarity of both types? And to what extent is there compensation, like an increase of face-to-face communication on higher levels following from electronic communication on lower levels? The answer so far is that there is only substitution of codified knowledge and this seems to be accompanied by some compensation. Tacit communication and contextual communication suffer from major constraints using electronic devices, although in the former some progress is being made.

Table 2 Forms of communication

	Codified	Tacit	Contextual
Content	Objective knowledge in facts, figures, formulas, design	Subjective knowledge connected with ideas, perceptions and personal experience	Subjective knowledge about perspectives and interpretative frameworks
Environment	Within and between organisations	Mainly witbin organisations and between organisations tbat share culture	Between organisations with a different culture and frame of references.
Way of Transfer	Standard codes	Observation, interactive participation and practice	Continuous real-time interactive learning
Zontext of Transfer	Intentionally	Intentionally, but often by chance	Intentionally
Success factors	Unifortnity of codes	Trust Share of interpretative framework	Different frames of interpretation
Focus	Standardisation, replicability, reliability, speed, efficiency, automatic processing	Flexibility, variability, management of ambiguity	Innovative content, context exploration, ricbness of form and content
Zonstraints	Few In EDI a shortage of formalisation of cotnmunication	Substantial • Intelligent agents: problems of validity, learning in unexpected situations and trust in delegating tasks • Multimedia using interactive tools: impossible to integrate all functions with universal applicability	Structural • Frustration of basic needs: continuous real-time interaction, broad range of information without pre-defined language, variety of means and channels • No predefined aims and expected results (and costs)

With regard to codified knowledge there are no constraints as long as the communication is sufficiently formalised. Thus, an increase of the use of Electronic Data Interchange (EDI) is only hampered by a shortage of universal languages in business communication. For tacit communication, there are much more constraints. Trust and similarity in interpretative framework are critical success factors, and these can only be established in face-to-face comrnunication. From experiences with global virtual teams in geographically distributed decision-making, one may draw the conclusion that important decision-making can be done using electronic devices, but there remains a need for face-to-face communication from time to time to refresh relationships and to re-establish trust and confidence (e.g. Maznevski and

Chudoba, 2000; Mitchell, 1999). Furthermore, two approaches to deal with the specificity of tacit knowledge transfer, i.e. the use of intelligent agents (based on artificial intelligence) and multimedia with interactive tools, have led to important progress but stil1 suffer from serious shortcomings (Table 2). For example, the use of intelligent agents suffers from a lack of validity in the representation of mental models by codified software and a lack of trust by the user. In addition, multimedia approaches are only partly able to match with the need for the richest information content and for a whole array of possible functions with universal applicability. With regard to contextual communication, one may say that substitution of face-to-face contact seems impossible, also on the longer term. The major reason for this is that some important points of departure are not defíned in advance, i.e. the aim of communication and the means (channels). In addition, the communication is a long-term interactive process using a great variety of means and content.

At the same time, in daily personal and professional life there is a continuous evaluation and selection of communication modes (Table 3). By using two dimensions, i.e. the time dimension in terms of synchronous and asynchronous, and the spatial dimension in terms of local and distributed, we can identify four different modes. It seems that all modes have their appropriate roles, and choices will be made dependent on needs for specific communication and willingness to pay the associated costs in particular contexts (Mitchell, 1999). For example, e-commerce is mainly in the quadrant distributed, synchronous. This is also true for global virtual teams active in distributed decision-making but, as indicated previously, a key success factor is additional local, synchronous communication (face-to-face contact) on a regular basis.

Table 3 Advantages and disadvantages of modes of communication

	Synchronous	Asynchronous
Local	Requires transport Requires co-ordination Richness of communication (intense, personal) **Very high costs**	Requires transport Eliminates co-ordination Reduces costs
Distributed	Eliminates transport Requires co-ordination Requires additional modes in complex communication Reduces costs	Eliminates transport Eliminates co-ordination Limited to particular communication **Very low costs**

Source: Adapted from Mitchell, 1999 (p. 138).

In genera1 there has been a move towards the very low cost, distributed asynchronous quadrant in the past decades. As we have seen previously, there are quite some constraints in the distributed, synchronous quadrant for tacit and contextual communication.

5. Urban Functions in the Future

In this section we focus in on a number of adjustments in the value chain, partly based on empirical results from the financial sector. It is important to note that the financial services chain, like for example travel agency services, deal with immaterial services. The situation is more complex for chains including physical goods, because these have to be shipped to the customer. The following developments can be observed:

- an increased customer driven production
- an increased importance of customer services (customer management)
- a removal of sections of chains (desintermediation) and an entering of new intermediaries (re-intermediation)
- the rise of new e-firms and webs with e-firms
- increased innovation
- an increased flexibility of work locations.

Customer-driven Production

The phenomenon of increased customer-driven production need to be seen in the context of mass-individualisation. E-commerce matches this development because there are lots of opportunities for selection and price-reduction, for example using "co-buying". Consumers may scan offerings world-wide, using search machines to compare prices and using intelligent agents to negotiate. Accordingly, consumers may select unique packages of products and services. This holds true for financial services, books, music, travel reservation, consumer electronics, toys, apparel and self-assembly personal computers (ABN-AMRO, 1999). A major consequence is the closing down of retail outlets or service offices at the lowest level. In financial services, known for the use of a wide range of electronic devices in routine transactions, we have seen a closing down of local offices by 21% in the past seven years (Table 4). This implication is also true for travel agencies, book shops, music shops, and employment agencies. However, it must be noted that the contraction at the lowest leve1 of

services can partly also be ascribed to processes of rationalisation following mergers and acquisition.

A true customer-driven system means that risk and inventory can be removed from the system, leading to particular cost reductions. The changes in logistic organisation and transport are not known to date but what stands clear is an increase in the number of trips and of the distances involved, as well as changing roles of distribution centres. A major point of attention is to improve customer delivery.

Customer Services

The second development – an increased supply of customer services – is also evident in a number of chains. These services are based on personal face-to-face contact and physical presence of consumers. Pre-sales for example, deals with customer specific advice and user information. For particular goods, it is necessary that consumers touch, feel and test the product, or merely enjoy the atmosphere (the so-called "shopping experience"). It is plausible that such services can only be provided at higher levels than the local. In the United States electronic banks make 65 to 70% less costs than existing "brick and mortar" banks, meaning that they can supply services at cheaper rates. Accordingly, "brick and mortar" banks feel the need to preserve the loyalty of their clients and supply custom-made services based on a deep knowledge of the clients' profile. Thus, the financial sector shows the rise of meeting places between banker and client at the regional level. The rise of regional bank offices with extended personal services can be seen as a kind of "compensation" for the loss of face-to-face contact at the lowest level.

Desintermediation and Re-intermediation

Desintermediation often occurs at the end of the value chain, but in some chains a whole range of intermediaries may disappear. This is the case if music players or writers (poets) sent their work directly to customers, thereby circumventing producers, wholesale and retail. In other chains one may observe the disappearance of physical intermediaries like auctions and purchasing agents, as well as the joining of virtual intermediaries. Internet business-to-business auctions are meant to purchase globally at cheapest rates. Some firms have established vertically oriented sites, like Genera1 Motors and Ford for car components and Boeing for aircraft components. The disappearance of physical segments of the value chain

may cause a decrease of importance of cities as meeting places, trade- and transaction centres, and may concomitantly lead to a reduction of the traffic concemed.

In financial services and many other chains one observes the emergence of virtual intermediaries that support consumers in information gathering and processing, e.g. in the process of selecting products and services, and in connecting with selected suppliers. The rise of these "infomediaries" is typical for Internet because of the abundant and open information supply. Infomedairies may also – if neutral – verify the identity of buyers and sellers, and certify crucial information transfer (Saanen et al., 1999). It seems that the function of cities as meeting and information places for routine and less complex matter may be taken over by all kind of virtual intermediaries. However, at the same time it seems that new types of physical meeting and information centres will arise in close interaction with electronic ones, maybe with a lower frequency than previously but with the important role to make electronic meetings and information handling run smoothly. Thus, face-to-face contact and telecommunication seem inextricably intertwined (Mitchell, 1999).

Emergence of E-firms

The rise of e-firms can be observed in many value chains. These firms not only save substantial costs of retail outlets, inventory and personnel, but they may cover the entire world as their market area. However, substantial entry barriers arise in situations where "first movers" have established market positions, trade marks and customer relations. Thus, entry barriers of followers consist of considerable costs of marketing in order to attract the attention of customers. It is not easy to assess the impact of these developments on the function of cities and transport and traffic; this is the more true because many new initiatives of e-firms are not successful. In any case, we may expect some blurring of the centra1 place structure with more diffise market relations and thinner good flows. In addition, what might happen is that established firms – by co-operating with e-firms and establishing e-firms by themselves – strengthen their position, particularly those firms located in certain large and medium-sized towns because they enjoy particular agglomeration economies available here.

Innovation

An important answer to the increased competition from e-activity is innovation. We expect that what is indicated above for the rise of e-firms also holds true for innovative activities of established firms. Given the previously discussed constraints in tacit and contextual

communication one may draw the conclusion that large cities and some smaller ones *remain* the seedbed of innovations. These cities are not only connected with the fastest telecommunication grids in the world, they also host a reservoir of specialised knowledge workers serving complex data-processing and application (Glaeser, 1998). This situation seems also true for the function of cities as headquarter centres. If we take Amsterdam as an example for headquarter activity in the financial services chain, there seems to be a consolidation in the past years (Table 4). The number of jobs has increased, but the share in the nationai total has remained the same. What is remarkable is a slight decrease of the share in all headquarters in the Netherlands. An in-depth analysis however, shows that this decrease can be partly attributed to a withdrawal of foreign banks due to internal reorganisation (van Geenhuizen and van der Knaap, 1998). The latter observation shows that urban functions are also subject to other influences than ICT and the e-economy, and these are difficult to disentangle.

Table 4 Indicators for spatial dynamics in financial services in The Netherlands

Local and regional level (a)	**1991**	**1998**	**Change**
Number of retail offices	3971	3140	- 20.9%
Number of offices including special customer services	93 (b)	247	+ 165.6%
Amsterdam			
Number of jobs (x1000)	44,6	51,5	+ 15.5%
Share of jobs in national total (%)	22,6	22,3	+/-
Share of headquarters (%)	61,5	55,0	- 6.5%

(a) Data for retail offices derived from the three largest banks in NL, data for higher leve1 offices derived from ABN-AMRO and ING.
(b) 1988
Bron: van Geenhuizen, 2000.

Flexibility of Work Locations

Already for some years, the use of electronic communication has enabled employees to perform working tasks at home that would otherwise be performed in the working place (telework). It seems that there is only a partial substitution, based upon a couple of social-psychological reasons, like the need for social contacts in the workplace and the need for a certain travel time (to "disconnect" from home and work) (Salomon, 2000). A relatively new development is the establishment of telecentres (or "flex-offices") at the edge of agglomerations, where employees from different firms work by connecting themselves electronically with their headquarters. These developments seem to lead to a reduction in the

nurnber of cotnrnuting trips and a reduction in average distance. However, there is hardly any knowledge of the secondary impacts, although these may be as important as the primary ones for the function of cities. It is plausible that a reduction in the nurnber and distances of commuting trips causes a relocation of living places at larger distances from the city centre, thus increasing suburbanisation over larger areas.

Table 5 Impacts on urban functions and transport

Value chain changes	Urban functions	Transport and traffic	Uncertainty (a) Direction	Magnitude
Pull by customers	Decrease of role as a node in distribution	More trips and higher frequency	+	+
	Decrease of retail function and other services at the lowest (local) leve1	Decrease of customer trips on level of living quarters and smal1 centres		+
Customer management and services	Increase of retail and other services at higher (regional) leve1	Increase of customer trips at higher levels (sub-centres in cities and medium-sized towns)		+
Desintermediation (elimination of physical markets, auctions, etc)	Decrease of trade and transaction centre fünction at different levels	Decrease of trips for trade and transactions at different levels (see also 1)	+	++
Ze-intermediation (insertion of virtual intermediaries)	Some loss of function of meeting and information place but new forms	Some decrease of trips to city centre or sub-centre for meetings and information	++	++
Emergence of e-firms with global markets and of global e-webs	Blurring of the centra1 place system (urban hierarchy)	More dispersed flow of customer trips, good supply, and work trips		++
		Adjustment of global logistic chains	++	++
Increased innovation	Remaining strong incubation function of large cities, and some medium-sized ones	No change	+	+
Iilexibility of work locations	Partial loss of work fnnction by centra1 city, and gain by edge	Less and on average shorter commuting trips Less focus on centra1 city		+
	Maybe spread of living fùnction	On average longer trips	+	++

a. • + small; + = considerable; ++ = large

6. Uncertainty

If one thing stands clear it is that the pattem of impacts of the e-economy on cities is highly differentiated, both with regard to urban functions and with regard to the spatial scale level. In addition, the images and expectations of changing urban functions and transport and traffic indicated in the previous sections are by no means certain, and this holds both for the direction of the impacts and their magnitude. Four changes are relatively clear in terms of direction. These are a decrease of retail activity at the lowest level, increase of customer services at higher levels, a blurring of the market function (centra1 place), and a loss of workplaces in city centres. High uncertainty – both in terms of direction and magnitude – exists with regard to impacts of new (information) intermediaries and impacts of e-firms and e-webs of production. Traditional meeting place and relatively simple information supply functions may disappear from the cities. However, new physical meeting places - closely related with electronic networks and clubs - may arise but these are largely unknown to date. Also largely unknown are the impacts from the reorganisation of global logistic chains on cities as nodes.

Uncertainty sterns from various sources, i.e. the complexity of urban reality, the lack of knowledge about new ICTs and about the direct and indirect impacts that unfold after different times. In addition, interest groups respond quickly to new opportunities partly in a fashionable way, but they may also easily shift attention. This turbulence increases complexity, particularly in terms of policy-making. Another point that needs to be kept in mind is that the available knowledge is fragmented and not achieved in a co-ordinated way. In this context we can identify the following knowledge gaps:

- The pace of the changes; to what extent are physical (infra)structures or ongoing developments working as impediments to change, or as catalysts or movers of change?
- The comprehensiveness of the changes; are the impacts general, or specific for particular value chains?
- The causal background of the changes; to what extent are particular adjustments in the value chain caused by ICTs and the e-economy or by other (autonomous) organisational changes with similar impacts?
- The nature of indirect effects on the city, and the different time-scales involved.

This situation of important unanswered questions has two implications for ICT policy and for urban policy at different levels. First, there is a need for increased research and experimentation efforts, and a better co-ordination of these efforts. Secondly, the manifold uncertainty needs to be dealt with in policy-making, and one important way for this is the design of flexible policies that can be adapted in time. An adaptation of once chosen policy lines is needed if actual developments turn out to be different from expected ones and new results from research and leaming experiments become available.

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