Ann Reg Sci (2009) 43:879–896
DOI 10.1007/s00168-009-0298-3

SPECIAL ISSUE PAPER

Place-bound versus footloose firms: wiring metropolitan areas in a policy context

Marina van Geenhuizen · Peter Nijkamp

Received: 16 June 2008 / Accepted: 3 March 2009 / Published online: 3 April 2009

Abstract In the development of modern urban systems, we are facing a shift from central cities as the major location of coordination functions, high-order services and innovative activities, to interconnected nodes at some distance in a larger metropolitan area. However, which cities in the emerging new spatial constellation qualify to become such a node is not yet clear, and depends also on the organizing capacity of the municipalities involved. This article addresses spread over a larger metropolitan area from the point of view of place-bound versus footloose behavior of young, innovative firms as the drivers of economic renewal. A theoretical review of location needs and footlooseness is followed by an empirical contribution to identify whether increased footlooseness of such companies is emerging in the Netherlands. The results prompt the need for a more thorough reflection on related policy issues. The policy part of the article addresses in particular some evolutionary views to understand why urban policymaking is subject to various systemic constraints, while next some empirical results on weaknesses in the urban organizing capacity to benefit from a shift towards a global metropolitan area are highlighted. In this context, we focus the attention specifically on policies dealing with information and communication technology and the uncertainty at hand.

JEL Classification D21 · O32 · R58

M. van Geenhuizen (✉)
Faculty of Technology, Policy and Management, OTB Research Institute,
Delft University of Technology, P.O. Box 5015, 2600 GA Delft, The Netherlands
e-mail: m.s.vangeenhuizen@tudelft.nl

P. Nijkamp
Faculty of Economics, Free University, De Boelelaan 1105,
1081 HV Amsterdam, The Netherlands
e-mail: pnijkamp@feweb.vu.nl

1 Modern cities in perspective

Cities are fireplaces of economic, social and political forces (see Capello and Nijkamp 2005). They show strong and rapid dynamics in all regions of our world with a significant change in traditional role functions. As Sassen (1991) pointed out, today's world cities are concentrating on (1) strategic command points in the organization of the world economy, (2) key locations and marketplaces for the leading industries of the modern age (e.g., finance and specialized producer services), and (3) major sites of production for these industries, including the production of innovations. Sassen (2002) also argued that the concept of centrality—in the core of the world cities' development in the past decades usually associated with the central business district (CBD)—increasingly refers nowadays to a larger geographical scale, like central cities and a grid of nodes of high level business activity spread over a larger metropolitan area, raising new questions on urban competitiveness and sustainability (for example, Le Galès 2006).

There is an abundance of literature that suggests that modern information and communication technologies (ICTs) increasingly act as connecting technologies through which world cities can extend their action radius all over the world, as 'global command centers'. World cities have clearly reinforced their position as global nodes in electronic grids as is witnessed by the spatial clustering of advanced telecommunication services and infrastructure in various urban areas, as measured e.g., by bandwidth, collocation, switches and grid accessibility, but some smaller cities may have jumped forward (e.g., Gorman and McIntee 2003; Graham 1999; O'Kelly and Grubesic 2002; Townsend 2001). ICTs are not only a primary "connector" between world cities and their command regions, but as new technologies also provide the base for new and innovative companies in the metropolitan economy, aside from other high-tech sectors and various combinations of them. As such these technologies constitute a permanent source of renewal for the metropolitan economy and—in later stages of technology development and diffusion—for various parts of the global economy. In addition, the application of ICT may help to improve transport in cities, not only in terms of improving the flow, but also increasing the safety (Black and van Geenhuizen 2006; Wolf 2006), improve safety in public places and assist cities in making decisions (e-governance), all contributing to a stronger competitiveness.

Against the background of the emergence of new companies (sectors) and of underlying strong agglomeration economies, there is an increasing claim by several researchers that a substantial spread of innovative economic activity from merely the traditional central city (or central cities) to a larger metropolitan area is taking place (e.g., van Oort and Stam 2005; Sohn 2004). Although there are no conclusive empirical studies that confirm this development as a universal trend, it seems that the spread is both contagious (into adjacent areas) and agglomerated (in larger nodes here). Such a development would also be in agreement with the edge city hypothesis (see Garreau 1991; Haynes and Stough 1999).

With regard to the type of economic activity concerned, some researchers such as Sassen (2000) and Taylor et al. (2002) place much emphasis on advanced business services development as the prime driver of world city development, whereas Scott (1988) and others place more emphasis on manufacturing. In this article, we

include both advanced services and manufacturing, because information processing and the conversion of information outcomes into new strategies are the key activities determining effectiveness and productivity of all steps in complex value chains. Accordingly, this article seeks to contribute to the world cities debate by addressing the pattern of spread of innovative manufacturing and service activity within extended world cities and by addressing ways in which medium-sized nodes deal with the new opportunities in policymaking, using a blend of both the theoretical and empirical arguments.

Processes of geographic spread—be it on a hierarchical basis or on the basis of specialization and complementarity—prompt local policymakers to develop new strategies that anticipate such new opportunities and threats (Musterd et al. 2004; Haynes 2006). Whether the cities involved may be able to maintain their initial position (or fail to adjust themselves to new situations) and fall back for a longer time, is largely dependent on effective visionary strategies and organizational capacity of local policymakers, and on the institutional setting. For example, the related institutionalized decision structure is important because continuing investment, management and taxing decisions concerning urban infrastructures and services are taking place within this structure and set the incentive pattern for expectations of individuals, companies and other organizations.

From an evolutionary perspective, policymaking organizations are often facing path-dependency brought about by the existing city structure and institutional rigidities, implying that the scope of policy options to decide upon is narrowed down by particular decisions taken in the past and by related limited views on the cities' development (see for similar situations in regional economic policy, Lambooy and Boschma 2001). The nature of uncertainty in the policy field concerned also plays a major role. Some types of uncertainty can be dealt with ease, while others like impacts on the urban economy as a result of unmanageable external factors and specific city circumstances are more difficult to deal with (van Geenhuizen and Thissen 2002; Haynes 2006). There is not much knowledge about how path-dependency manifests itself in early stages and how it can be prevented in time (for example, Dormois et al. 2005; van Twist et al. 2004). This observation demands for more exploratory research.

In this article, we address the above-mentioned issues in the context of large and medium-sized cities in the Netherlands through the following two questions:

1. To what extent can an increase be observed in footlooseness in metropolitan areas among young innovative entrepreneurs and which location constraints do still remain? Which factors determine differences in footlooseness?
2. How did the quality of urban policymaking on ICT in the recent past impact on these developments and what can be learned to improve the organizational capacity in order to better respond to the new opportunities of world city development?

The structure of this article is as follows. First, we reflect concisely on theory that can help us to understand the location behavior of young, innovative entrepreneurs (Sect. 2). Second, we present the outcomes of an empirical investigation among young, innovative firms to explore whether footlooseness is increasing and location constraints still hold in the larger urban area in the Netherlands (Sect. 3). Third, in a policy section, we review evolutionary theory to increase an understanding of some

limitations in urban policymaking (Sect. 4) and then, we discuss various shortcomings in recent urban ICT policymaking (Sect. 5). The paper concludes with a summary and some recommendations to improve the effectiveness of policymaking.

2 Agglomeration advantages and footlooseness

In this section, we review concisely some theoretical views that may shed light on advantages of agglomeration in business life in large cities. These are derived from: (1) agglomeration theory and the related spatial cluster approach dealing with the supply side of cities as places of location, and (2) resource-based theory addressing the needs of companies for specific resources.

Following the tradition of Marshall—already established in the late 19th and early 20th century—a strong emphasis is placed on location benefits in large cities derived from agglomeration economies and supply side externalities. The former include benefits from easier access to, and reduced costs of, certain collective resources. The latter include positive externalities covering inputs from local supplier industries, labor-market pooling and knowledge spillovers. In a more recent version, Duranton and Puga (2003) identify cooperation and sharing (of indivisibilities, variety, specialization and risk) as the leading benefits. A second major view in agglomeration theory and related cluster approaches puts an emphasis on the role of knowledge and learning processes based on the local flows of sticky tacit knowledge and an abundant availability of knowledge workers in the labor market (Acs 2002). Spatial concentration of activities, involving spatial and social proximity, increases the opportunities for interaction and knowledge transfer, and the resulting spillover effects reduce the cost of obtaining and processing new knowledge. In addition, knowledge workers preferably interact with each other in agglomerated environments to reduce interaction costs, and they are more productive in such environments (Florida 2002). Some authors claim that knowledge spills over more easily between similar economic sectors—hence in the case of regional specialization—because the knowledge is highly industry-specific (Arrow 1962; Romer 1986; Henderson et al. 1995). Others claim instead that a certain diversity contributes to knowledge spillovers (e.g., Jacobs 1969; Glaeser et al. 1992). In addition to this, attention has been more recently drawn to the advantages of large cities in providing local access to *global* knowledge—be it with specialized research laboratories or with customers or suppliers abroad—as a significant factor in the competitive advantage of metropolitan areas (Bathelt et al. 2004; Simmie 2003). This knowledge transfer or interaction may use telecommunication (e-science), particularly in processing large, distributed databases across the globe (data-mining, monitoring, etc.). It may also work by personal visits using high-speed connections by air.

From the above spectrum of views, we may argue that cities are the cradle of new and innovative industries. Companies in the early stages of the product and company lifecycle—when dealing with a great deal of uncertainty—prefer locations where new and specialized knowledge is abundantly available for free (e.g., Audretsch 1998; Camagni 1991). It is also widely recognised that the spatial radius of knowledge spillovers may be limited because of geographic barriers, e.g., a daily activity system where people meet easily and where people change jobs in their careers, or a smaller system

such as quarters in a central business district or university premises where people see each other by chance (e.g., Rosenthal and Strange 2001).

However, the need for spatial proximity to enjoy knowledge spillovers seems at odds with the impacts of the recent telecommunication revolution; i.e. the costs of electronic communication have drastically declined, and advanced ICTs allow for long-distance contacts such as videoconferencing, data-mining, virtual design, computer-assisted decision-making, etc. In this context, it is often claimed that companies become more footloose caused by fewer limitations from location constraints of information advantages. The solution for this paradox on localisation of knowledge spillovers seems to be in the type of knowledge concerned (Howells 2002). On the one side, there is codified knowledge (partly just information) that can easily circulate electronically, like prices determined at a stock exchange and statistical data. On the other, there is tacit knowledge and its context, and these are critical in innovation processes. These types of knowledge are vague and difficult to codify and, accordingly, spread mainly through face-to-face contacts of the persons involved. More precisely, tacit knowledge is transferred through observation, interactive participation and practice. Knowledge about context is achieved through longstanding and interactive learning, often in relatively open (unstructured) processes requiring a co-location of the partners involved, be-it permanent or temporary but on a regular basis (Bolisani and Scarso 2000).

According to resource-dependence views, the success of companies in generating profits depends on their capabilities to create opportunities for profit-making and to make resources available, including resources in their local production environment (e.g., Barney 1991), like knowledge, capital and networks. The growth of companies is constrained if there is a shortage or weakness in the available resources, or in the capability to mobilize or generate adequate resources. Young, innovative companies have strong needs for new knowledge, i.e., knowledge about the technology concerned and knowledge to deal with the market (including that for capital), but they cannot generate this knowledge by themselves (e.g., Lockett and Thompson 2001). Reid and Garnsey (1998) distinguish between different stages in growth, running from achieving access to resources of others, to the mobilization of resources and the own generation of resources. For young, innovative companies, using the right combination of resources at the right time enables to undertake a jump in growth into next development stages. A failure in this critical match may cause a delay in growth and even a fall back into previous stages. Quite recently, a new emphasis is being placed on the heterogeneity between innovative companies at their start, leading to different needs for resources and capacities to fill these needs (Druilhe and Garnsey 2004). We might think of a different experience of the entrepreneurs, like between academic and corporate start-ups, and a different risk-profile of the venture, like between service companies and research and manufacturing companies. These differences may cause a different importance of particular agglomeration benefits among companies.

There is not much conceptualisation of the situation in which companies are free from needs for agglomeration economies, or "footloose". An early use of the term footloose can be found in the work of Klaassen (1967). Accordingly, an industry is footloose if its long run profitability is the same for any location in an economy. This is a quite strict definition that excludes different degrees of footlooseness. We prefer to conceive footloose and, its counterpart, location-bound as each placed at the

two ends of a spectrum with various degrees of footlooseness and location-boundness in-between. Note that footlooseness may be connected with different areas or scales, for example, a larger region and a national space-economy. Note also that footlooseness so far has been mainly determined indirectly through changes in the spatial distribution patterns of industries (for example, van Oort and Stam 2005; Sohn 2004; Wernerheim and Sharp 2003). However, we prefer to identify the different extent of footlooseness among individual companies in an in-depth analysis. A major issue is now of course, whether footlooseness is stimulated through the use of ICT or any firm-specific characteristic.

3 Empirical results on footlooseness and location strategy

3.1 Methodological aspects

The previous observations call for a proper empirical underpinning. In our empirical research, we address the question whether young innovative companies become increasingly footloose and prefer to locate in a larger area than the existing large agglomerations; and if so, which location constraints still remain. Further, we try to identify which factors determine footlooseness and whether these factors may increase in importance in the future. The research design employed an inductive approach, using 21 case studies selected on different positions on factors influencing the need for resources and capabilities to satisfy these needs (van Geenhuizen 2005). The innovative sectors considered in our study are as follows: biotechnology, ICT-services and engineering services, and mechatronics (optronics). Furthermore, all companies serve intermediate markets.

Footlooseness in our empirical work was measured based on importance attached by the management of the companies to a set of variables representing agglomeration advantages, i.e., proximity to knowledge institutes, suppliers and customers; a specialized labor market, personal networks in the area, and proximity to high-level ICT nodes (services) and to Amsterdam Schiphol Airport. Accordingly, the companies could be classified into those for which various agglomeration economies strongly matter (location-bound) and those for which these economies matter to a small degree (entirely or partly footloose), aside from companies without a conclusive pattern. Conventional statistical analysis, such as multiple regression analysis or discrete choice modeling, could not be applied because of the low level of measurement of some variables, the small sample, and sometimes fuzzy data. Therefore, we made use of a non-parametric technique, i.e., rough set analysis (e.g., Pawlak 1991; for details, Polkowski and Skowron 1998). Through a distinction made between stimuli (*condition variables*) and response (*decision variables*), rough set analysis is able to identify causal linkages between classified conditions and decision variables and to produce a number of conditional statements of an "if ....., then ....." nature (decision rules). Accordingly, we could identify which conditions lead—in a logic deterministic way—to a particular state of the decision variable, i.e., place-bound and somewhat footloose. The condition attributes were selected based on the previously indicated resource-based approach to growth as follows: (A1) (in)dependence (corporate position); (A2) age; (A3) size

(employment); (A4) main activity (manufacturing or services); (A5) innovation intensity; (A6) overall spatial strategy. Almost all companies attached a high value to ICT-use in business operations; thus, this attribute could not contribute to a clarification of a different degree of footlooseness[1]. We draw on a database established using semi-structured questionnaires and interviews with corporate managers (van Geenhuizen 2005).

The rough set procedure produces some quality assessments based on the characteristics of the condition variables and decision variable. Fortunately, in all cases analyzed, the accuracy and the quality of the rough set approximation appeared to be equal to 1, meaning that the reliability of the classification for the dependent variable and the overall quality are at their maximum. The 21 cases are apparently totally distinguishable. Next, the procedure may identify a 'core' that consists of the class of all indiscernible equivalence relationships. Attributes in a core may be seen as the critical variables in an exploratory sense. It appeared that all six condition variables belong to the core, meaning that all of them contribute to an explanation with no variable containing redundant information, and that the core has the maximum quality of 1.0 (Annex). It is important to note that the interpretation of the rough set analysis results is valid to the extent in which the selected case studies provide a fair representation of important segments of young, innovative, companies. In addition, various testing experiments using similar rough set procedures in other studies indicate that the prediction accuracy of the rules is around 73% (Soetanto and van Geenhuizen 2007).

In understanding the decision rules, we use the coverage of the rules and the frequency in which condition variables appear in all the rules. The coverage gives the percentage of all cases sharing a similar score on the decision variable for which the rule is true, and accordingly, indicates the strength of the rule, whereas the frequency of appearance of each individual condition variable indicates the strength of these variables (Annex).

3.2 Results

Our assessment has produced a set of 11 decision rules (out of 12 decision rules) that can be interpreted straightforwardly. We may summarize the outcomes on different degrees of footloosenes as follows (Table 1, Annex). The pattern of footlooseness is rather differentiated, even within the economic (sub)sectors and within the urban places studied. Location-bound and somewhat footloose companies tend to co-exist in the same sector and in the same urban places. In addition, a small class of companies could be identified for which the results were ambiguous.

It appears that (in)dependence in terms of position of the company is the strongest determining factor (a frequency of appearing in the rules of 58.3%). This refers particularly to spin-offs: young academic spin-offs tend to be place-bound (Rule L4),

[1] The case study design permits a logic in the sense of "replication", allowing the case analysis to be treated as a series of independent experiments (Yin 1994). Note that the interpretation of the rough set analysis results is valid to the extent in which the case studies selected provide a fair representation of young, innovative, companies.

Table 1 Types of companies as outcomes of the rough set analysis

Rules	Strength of rules (%)	Number of companies involved	Generalized company types
Rules on location-bound: city agglomerations			
(L1) Overall local strategy	38.5	5	Biotechnology and advanced ICT services; the latter are tied to highest telecommunication nodes and the metropolitan labor market.
(L2) Long-lasting innovation projects	30.0	4	Advanced research companies in biotechnology and mechatronics.
(L3) Independent position and short innovation projects	38.5	5	Particular ICT service-companies and biotechnology service-companies *(overlap with type 1).*
(L4) Very young academic spin-offs	15.4	2	Research companies in ICT and biotechnology in the first life stage (close ties with university of origin).
Rules on footlooseness: spread over larger areas			
(F1) Small due to employing a network model	20.0	1	Research companies in risk markets employing a model of comprehensive outsourcing.
(F2) Corporate spin-offs engaged in services	20.0	1	Highly specialized service companies inserted into global networks by multinationals (origin).
(F3) Older age and long-lasting innovation projects	40.0	2	More mature research companies in biotechnology and mechatronics that start to enter global networks (R&D alliances or outsourcing relations).
(F4) Medium-sized subsidiary (foreign) engaged in services	33.3	1	More mature producer service-companies with clients all over the country.
Ambiguous results			
(A1-3) Spin-offs (corporate, academic), partly a mix of local and global overall strategies	33.3	1[a]	Miscellaneous, but all speculate on (partial) relocation in the near future.

[a] Each of the three rules has a coverage of 33.3% and is supported by one company

whereas spin-offs of multinationals tend to be footloose by being inserted into global networks (Rule F2). A focus on network-based relations seems also important for other types of companies, like for small companies employing outsourcing as their business model (Rule F1) and for global knowledge interaction (Rule F3). Companies

that employ comprehensive outsourcing and those that (start to) employ strategic R&D relations with different global partners tend to be somewhat footloose.

Overall, network characteristics of the company seem most determining for the degree of footlooseness, i.e., related with corporate position (network of parent company), the business model (outsourcing relations) and degree of innovativeness (research alliances). By considering changes in footlooseness, we can identify the following trends (van Geenhuizen 2005)

- Companies qualified as *location-bound* tend to be more strongly location-bound in the future, *inter alia* based on a pool of specialized workers and the proximity of customers in the city. This trend is exemplified by service companies in biotechnology, and by customer- and labor market oriented ICT-services. The latter companies are also highly fixed in place, i.e., they need direct access to the highest level node in the global telecommunication grid. An increase of footlooseness seems only true for research companies (biotechnology) entering global research (alliance) networks.
- Companies qualified as *somewhat footloose* show partly a trend for increasing and partly a trend for decreasing footlooseness. An increase tends to be connected with employing a network model based on a comprehensive outsourcing, and with a shift towards a global orientation (customers, knowledge).

We will now interpret the above findings in relation to further empirical evidence. So far we may conclude that the empirical material from the Netherlands does not support the hypothesis of a large scale increase of footlooseness. Only particular segments of young, innovative companies tend to become more footloose, i.e., those that enter global knowledge relations, employ and extend a network model (extreme levels of outsourcing), and enter global markets. These segments may, however, increase in size and kind because there is a move to global knowledge relations (e.g., Simmie 2003) and the most determining factor of footlooseness—(in)dependence in corporate position—points to the influence of corporate ownership relations that are also in a process of increasing globalisation. Whether a rise in network model companies can be expected, is more difficult to assess. Extreme outsourcing is a strategy that matches only high-risk situations including cyclic markets, like in the semi-conductor and related industry.

With regard to footlooseness, we may notify that a certain level of footlooseness may be coupled with some specific location constraints. Among the somewhat footloose companies, we observe a clear importance attached to: (1) a certain level of agglomeration; (2) a certain level of centrality in the country, excluding a location in the north and northeast; (3) access to knowledge and a good knowledge culture; (4) accessibility by car; and (5) access to a well-connected international airport. In an attempt to identify cities in the Netherlands outside the four large ones (i.e., Amsterdam, The Hague, Rotterdam and Utrecht) which broadly satisfy the above constraints, we may arrive at four "candidate" cities due to sheer size of their population, a certain level of centrality, an easy access to Amsterdam Schiphol Airport (within approximately a maximum of 1.5 h travel time by public transport), as well as access to knowledge through a university and direct access to the prime science and education telecommunication grid SURFnet (Gigaport 2004). The agglomerations that satisfy these criteria are

Table 2 Agglomerations as nodes in a larger metropolitan area in the Netherlands

Large cities	Medium-sized (central)	Medium-sized at a distance (South and East)
Amsterdam (1017.050)	Leiden (254.130)	Eindhoven (319.670)
Rotterdam (1001.450)	Dordrecht (246.490)[a]	Tilburg (221.350)
The Hague (616.090)	Haarlem (189.930)[a]	Breda (166.035)[a]
Utrecht (405.470)	Amersfoort (161.960)[b]	Nijmegen (157.470)

Source: Netherlands Central Bureau (2004) and Gigaport (2004). In brackets: number of inhabitants of the urban agglomeration in January 2004. Only agglomerations larger than 150.000 inhabitants
[a] No university; but linked to SURFnet in a second stage
[b] No university; not connected to SURFnet in later stages

Leiden, Eindhoven, Tilburg, and Nijmegen (Table 2), of which Leiden is the most central place with respect to the four large cities in the Netherlands. In addition, there are three agglomerations without a university, but endowed with higher educational institutes and upgraded connections to the SURFnet grid, i.e., Dordrecht, Haarlem, and Breda. This tentative picture of medium-sized cities illustrates differences in potentials for catching up in world–city development given a spread of agglomeration advantages from the large cities to medium-sized cities centrally located in the Randstad (western part) and in the southern and eastern part of the country.

The above sketch of emerging patterns in the Netherlands calls for a more thorough interpretation based on a more general methodology. In the next sections, we will focus on ways in which medium-sized agglomerations in the Netherlands have coped with the above-mentioned new opportunities in policymaking. We will offer an interpretative framework based on an evolutionary view on policymaking.

4 An evolutionary view on policymaking

In recent years, evolutionary thinking and principles have become ‘en vogue’ in the social sciences. In the core of this thinking is the long-term development of organizations and their potential to adjust to a dynamic changing and competitive environment. A key role in adjustment processes, such as gaining benefit from new opportunities, is played by the organizing capacity of organizations. This can be seen as the ability to bring relevant stakeholders together based on a vision or goal, and to ensure their commitment to action to work towards the realization of visions and goals (van Twist et al. 2004).

In evolutionary approaches, policymaking may be viewed as a process of selection in a changing environment composed of the market, institutions and the spatial environment. The selection environment works as a kind of filter that allows well adjusted policymaking entities to pass and survive, and less adjusted ones to decline or disappear. For urban policymaking, we may conceive of the market as the one in which new technologies, capital investment and a creative class of knowledge workers, etc. are attracted (or developed). In daily life this becomes apparent in different competitive positions of cities, for example, concerning the hosting of important con-

ventions, festivals and sporting games, and the presence of clusters of highly innovative companies in specific markets such as medical biotechnology, fashion design and multi-media activity. Very often changes in policymaking are incremental, meaning changes in small steps compared with the current situation. This pattern is based on a type of learning in which actors find solutions based on previous success, i.e., familiar procedures and routines (e.g., van den Bergh and Fetchenhauer 2001; Nelson and Winter 1982). The use of such procedures and routines in fact reduces the range of different possibilities and causes a situation in which the next future is very much like the recent past (path-dependency). In more extreme developments, accumulated investments (sunk costs) and strong lobbies add to path-dependency in such a way that organizations remain led by previous success (or failure) and reinforce old trajectories (negative lock-in) (e.g., Magnusson and Ottosson 1997; Maskell and Malmberg 1999). While the general development trend is one of path-dependency, evolutionary views also recognize that particular high-impact events, such as a simultaneous closure of old manufacturing companies in one municipality, may work as a trigger to quickly open the road to new trajectories. This reasoning may be helpful to better understand the dynamic patterns of economic activity in different types of urban development as described above, against the background of the distance-reducing impact of ICT.

5 Urban ICT policies

The reason for focusing on ICT policy in this section is the recognition that an improved use of ICT helps cities in attracting young, innovative companies in various ways; for example, to increase the reach of these companies (market, labor, inputs), to improve road accessibility, to create a good knowledge culture (creativity) and to provide access to the high-speed internet allowing for what is named e-science, including remote and interactive data-mining, experimentation, design, and monitoring. In general, the bottlenecks to an improved use are not in the technology itself but in the organizing capacity. What is new on ICT in municipal policymaking is that ICT impacts manifest themselves in many different fields requiring an integral approach and introduce the need to bring stakeholders together from different organizations and, even more important, to keep them together and committed to arrive at satisfactory solutions. In addition, ICT is a highly dynamic field, witness an increasingly higher speed of transmission and processing of information, an increasingly advanced intelligence of the systems (van Geenhuizen 2004) and a growing number of applications, including processes in the own municipal organization, the providing of municipal services, and e-governance and participation by local actors in policymaking (Conroy and Evans-Cowley 2006). The changes concerned are not only of a technical nature but may have major impacts on the way of policy making and relationships between the actors concerned (Marche and McNiven 2008).

If we focus in on policies concerning major urban ICT infrastructure and services, we may identify a manifold uncertainty, stronger than in any other infrastructure policymaking (Haynes 2006). There is uncertainty about the potentials of ICT use, such as the emergence of new corporate strategies and structuring of value chains, the supply of new services by private and public actors, and the concomitant impacts on the

urban economy, particularly due to changing location behavior. Also, the technology is a source of uncertainty. A wide range of technologies is already in existence or in the process of research and development, but knowledge about which specific techniques and strategies will be the most effective and beneficial for the tasks they are designed to perform, is only increasing by bits and pieces. And when new technologies are available, acceptance by the urban public may be difficult to assess, for example end-users' willingness-to-pay and the private sector's or public/private combination's willingness to provide or invest in infrastructure and services. The latter point refers to a further source of uncertainty, namely institutional uncertainty. The design and introduction of new institutions that need to go along with application of the new technologies, like concerning protection of privacy, safety of data transport, authorization, etc., and local roles herein, but also new ways of financing and operation of the infrastructure and services (public–private partnerships) often lag behind the introduction of the new technologies. It is needless to say that an adequate dealing with these different types of uncertainty requires a well-developed learning and organizing capacity.

In the remaining section, we summarize and deploy two empirical studies to explore the opportunities for effective policymaking in the area of ICT in Netherlands, namely findings from a large-scale empirical research (Cohen et al. 2005) and results from an in-depth case study (van Geenhuizen 2004), respectively. The following observations can be made concerning single roles and goals of ICT as perceived by policymakers in medium-sized towns in the beginning of this century (Table 3). Policymakers appeared to see an important role for ICT in developing the city and its opportunities, mainly in terms of economic development. However, there was no further articulation of such a role, particularly ICT as a base of new economic activity and ICT as a means to enhance integration into global relationships. It seems that ICT was not seen as a factor that can improve the economy and urban social life structurally and speed-up a shift towards a new urban economic trajectory or a new stage in such a trajectory. It may be that uncertainty in realizing such basic changes was felt to be too high or the

Table 3 Urban policymakers' perceptions of ICT (early 2000s)

Perceived roles and goals	Important	Not important
Role of ICT for the city	Mainly in communication and issues of access to municipal information and services	No role in structural changes in power distribution and social inequity issues
General goals for ICT policies	Developing the city and its opportunities, mainly economic development	No articulation of ICT as a base of new economic activity
		No articulation of ICT as a means to connect globally
Direct goals of ICT policies	Supplying of municipal information and services, and promoting ICT use in planning	No articulation of promotion of various ICT activities for citizens
	Improving ICT infrastructure: network and PC availability	No perceived need for promoting studies about ICT and ICT use

Source: Adapted from Cohen et al. (2002, 2005)

changes not to be realistic. Reactions like these are common in a frame of uncertainty and path-dependency. What is worrisome is that promoting studies to learn about ICT (use) was not qualified important.

To structure the shortages in policymaking, we make use of an analytic frame adapted from van den Berg et al. (2002) in which external influences, like the spatial-economic situation and the socio-cultural situation of the cities, are distinguished from internal factors. We confine ourselves to two types of *internal* factors, i.e., concerning (1) the interaction between the municipality and relevant stakeholders (from leadership to open learning) and (2) steps in policymaking and implementation (from strategy to policy results). Note that the factors are strongly mutually dependent. The results of the analysis point to a weak organizing capacity, in terms of leadership, support, strategy and action. Leadership was often missing due to the fact that ICT was not recognized as a relevant area with important opportunities and implications for the competitive position of the city, and this was reinforced by a lack of knowledge (awareness) and a weakly developed learning attitude. This, alongside a lack of co-operation between relevant stakeholders or counter-action of stakeholders supporting old paradigms, implicates that there was no coherent vision (ambition) on an ICT future, meaning that the single initiatives that were taken, faced a relatively large chance to fail because of lack of support and commitment. By contrast, a few visionary people in a leading or strategic position in the municipal organization could have worked as a decisive force in creating support for taking new roads.

Aside from moderate expectations, there was some lack of awareness and imagination about what is possible with modern ICT. However, a learning attitude towards opportunities of ICT was often also missing. Of course, this situation does not mean that each single initiative failed. There are certainly some success stories, but these remained isolated without generating advantages of coherence and synergy.

We may conclude that urban policymaking on ICT in the recent past showed a low profile involvement in structural matters, fitting into a wait-and-see attitude. Particularly, the moderate expectations, low awareness and low priority for study on ICT opportunities in the stage at that time, are worrisome, but can be understood from a still limited local capital supplying ICT services and of limited social and human capital creating a demand for use of ICT and particularly e-governance (Rose 2005). It means that urban policymakers in many medium-sized towns in the Netherlands were facing the risk of not exploiting economic advantages from ICT in a timely manner, and therefore, contributed to a decreased competitive power, potentially leading to relocation of innovative activity to other world cities. This may implicate a stagnation of growth at the level of the individual city, but it may also—given the context of a larger metropolitan area and a certain complementarity between cities—cause a weakening of this area at large in comparison with competing world cities. The recognition of the need for collaborative digital environments to enable local competitiveness and prosperity through knowledge networks and partnerships, integrated e-services and e-participation in major decisions has arised later in time for most medium-sized cities (Paskeleva 2009).

What was and still is missing in terms of improving the situation, is insight into prescriptive rules and sets of actions leading to a building or strengthening of the urban organizing capacity; thus, there is also uncertainty about adequate conditions

and practices in policymaking itself (van Twist et al. 2004; Fainstein and Campbell 2002). We may illustrate this with two examples. The need for building networks of stakeholders is beyond doubt, but how should this building take place to derive networks that actively stimulate support and action, and prevent the creation of networks that hamper an active stimulation through a stiffing influence? Likewise, the design of a vision (eventually coupled with ambitions) is necessary, but not all visions provide the inspiration necessary for creating support and for designing innovative strategies. Under which conditions can a vision provide positive impacts and under which conditions are these missing?

The situation around the beginning of the century is, of course, a snap-shot. Various new modes of management have emerged in later years, providing coherent action approaches to improve the learning and organizing capacity of policymaking organizations. We may mention transition management (e.g., Rotmans 2003) and complexity management (Teisman 2005), process management including new arrangements (de Bruijn and ten Heuvelhof 2004) and management through informal and adaptive networks (Nooteboom 2006), but the link between the design of solutions and action-oriented approaches remains rather weak. Currently, various experiments on ICT use in cities have reached completion and are in the stage of evaluation[2]. The adoption of an open learning attitude by policymakers is important to prevent path-dependency influencing evaluation and to remain alert in taking the right actions in responding to opportunities of world-city development.

6 Concluding remarks

In this article, we have taken urban dynamics and location patterns in the Netherlands as an example of world-city development, and focused on a shift in centrality towards a larger metropolitan area with the western part of the country as its core. In an empirical study of young, innovative companies, we explored empirical signs for such a shift, namely an increased footlooseness. We could identify two types of companies, i.e., (1) persistently location-bound, based *inter alia* on agglomeration factors exclusively in the largest city —immediate access to the highest-level telecommunication node and a pool of young and internationally oriented workers, and (2) somewhat footloose companies that may function profitably in larger parts of the Netherlands. The latter type suggests that some agglomeration factors are available in a larger metropolitan area, like sheer size of medium-sized agglomerations and access to high-level knowledge in local universities. Although the empirical material provided no conclusive ground for a trend towards large scale footlooseness in the near future, we may expect an increase based on determining factors that become stronger in the medium term, on the basis of a growing globalization. This would mean that medium-sized agglomerations at some distance from the large cities are facing additional opportunities for economic growth.

[2] For example, the municipality of Eindhoven started an experiment in 2001 with providing broadband Internet connections to all inhabitants in particular city-quarters based on the idea that a favorable ICT climate and ICT-minded population could attract various e-commerce oriented companies and related business (van Winden and Woets 2004).

Next, we used ICT policies practiced in the early 2000s to illustrate the constraints of municipal organizations to imagine, set goals and anticipate situations which seem to be distant in time, the development towards being part of a larger world city being one of such challenges. We observed a shortage in awareness, visions, strategies and coherent policies, based upon a poor learning and organizing capacity, whereas ICT policies—more than any other policy area—urge municipal organizations to deal with uncertainty and bring relevant stakeholders together by crossing organizational boundaries. The more recent design of improved models of policymaking appeared to be hampered by a shortage of action-oriented insights into critical success factors at work in different city-specific circumstances. For municipalities this situation would mean first, to invest more in the learning capability of the own organization, for example, by attracting highly qualified people from outside and, second, to take joint initiatives for comparative experiments and for monitoring to generate more action-based knowledge and understanding of critical conditions in world-city development.

Annex

Outcomes of rough set analysis are explained in Table 4.

Table 4 Outcomes of rough set analysis

Quality of information	
Number of core variables	6 out of 6 (quality of core: 1.0)
Strength of condition variables	Frequency of all rules
(In)dependence (position)	7 out of 12 (58.3%)
Age	4 out of 12 (33.3%)
Size	5 out of 12 (41.7%)
Main activity	2 out of 12 (16.7%)
Innovation intensity	3 out of 12 (25.0%)
Overall spatial strategy	4 out of 12 (33.3%)
Strength of rules	Highest coverage
	Rule 1 (38.5%), including 5 companies
	Rule 3 (38.5%), including 5 companies
	Rule 8 (40.0%), including 2 companies

References

Acs ZJ (2002) Innovation and the growth of cities. Edward Elgar, London

Audretsch DB (1998) Agglomeration and the location of innovative activity. Oxf Rev Econ Policy 14(2): 18–29. doi:10.1093/oxrep/14.2.18

Arrow KJ (1962) The economic implications of learning by doing. Rev Econ Stud 29:155–173. doi:10.2307/2295952
Barney JB (1991) Firm resources and sustained competitive advantage. J Manage 17:99–120. doi:10.1177/014920639101700108
Bathelt H, Malmberg A, Maskell P (2004) Cluster and knowledge: local buzz, global pipelines and the process of knowledge creation. Prog Hum Geogr 28(1):31–56. doi:10.1191/0309132504ph469oa
van den Berg L , Braun E, Otgaar A (2002) Organizing capacity in perspective (in Dutch). European Institute for Comparative Urban Research, Rotterdam
van den Bergh JCJM, Fetchenhauer D (2001) The rational model passed. Evolutionary explanations of behavior and socio-economic institutions (in Dutch). NWO (Netherlands Organization for Scientific Research), The Hague
Black W, van Geenhuizen M (2006) ICT innovation and sustainability of the transport sector. Eur J Transp Infrastruct Res 6(1):39–60
Bock S (2006) City 2003; 21 cities in quest of the future; new forms of urban and regional government. Eur Plann Stud 14(3):321–334. doi:10.1080/09654310500420818
Bolisani E, Scarso E (2000) Electronic communication and knowledge transfer. Int J Technol Manag 20(1/2):116–133. doi:10.1504/IJTM.2000.002855
de Bruijn JA, ten Heuvelhof EF (2004) Process arrangements for variety, retention, and selection. Knowl Technol Policy 16(4):91–108. doi:10.1007/s12130-004-1017-0
Camagni R (1991) Local "milieu", uncertainty and innovation networks: towards a new dynamic theory of economic space. In: Camagni R (ed) Innovation networks: spatial perspectives. Belhaven, London
Capello R, Nijkamp P (eds) (2005) Urban growth and dynamics. Elsevier, Amsterdam
Cohen G, van Geenhuizen M, 'Nijkamp P (2002) Urban planning and information and communication technology: perceptions, ideas and facts. In: Higano Y, Nijkamp P, Poot J (eds) The region in the new economy. Aldershot, Ashgate pp 47–68
Cohen G, van Geenhuizen M, Nijkamp P (2005) ICT as a contributing factor to urban sustainable development: policymaking in Dutch cities. In: Geenhuizen M, van Gibson DV, Heitor MV (eds) Regional development and conditions for innovation in the network society. Purdue University Press, West Lafayette (Indiana) pp 99–117
Conroy MM, Evans-Cowley J (2006) E-participation in planning: an analysis of cities adopting on-line citizens participation tools. Environ Plann C 24(3):371–384. doi:10.1068/c1k
Dormois R, Pinson G, Reigner H (2005) Path dependency in public–private partnerships in French urban renewal. J Housing Built Environ 20(3):243–256. doi:10.1007/s10901-005-9008-3
Druilhe C, Garnsey E (2004) Do academic spin-outs differ, and does it matter? J Technol Transf 29:269–285. doi:10.1023/B:JOTT.0000034123.26133.97
Duranton G, Puga D (2003) Microfoundations of urban agglomeration economies. In: Henderson JV et al (eds) Handbook of regional and urban economics, vol 4. Elsevier, Amsterdam
Fainstein S, Campbell S (2002) Readings in planning theory (rev. edn). Blackwell, Oxford
Florida R (2002) The rise of the creative class, and how it is transforming work, leisure, community and everyday life. Basic Books, New York
Le Galès P (2006) New state space in Western Europe? Int J Urban Region Res 30(3):717–735
Garreau J (1991) Edge city: life on the new frontier. Doubleday, New York
van Geenhuizen M (2004) ICT and regional policy: experiences in the Netherlands. In: Gibson D, Heitor M, Ibarra A (eds) Learning and knowledge for the network society. Purdue University Press, West Lafayette (Indiana) pp 224–227
van Geenhuizen M (2005) Footloose, or not? A rough set approach to footlooseness of young, innovative companies. Udevalla Symposium 2004 Anthology Book, Udevalla, pp 389–401
van Geenhuizen M (2004) Cities and cyberspace: new entrepreneurial strategies. Entrepreneurship Reg Dev 16(1):5–19
van Geenhuizen M, Thissen W (2002) Uncertainty in intelligent transport systems, a policy view. J Technol/Policy Manage 2(1): 5–19
Geenhuizen M, Nijkamp P (2007) Cities and footlooseness: in search of place-bound companies and critical policies to attract them. Environ Plann C 25:692–708
Gigaport (2004) The new generation of internet in the Netherlands. http://www.gigaport.nl
Glaeser EL, Kallal HD, Scheikman JA, Schleifer A (1992) Growth in cities. J Polit Econ 100:1126–1152. doi: 10.1086/261856
Gorman S, McIntee A (2003) Tethered connectivity? The spatial distribution of wired infrastructure. Environ Plann A 35(97): 1157–1171

Graham S (1999) Global grids of glass: on global cities, telecommunications and planetary urban networks. Urban Stud 36(5–6):929–949
Graham S, Marvin S (1996) Telecommunications and the City. Routledge, London
Haynes KE (2006) Infrastructure: the glue of megacities, megacities lecture. Megacities Foundation/NICIS, Amsterdam/The Hague
Haynes KE, Stough RR (1999) Space, technology and the edge city: patterns of service and infrastructure development—the US capital region. In: Brotchie J et al (eds) East west perspectives on the 21st century urban development. Ashgate, Aldershot
Henderson V, Kuncoro A, Turner M (1995) Industrial development in cities. J Polit Econ 103:1067–1085. doi:10.1086/262013
Howells JRL (2002) Tacit knowledge, innovation and economic geography. Urban Stud 39(5):871–884. doi:10.1080/00420980220128354
Jacobs J (1969) The economy of cities. Vintage, New York
Klaassen L (1967) Methods of selecting industries for depressed areas: an introduction to feasibility studies. OECD, Paris
Lambooy J, Boschma R (2001) Evolutionary economics and regional policy. Ann Reg Sci 35:113–131. doi:10.1007/s001680000033
Lockett A, Thompson S (2001) Resource-based view and economics. J Manage 27(6):723–755. doi:10.1177/014920630102700608
Magnusson L, Ottosson J (eds) (1997) Evolutionary economics and path dependence. Edward Elgar, Cheltenham
Marche S, McNiven J (2008) e-Government and e-governance: the future isn't what it used to be. Can J Adm Sci 20(1):74–86
Maskell P, Malmberg A (1999) Localised learning and industrial competitiveness. Camb J Econ. 23:167–185
Musterd S, Bontje M, Ostendorf W (2004) Structures and dynamics in the vital Amsterdam urban region. Paper presented at the ENHR Conference, Cambridge, 2–6 July 2004
Nelson RR, Winter SG (1982) An evolutionary theory of economic changes. Harvard University Press, Cambridge
Netherlands Central Bureau of Statistics(2004) Monthly statistics on population in regions. Voorburg/Heerlen
Nooteboom S (2006) Adaptive networks. Eburon, Delft
O'Kelly ME, Grubesic TH (2002) Backbone topology, access, and the commercial Internet, 1997–2000. Environ Plann B 29:533–552. doi:10.1068/b12829
O'Kelly ME, Kim H, Kim C (2006) Internet reliability with realistic peering. Environ Plann B 33:325–343. doi:10.1068/b3187
Oort FG (2004) Urban growth and innovation. Spatially bounded externalities in the Netherlands. Ashgate, Aldershot
Oort FG, Stam E (2005) Entrepreneurship and agglomeration economies in the Dutch ICT Industry. Udevalla Symposium 2004 Anthology Book, Udevalla, pp 689–717
Paskeleva KA (2009) Enabling the smart city: the progress of city-governance in Europe. Int J Innov Reg Dev 1(4):405–422
Pawlak Z (1991) Rough sets. Kluwer, Dordrecht
Polkowski L, Skowron A (eds) (1998) Rough set in knowledge discovery. Springer, Berlin
Reid S, Garnsey E (1998) Incubation policy and resource provision: meeting the needs of young innovative firms. In: Oakey R, Dunning W (eds) New technology based firms in the 1990s, vol V. Paul Chapman, London pp 67–80
Romer PM (1986) Increasing returns and long-run growth. J Polit Econ 94:1002–1037. doi:10.1086/261420
Rose R (2005) A global diffusion model of e-governance. J Public Policy 25:5–27
Rosenthal SS, Strange WC (2001) The determinants of agglomeration. J Urban Econ 50:191–229
Rotmans J (2003) Transition management: key to a sustainable society (in Dutch). Van Gorcum, Assen
Sassen S (1991) The global city. Princeton University Press, Princeton
Sassen S (2000) Cities in a world economy. Pine Forge Press, Thousand Oaks
Sassen S (ed) (2002) Global networks/linked cities. Routledge, New York
Scott AJ (1998) Metropolis. From the division of labour to urban form. University of California Press, Los Angeles
Simmie J (2003) Innovation and urban regions as national and international nodes for the transfer and sharing of knowledge. Reg Stud 37:607–620. doi:10.1080/0034340032000108714

Soetanto DP, van Geenhuizen M (2007) Technology incubators and knowledge networks: a rough set approach in comparative project analysis. Environ Plann B 34:1011–1029

Sohn J (2004) Information technology in the 1990s: more footloose or more location-bound?. Pap Reg Sci 83:467–485. doi:10.1111/j.1435-5597.2004.tb01918.x

Taylor PJ, Catalano G, Walker DRF (2002) Measurement of the world city network. Urban Stud 39: 2367–2376. doi:10.1080/00420980220080011

Teisman GJ (2005) Public management on the fringe of order and chaos (in Dutch). Academic Services, The Hague

Townsend AM (2001) The internet and the rise of the new network cities, 1969–1999. Environ Plann B 28:39–58. doi:10.1068/b2688

van Twist M, Kort MB, Timmerman M (2004) STIP study on the organizing capacity in large cities (in Dutch). Netherlands Organization for Scientific Research and Knowledge Center for Large Cities, The Hague

Wernerheim CM, Sharp CA (2003) High-order producer services in metropolitan Canada: how footloose are they? Reg Stud 37(5):469–490. doi:10.1080/0034340032000089040

van Winden W, Woets P (2004) Urban broadband internet policies in Europe: a critical view. Urban Stud 41(10):2043–2059. doi:10.1080/0042098042000256378

Wolf N (2006) Cities, transport and communications. J Econ Geogr 6(2):248–249

Yin R (1994) Case study research: design and methods, 2nd edn. Sage Publishing, Thousand Oaks