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**THE E-ECONOMY AND THE FUNCTION OF CITIES AS NODES IN
TRANSPORT AND COMMUNICATION: TOWARDS A RESEARCH
AGENDA**

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Abstract

The comprehensive use of information and communication technology (ICT) leads to structural changes in our economy and society. The changes embrace not only a faster and denser communication but also a reorganisation of value chains, firms' structures, and labour relations, with concomitant impacts on the function of cities. The aim of the paper is to identify and discuss actual and potential impacts on urban functions and transport patterns at different spatial levels. A scan of the literature serves this purpose and this includes attention for customer driven production, customer services, desintermediation and re-intermediation, the emergence of e-firms, and flexibility of work places. A special focus is on different modes of communication and forms of knowledge, and on concomitant constraints in electronic communication. The paper concludes with various hypotheses and a list of research questions.

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1. Introduction

Communication in daily business activity involves a continuous evaluation, selection and combination of communication modes (Table 1). Two dimensions may be distinguished, i.e. the time dimension in terms of synchronous and asynchronous contact, and the spatial dimension in terms of local and distributed contact, leading to four different modes. All modes seem to have their appropriate roles, leading to choices dependent on the needs and willingness to pay the associated costs in a particular context (Mitchell, 1999).

Table 1 Communication modes

	Synchronous	Asynchronous
Local	Requires transport Requires co-ordination Gives 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 Is limited to particular communication Very low costs

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

In general there has been a move towards the very low cost, distributed asynchronous quadrant in the past decade, illustrated by e-mail, and there has been an increase in potentials of distributed, synchronous modes, such as in teleconferencing. In most interaction, however, there is a combination of modes, like in decision-making by global virtual teams. From experiences in geographically distributed decision-making, the conclusion can be drawn that important decision-making can be undertaken by using electronic devices but that a need remains 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).

The use of information- and communication technology (ICT) in commercial transactions and work 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. An explanation of the popularity

of Internet and e-commerce can be found in network externality theory (e.g. Katz and Shapiro 1985; Capello, 1994; Economides, 1996). The positive network effects include increasing returns and first-mover advantages. In addition, various critical transaction and co-ordination advantages can be observed (e.g. Wigand, 1997). The aim of this paper is to explore actual and potential adjustments in value chains linked with the use of new ICT and internet, and concomitant repercussions for the function of cities as nodes for transport and communication. The aim is also to identify major knowledge gaps.

2. Knowledge and Electronic Communication

When considering opportunities and constraints of electronic communication it is common practice to distinguish between codified knowledge and tacit knowledge. Contextual communication has been added as a separate class more recently (Bolisani 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 (Table 2). 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.

Table 2 Types of communication and their characteristics

	Codified	Tacit	Contextual
Content	Objective knowledge in facts, figures, formulas	Subjective knowledge connected with ideas, perceptions and personal experience	Subjective knowledge about perspectives and interpretative frameworks
Environment	Within and between organisations	Mainly within organisations and between organisations that 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
Background of transfer	Planned	Often by chance	Planned, but without pre-defined aim

The third type, contextual communication, differs from the previous ones in terms of the aim of communication, namely transfer (exchange) of new meanings and new interpretative frameworks. There is a concomitant need to avoid predefined methods and outcomes etc. in communication that basically serves a long term process of interactive learning. The crucial question is to what extent these three types of communication can be carried out electronically (with sufficient cost savings), particularly whether there is substitution of face-to-face communication by electronic communication or complementarity between the two types of communication.

Table 3 Types of communication, success factors and constraints in electronic transfer

	Codified	Tacit	Contextual
Success factors	Uniformity 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, richness of form and content
Constraints in electronic transfer	<i>Few</i> In EDI a shortage of formalisation of communication	<i>Substantial</i> <ul style="list-style-type: none"> • 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 	<i>Structural</i> <ul style="list-style-type: none"> • Frustration of basic needs: continuous real-time interaction, broad range of information without pre-defined language, variety of means • 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 (Table 3). 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 the use of an interpretative framework are critical success factors, and these can only be established and maintained in face-to-face communication, like in the case of the above indicated decision-making by global virtual teams.

Two approaches to deal with the specificity of tacit knowledge transfer, i.e. the use of intelligent agents and multimedia using interactive tools, have led to important progress - in fact by codification - but still suffer from serious shortcomings (Table 3). 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 only partly enable 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 defined, i.e. the aim of communication and the means (channels). The communication is a long-term interactive process using a great variety of means and content.

We may conclude that there are still substantial barriers in electronic communication of tacit knowledge, despite some progress in codification, and that barriers in electronic communication of contextual knowledge are insurmountable. Furthermore, the question of substitution is complicated due to the use of combinations of communication modes.

3. A Broad Set of Changes

The current 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). There has been quite some speculation about the spatial impacts of this transformation, in particular the impacts on cities. Two extreme scenarios and one moderate scenario have been developed in this respect. In the first, extreme, scenario it is emphasised that modern ICT enables 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 this situation of the “death of distance”, place and location no longer matter in interaction and, as a consequence, large cities weaken their hold over economic and social life (Cairncross, 1997). The basic hypothesis here is the ubiquitous access of firms and households to fast

telecommunication networks. The other extreme scenario says that large cities strengthen their position at the expense of smaller ones. This is based on the recognition of the role of large corporations in decision-making in the global economic system and the fact that their 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, and access is available to the fastest global electronic networks (see e.g. Gillespie and Williams, 1988; Graham and Marvin, 1996; Sassen, 1996). ICT helps 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 underpinning agglomeration under the influence of ICT. First, the use of ICT has enabled flexible specialisation. This development has stimulated 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 knowledge workers present here (e.g. Duranton, 1999). The local linkages of these workers are reinforced by an increasing demand for fast establishment of face-to-face contacts in high-density knowledge transfer with customers and suppliers of services. A third argument in favour of agglomeration is based on 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 increasingly acts as a counterbalance against the impersonal and straightforward nature of electronic communication.

In the third scenario the possibility of access of various selected medium-sized towns and smaller settlements to global decision-making networks is recognised. In this vision ICT has no deterministic impacts but works through the way in which it is “constructed” in society. Socio-economic actions influence the application of the new technology and may change its impacts over time. The relation between the development of cities and the use of ICT is thus 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 future of cities is the more interesting because a general trend for spatial dispersal has been identified recently Europe (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 so far to certain agglomeration diseconomies (Manshanden et al., 2000). The key issue in the context of the economy is whether the concomitant changes reinforce ongoing trends of spatial dispersal, or weaken them.

4. Types of Value Chains and Adjustment

In this section we focus on adjustments in the value chain in terms of needs for physical transport (goods and/or persons) and potentials of electronic communication. In order to differentiate between value chains or parts of them in this context we use a matrix based on two dimensions (e.g. Kenney and Curry, 2001):

- Physical aspect. This differentiates between chains (segments) including delivery of physical products, services applied to the customers' body, and activity in need for (regular) face-to-face communication on one side, and chains of electronic goods and services without any physical aspect on the other side.
- Main types of knowledge. This differentiates between chains (segments) dominated by the use of codified knowledge that is easily transmitted electronically, and those segments where tacit and contextual knowledge play an important role and remain so far mainly limited to face-to-face communication.

Table 4 A typology of chains and segments of chains

	Tacit and Contextual Knowledge	Codified Knowledge
Physical Aspect	<ul style="list-style-type: none"> ▪ Innovative manufacturing ▪ (Advanced) body-based services like medical treatment ▪ Advanced services and advanced co-ordination 	<ul style="list-style-type: none"> ▪ EDI-based manufacturing, like cars and electronics ▪ Electronic commerce of physical goods (books, CD's, etc.)
No Physical Aspect	--	<ul style="list-style-type: none"> ▪ Services, like routine banking, brokerage, job intermediation, music and images

Accordingly, chains in the right hand-side lower box lend themselves most to electronic transmission, leading to the elimination of physical chain segments (desintermediation) and reducing the need for physical transport for goods and persons. If this desintermediation deals with activities located in cities (nodes), there will be a loss of activity here, unless there is compensation in new (renewed) physical segments.

In the next section this phenomenon will be placed in a broader context, including the increasing customer driven production and growing customer services, the emergence of e-firms, and the so-far typical urban functions of innovation and advanced co-ordination.

5. Cities as Nodes of Transport and Communication

There is an increased customer-driven production, and this needs to be seen in the context of mass-individualisation. E-commerce matches the latter development because there are many opportunities for selection and price-reduction of goods and services, for example using “co-buying”. Consumers may scan offerings world-wide and negotiate prices using intelligent agents. Accordingly, consumers may select unique packages of products and services. This development is true for financial services, books, music, travel services, job intermediation services, consumer electronics, toys, apparel and self-assembly personal computers (ABN-AMRO, 1999). A major consequence is the closing down of retail outlets and service offices at the lowest level of transactions (Table 5). With regard to financial services, known for the use of a wide range of electronic devices, we have seen a closing down of local offices in the Netherlands by 21% in the past seven years (van Geenhuizen and Nijkamp, 2001). Note that such a contraction can also partly be ascribed to rationalisation following a wave of mergers and acquisition. Another point is that a true customer-driven system in goods chains means that risk and inventory, such as of books and computer components, can be removed from the system. The concomitant changes in logistic organisation and transport are not well-known to date but what seems 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 which may lead to new types of logistic networks and nodes at the end of the chain.

The second development – an increased supply of customer services – is also evident in a number of chains. Customer services are often based on personal face-to-face contact and

physical presence of consumers. Pre-sales for example, deals with customer specific advice and user information.

Table 5 Impacts on urban functions and transport

Value chain changes	Urban functions	Transport	Uncertainty (a) Direction Magnitude	
Customer driven production	Decrease of role as a node in distribution	More trips and higher frequency	+	+
	Decrease of retail function and other services at the lowest (local) level	Decrease of customer trips on level of living quarters and small centres	-	+
Customer management and services	Increase of retail (other) services at higher (regional) level	Increase of customer trips at level of sub-centres and medium-sized towns	-	+
Desintermediation (elimination of physical markets, auctions, etc)	Decrease of trade and transaction centre function at different levels	Decrease of trips for trade and transactions at different levels	+	++
Re-intermediation (insertion of virtual business-to-business 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	++	++
	Dispersal of production due to increased global outsourcing etc.	Increased distances	+/-	++
Emergence of e-firms active in global markets	Blurring of the central place system (urban hierarchy), except for upper level	More dispersed flow of customer trips, work trips and goods	-	++
Innovative activity and advanced management	Remaining strong role of large cities, and some medium-sized ones	No change	+	+
Flexibility of work locations	Partial loss of work function by central city, and gain by edge and suburbs	Less commuting trips (home-based telework) and on average shorter trips (centre-based telework). Smaller focus on central city	-	+
	Maybe spread of living function as secondary effect	On average longer trips	+	++

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

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 in nodes (cities) at a higher level than the local. We may illustrate this with financial services. Electronic banks make 65 to 70% less costs than existing “brick and mortar” banks (Westland and Clark, 1999), meaning that they supply services at cheaper rates and capture customers from “brick and mortar banks”. In this competitive environment, “brick and mortar” banks feel the need to preserve the loyalty of their clients and supply custom-made services based on a thorough knowledge of their clients’ profile. In the past years therefore, places have been established where banker and clients meet, often in offices 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 local level.

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 of music players or writers (poets) sending their work directly to customers, thereby circumventing producers, wholesale and retail. In other chains one may observe the disappearance of physical sections like markets and purchasing agents, and the insertion of new, virtual sections in the chain. Internet business-to-business auctions are meant to purchase globally at cheapest rates. Some firms have established vertically oriented sites, like General Motors and Ford for car components and Boeing for aircraft components. There seem to be two impacts here. First, 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 concerned. Secondly, by using electronic auctions the cheapest producers (suppliers) are identified and contracted on a global scale. This may lead to an increase of the distances over which goods (components) need to be transported. The latter impact, of course, does not apply to services like financial services. Here one may observe the emergence of virtual intermediaries that support consumers in information gathering and processing, e.g. in the process of selecting products (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 may be that the function of cities as meeting and information places and places to create trust in less complex matter will be partly taken over by 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, with the important role to make electronic meetings and information handling run smoothly. For example, communities of interest established through the Internet may run better if regular personal meetings are organised to create new impetus for electronic interaction. Face-to-face contact and electronic communication seem inextricably intertwined (Mitchell, 1999).

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. They have limited needs for physical location, allowing them to be relatively footloose. However, so far only a few e-firms are successful in surviving. One of the causes of this phenomenon is that substantial entry barriers arise for followers, where “first movers” have already established market positions, trade marks and customer relations, i.e. considerable costs of marketing. It is not easy to assess the impact of these developments on the function of cities and transport and traffic. In any case, we may expect some blurring of the central place structure with more diffuse market relations and thinner flows of goods. In addition, what may happen is that established “brick and mortar” firms – by co-operating with e-firms and establishing Internet activity by themselves – strengthen their position. Firms located in certain large and medium-sized towns may be ahead in these developments because they enjoy agglomeration and information economies available here.

The above assumptions touch upon the future innovation and advanced co-ordination function of cities. One may draw the conclusion that large cities and some medium-sized towns remain attractive as a location of such functions, given opportunities for face-to-face contacts, a quick access to the richest electronic information in these places, and a reservoir of specialised knowledge workers serving complex data-processing and application (Glaeser, 1998). If we take the development of Amsterdam as a financial centre as an example, there seems to be a trend for concentration, although this is not evident in all respects (van Geenhuizen, 2001). The number of jobs in Amsterdam has increased, but the share in the national total has remained the same. Further, there is a small trend for dispersal of headquarter activity in The Netherlands, given a decrease in the share of all headquarters in the country, but there is a clear trend for concentration when taking the size of the banks into account. There has been an increase in the share in the national balance sheet total in Amsterdam of more than 10 percent in the last decade.

In the e-economy, work relations are becoming more flexible, including the location of the working place. One may think of a variety of alternative work locations, including the home, a telecentre, a vehicle, a client's office, a hotel room, a virtual drop-in office, and so on. The discussion here will focus on two common forms, i.e. home-based and centre-based telecommuting. 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 (named telework or home-based telecommuting). It seems that there is only a partial substitution, based upon a couple of reasons. We mention the need for social contacts in the workplace, the need for a certain travel time to "disconnect" from home and work, and the need for face-to-face working contacts (Mokhtarian and Bagley, 2000; Salomon, 2000). With regard to the latter argument, it is reasonable that in chain segments that include management tasks and creative exchanges of ideas, only a partial substitution of physical meetings and travel can be expected. Some disadvantages of home-based telecommuting are avoided in a second type of telecommuting, i.e. the centre-based form. In this telecommuting employees make use of conventionally-equipped offices at the edge of agglomerations or suburban centres ("flex-offices"), leased by the firm, where they connect themselves electronically to the firm and its clients and other relations. This telecommuting is still in a stage of experimentation in which success in terms of achieving economic self-sustainability remains questionable (Mokhtarian and Bagley, 2000). With regard to transport, we may say that a partial substitution of the home-work trip (home-based telecommuting) and shorter home-work trips (centre-based telecommuting) altogether cause a substantial reduction of commuter traffic. There are also secondary impacts to be expected, which may be as important as the primary ones. The reduction of the number of commuting trips and average distances involved enhances the attraction of living places at a larger distance from the city centre, thus increasing suburbanization over larger areas. However, such secondary effects have not yet been observed systematically because these occur with a time-lag.

6. Towards a Transatlantic Research Agenda

It stands clear that the impacts of the e-economy on cities are highly differentiated, with regard to the type of urban functions and the spatial scale level involved, the latter including central cities, edge cities, small villages within city-regions, etc. This differentiation is mainly based on diverse patterns of substitution of physical interaction between persons by electronic communication and on different needs for combinations of communication modes. There is

also differentiation in uncertainty surrounding the images of changes in urban functions, in terms of the direction and magnitude of these changes. Five changes seem relatively clear in terms of direction, based upon the increased use of electronic communication and e-commerce, particularly their “distance-shrinking” effects, but also the concomitant need for compensation. These are presented here as rather broadly stated hypotheses that need to be elaborated and tested in further research:

- 1) Business-to-consumer e-commerce leads to erosion of urban nodes at the lowest (local) level and this leads to compensation at a higher level of urban nodes.
- 2) Business-to-business e-commerce opens up global markets, leading to a dispersal of production activity, reorganisation of logistic chains and erosion of urban nodes.
- 3) The emergence of e-firms, active on global consumer markets, leads to a blurring of the central place system and concomitant transport patterns.
- 4) Telecommuting leads to a partial dispersal of work to the edge of cities and to suburban places causing a decrease in the role of cities as nodes in transport.

High uncertainty – in terms of direction and/or magnitude – exists with regard to the impacts of elimination of physical markets (auctions) and insertion of new (information) intermediaries in the city. Traditional meetings and relatively simple information supply 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 (Mitchell, 1999). In addition, important secondary effects of telecommuting in terms of related changes in the location of living places are highly uncertain.

Uncertainty stems from various sources, i.e. the complexity of urban reality, the lack of knowledge about new forms of ICT, 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. The latter turbulence increases complexity, particularly in terms of policy-making. Another point that needs to be kept in mind is that the available knowledge is highly *fragmented* and not achieved in a co-ordinated way. This situation of important unanswered questions has two implications for urban policy. 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 of doing this is the design of flexible policies that can

be adapted in time if new empirical evidence or results from experimentation (simulation) urge adaptation. Of course, such policies need to match with the policy traditions in the countries and regions involved (Stough and Rietveld, 1997).

The previous analysis has led to the identification of the following broad knowledge gaps to be addressed in a transatlantic research agenda:

- **Communication technology:** the extent to which tacit knowledge can be codified and transmitted electronically in the near future and how this may influence communication in chains. Are expectations in the US different from those in Europe?
- **Nature of the changes** and their spatial impacts: the extent to which physical chain segments are eliminated, replaced by virtual segments or new physical segments, and the impacts of these changes on the spatial structure of chains, particularly regarding concentration in or spread from cities. An important concept is footloose: what is it and to what extent do firms become footloose? The nature of *indirect* effects on cities and the different time-scales involved are also widely unknown. Are changes different in nature in the US compared with Europe?
- **Comprehensiveness of the changes:** are the changes and impacts general or are these specific for particular chains (segments), like electronic goods and services based on codified knowledge? How relevant are the dimensions physical aspect and type of knowledge in this respect? Are the changes more comprehensive in the US compared with Europe?
- **Causal background:** to what extent are e.g. physical (infra)structures or ongoing institutional developments working as impediments to change, or as catalysts or movers of change? Are there any differences between the US and Europe in such factors?
- **Causal relationship with e-economy:** to what extent are adjustments in the chains caused by ICT and the e-economy, or by (autonomous) organisational changes with similar impacts, like contraction following mergers and acquisition?
- **Policy context:** what design rules in urban policy-making can be given to improve the anticipation for changes in the function of cities as nodes of transport and communication? In what respect would such rules be different for conditions in the US compared with Europe?

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