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## Synergy between transport infrastructures and cities: towards a higher productivity of the economy

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May 30, 2011

**Synergy between transport infrastructures and cities. Towards a higher productivity of the economy**

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**Abstract**

Transport infrastructures and cities are usually treated as separate topics in discussions on the spatial future of Europe. Recently the relationship between urban nodes and infrastructure networks has been explored in a string of publications on polynuclear urban regions. This paper will elaborate further on this theme. The central research question is: How can the synergy between transport infrastructure and cities be enhanced? In other words, how can transport infrastructures help to create better places in cities? Our point of departure will be three recent studies: Ter Weel *et al.*, 2010; Dobbs *et al.*, 2011 and European Commission 2011. Each of these studies addresses the future of cities as nodes in global economic networks.

In the past we observe an increasing divergence of transport networks and urban patterns in Europe. If we want to improve the functioning of polynuclear urban regions a better integration of infrastructure networks and urban patterns is needed. For instance, the realisation of light rail networks can create better places in urban regions. The impact will be that the agglomeration costs, including the negative externalities of agglomerations, will decrease, and the agglomeration benefits, including the positive externalities, will increase. As a result the productivity of the urban economy will increase and the international competitiveness of the urban region will be strengthened.

## **Synergy between transport infrastructures and cities. Towards a higher productivity of the economy**

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### **1. Towards an urbanized world, according to McKinsey Global Institute (2011)**

Dobbs *et al.* (2011) argue that we live in an urban world. Half of the world's population lives in cities, generating more than 80% of global GDP. Only 600 urban centers, with a fifth of the world's population, generate 60% of global GDP (Dobbs *et al.*, 2011: 1). By 2025 Dobbs *et al.* (2011) expect 136 new cities to enter the top 600, all of them from the developing world and overwhelmingly (100 new cities) from China. The world will become much more urbanized and in the same time the center of gravity of the urban world's moves south and first and foremost east.

Expanding populations are not the largest drivers of urban growth. In most cities, rising per capita GDP is the major factor, fuelled by agglomeration benefits in larger cities and their capacity to attract higher investments and talented workers (Dobbs *et al.*, 2011: 5).

Around the world, the size of households is declining, leading to a more rapid growth in the number of households. We expect the number of households in the world's leading cities to grow at 2.3 times the rate of global population growth. The City 600 alone is likely to account for 250 million new households. An estimated 85 percent of these households will form in the cities of emerging regions; half of the total will be in China's cities alone. Globally, the three cities that will experience the strongest growth in housing demand will be Beijing, Shanghai, and Tokyo (Dobbs *et al.*, 2011: 6).

Table 1 presents the composition of the 25 highest-ranked cities, to be expected for 2025.

Table 1. Top 25 hot spots, 2025

**Exhibit 1a**

**Top 25 hot spots by 2025**

Cityscope 2025 city rankings

Bold text: Developing regions  
 Normal text: Developed regions<sup>1</sup>

Rank	GDP <sup>2</sup>	Per capita GDP <sup>2</sup>	GDP growth <sup>2</sup>	Total population	Children <sup>3</sup>	Total households	Households with annual income over \$25,000 <sup>4</sup>
1	New York	Oaks	Shanghai	Tokyo	Kinshasa	Tokyo	Tokyo
2	Tokyo	Doha	Beijing	Mumbai	Karachi	Shanghai	New York
3	Shanghai	Berlin	New York	Shanghai	Dhaka	Beijing	London
4	London	Macao	Tianjin	Beijing	Mumbai	São Paulo	Shanghai
5	Beijing	Tromsø	Chongqing	Delhi	Kolkata	Chongqing	Beijing
6	Los Angeles	Uddevalla	Shenzhen	Kolkata	Lagos	New York	Paris
7	Paris	Huairong	Guangzhou	Dhaka	Delhi	London	Rhein-Ruhr
8	Chicago	Asan	Nanjing	São Paulo	Mexico City <sup>5</sup>	Mumbai	Osaka
9	Rhein-Ruhr	San Jose	Hangzhou	Mexico City <sup>5</sup>	New York	Delhi	Moscow
10	Shenzhen	Yerevan	Chengdu	New York	Manila	Mexico City <sup>5</sup>	Mexico City <sup>5</sup>
11	Tianjin	Calgary	Wuhan	Chongqing	Tokyo	Rhein-Ruhr	Los Angeles
12	Dallas	Al-Ayn	London	Karachi	Cairo	Paris	São Paulo
13	Washington, D.C.	Edinburgh	Los Angeles	Kinshasa	Lahore	Kolkata	Seoul
14	London	Charlotte	Nashua	London	São Paulo	Lagos	Chicago
15	São Paulo	San Francisco	Taipei	Lagos	Kahiri	Osaka	Miami
16	Moscow	Durham	Delhi	Cairo	Buenos Aires	Dhaka	Mumbai
17	Chongqing	Ulsan	Moscow	Manila	London	Tianjin	Cairo
18	Bombay	Washington, D.C.	Singapore	Shanghai	London	Shanghai	Hong Kong
19	Guangzhou	Basel	São Paulo	Los Angeles	Los Angeles	Moscow	Taipei
20	Mexico City <sup>5</sup>	Belfast	Tokyo	Buenos Aires	Colombo	Chengdu	Buenos Aires
21	Osaka	New York	Shenyang	Rio de Janeiro	Bahia	Cairo	Shanghai
22	Philadelphia	Grande Vitória	Xian	Tianjin	Shanghai	Rio de Janeiro	Istanbul
23	Basel	Caracas	Dongguan	Paris	Paris	Wuhan	Delhi
24	San Francisco	Seattle	Mumbai	Jakarta	Jakarta	Los Angeles	Buenos Aires
25	Hong Kong	Zurich	Hong Kong	Istanbul	Istanbul	Buenos Aires	Moscow

1. Developed regions comprise the United States and Canada, Western Europe, Australasia, Japan, and South Korea.  
 2. GDP, per capita GDP in 2025, and GDP growth 2019 to 2025 in projected net working rate.  
 3. Populations below age 15.  
 4. Households with annual income greater than \$25,000 in purchasing power parity (PPP) terms.  
 5. Mexico City Metropolitan Region.  
 NOTE: For metropolitan regions, we use the first name of the region (e.g., New York for New York-Newark).  
 SOURCE: McKinsey Global Institute Cityscope 1.0

Source: Dobbs *et al.*, 2011: 3.

[Figure 1: about here]

Figure 1 shows that concentrations of megacities can be found mainly in China, the United States and Europe.

## 2. Four scenarios for Dutch cities in 2040, according to Ter Weel *et al.*, 2010

Ter Weel *et al.* (2010) develop four scenarios that can be used to think about the future of the Dutch economy in 2040. The study addresses the question of *how we will earn our money in 2040* by looking at people and cities. Scenarios bundle historical developments, current stylised facts and trends towards the future into consistent stories for the future. They assist policymakers in thinking through all possible outcomes of their decisions. It seems plausible that the scenarios are valid not only for the Netherlands, but also for Europe as a whole.

Computers change the way we work and the way we communicate. As a result, jobs are split up into different tasks. Increasingly, firms participate in complex global supply chains in which the many tasks required to manufacture a product are performed in different locations.

Cities are the places where people cluster, where start-ups flourish and face-to-face interactions increase productivity. As a result, cities are the places where productivity grows.

Ter Weel *et al.* (2010) have developed four consistent stories dealing with two basic uncertainties:

- (i) The future division of tasks among workers – will it occur anywhere in the world or will production occur more locally and
- (ii) whether the size of cities will become larger or smaller.

Together, the two uncertainties lead to the four scenarios presented in Figure 2.

The horizontal axis presents the options for the division of tasks, the vertical axis shows the possibilities for city size.

[Figure 2: about here]

The CPB analysis makes a distinction in four types of cities: Talent Towns, Cosmopolitan Centres, Egalitarian Ecologies and Metropolitan Markets (Ter Weel *et al.*: 17-19).

### *Talent Towns (TT)*

Talent Towns (TT) represent a world with relatively small cities (100,000 – 200,000 inhabitants) and specialised workers and firms. Communication technology (CT) enables specialist workers to co-operate in virtual teams, particularly in service industries. Firms employ specialists from all over the world. The wages of low-skilled workers suffer downward pressure due to global competition. The TT world faces the paradox of high demand for protection and redistribution, but limited supply. Substantial vulnerability and inequality together with low solidarity characterise TT.

### *Cosmopolitan Centres (CC)*

Cosmopolitan Centres (CC) are large cities (2 to 8 million inhabitants) with global connections hosting specialised workers and firms. In a CC city, many specialists from all over the world combine their efforts in design and production.

Specialist workers substantially benefit from grouping together. Working on complex tasks in a common location, specialists disseminate knowledge, exchange ideas, share common facilities and establish a reputation.

Income levels may differ substantially between centres and between a particular centre and its hinterland. Substantial income inequality also exists within cities, because the large CCs attract a broad range of supporting tasks.

### *Egalitarian Ecologies (EE)*

Variety and dispersion characterise Egalitarian Ecologies (EE). Economic activity spreads out over medium-sized cities (100,000 – 500,000 inhabitants) that host medium-sized firms.

Due to in-house production and meagre inter-firm knowledge flows, firms benefit little from being located near each other. Cities also face the risk of stagnation. Workers and plants can become locked-in, with limited opportunities inside the city, limited opportunities for learning from outside companies and limited outside options.

EE represents a world with little income growth and modest income differentials. Social relations may come under pressure from the considerable migration of low- and medium-skilled workers.

### *Metropolitan Markets (MM)*

Very large metropolises (Metropolitan Markets: MM) have more than 10 million inhabitants dominating the world. Large factories, huge office buildings and sky-high apartment blocks characterise these cities. Economic activity is concentrated in dense areas, where economies of scale and scope are optimally exploited. The hinterland and smaller cities face bleak prospects, talented workers leave and sufficient production size may never be reached. Metropolitan Markets is a world in which the winning cities take all.

Where the metropolis thrives, the hinterland lags behind. The metropolis attracts all of the highly productive firms and higher-qualified people. Income inequality is large – both within the metropolis and between metropolis and hinterland. This may pose serious social problems.

### *A critical observation*

It is debatable whether the four city types in the CPB analysis are mutually exclusive. The economy develops in different directions, combining both a differentiation and generalisation of tasks. A scenario could be envisaged in which all four types appear at the same time, depending on the scale that one applies to polynuclear regions. One could consider cities – Delft, Leiden, The Hague and Rotterdam – on the scale of individual entities. One could consider the Randstad South Wing as a network city and the Randstad as an urban network. Finally, one could consider North-West Europe as a mega-city region with the Randstad, the Flemish Diamond and the Rhine-Ruhr Area as components. This cross-scale approach does justice to the current urban pattern, which will undergo only limited change between now and 2040. Path-dependency plays a dominant role (Louw and Meijers, 2010).

### 3. Long-term urban images, according to the Strategic Research Framework Urban Europe

In view of the strategic orientation of the Urban Europe research calendar, four long-term urban images are identified (European Commission, 2011). These interlinked future appearances of urban environments (in the year 2050) offers stylized pictures of urban agglomerations, with the aim to distillate relevant and operational research issues for the Urban Europe's Strategic Research Framework (SRF). These four urban images and their main orientation are (see Figure 3):

- *Entrepreneurial City 2050*: economic vitality and innovation
- *Connected City 2050*: smart logistics & sustainable mobility
- *Pioneer City 2050*: social participation & social capital
- *Liveable City 2050*: ecological sustainability.

[Figure 3: about here]

These images may be used as strategic vehicles to identify important research challenges and foundations for an Urban Europe Strategic Research Framework (SRF). These interconnected urban images are described as follows:

#### *The Entrepreneurial City 2050*

This image assumes that in the current and future global and local competition, Europe can only survive, if it is to maximize its innovative and creative potential in order to gain access to emerging markets outside Europe; cities are then spearheads of Europe's globalization policy.

#### *The Connected City 2050*

The image of a connected city refers to the fact that in an interlinked (from local to global) world, cities can no longer be economic islands in themselves ('no fortresses'), but have to seek their development opportunities in the development of advanced transportation infrastructures, smart logistic systems and accessible communication systems through which cities become nodes or hubs in polycentric networks (including knowledge and innovation networks).

#### *The Pioneer City 2050*

This image refers to cities as attractors for creators and makers as pioneers, offering the general conditions for cutting-edge innovations and developments beyond conventional approaches, and providing innovative environments for the assessment and implementation of new (technological) solutions, through which Europe can become a global pioneer.

#### *The Liveable City 2050*

The final image addresses the view that cities have to consider all relevant aspects such as health, security and safety in order to provide an attractive environment to live and work for all citizens, and that smart environmental and energy initiatives (e.g., recycling, waste recuperation) shall act as engines for ecologically-benign strategies, so that cities may become climate-neutral agents in a future space-economy.

These four images highlight the strategic dimensions of urban futures in Europe. The future city will certainly be a combination of the four urban images. These images lend

themselves for systemic approaches to Urban Europe, they all need operational geoscience information and behavioural data to map out or understand uncertain urban futures, and they also reflect the need for strategic thinking on the governance of urban agglomerations in Europe. These four ideal-typical representations of European agglomerations in the year 2050 are not to be seen in isolation, but they are interconnected.

A wealth of innovative research ideas has been extracted from a creative envisioning process regarding these four interlinked urban images, on the basis of stakeholder consultation and interactive workshops with experts and policy-makers. To create a systematic and operational research agenda, a process of focusing and filtering has been carried out. This led to the identification of three major research issues to be addressed in the JPI Urban Europe. These can be presented as follows:

*A. Urban Megatrends*

What are the prominent demographic, economic and technological megatrends that are decisive for a promising future of urban systems?

*B. Urban Networks and Connectivity*

What are new mobility, logistic and land use developments and policies that are needed to create vital and attractive cities – and networks of cities – in the decades to come?

*C. Socio-Ecological Sustainability of City Systems*

Which ecological and social constellations have to be met and implemented in order to shape sustainable and balanced long-run urban development patterns (including energy systems) in Europe?

Figure 4 presents the knowledge arena of the Urban Europe Strategic Research Framework (SRF).

[Figure 4: about here]

Compared with the economic analysis of Ter Weel *et al.* (2010) the European Strategic Research Framework (SRF) suggests a multi-disciplinary approach with economic, social and physical dimensions. The common factor in the approaches by Dobbs *et al.* (2011), Ter Weel *et al.* (2010) and European Commission (2011) is the need to improve the synergy between infrastructure networks and cities.

#### **4. Divergence of transport networks and urban patterns in Europe**

Providing access for road traffic to European cities has proved a difficult challenge in the past. Since the 1960s ambitious demolition schemes were carried out in many European cities, designed – partly – to make room for car traffic. This trend met with opposition from many residents. It often badly damaged the spatial quality, the environmental quality and pleasantness of the city, and problems of congestion shifted to the motorway slip roads.

In a growing number of European cities cars are now increasingly discouraged from entering cities. It is almost impossible to transfer from train to car (and vice versa) in town centres; instead, people are re-routed to much smaller park-and-ride stations in the suburbs, or even more outlying areas. In general there is a lack of interconnectivity between transport networks and urban patterns (Priemus and Konings, 2000; 2001).



Craig (1988: 222-32) discusses the relationship between airports and cities: “The so-called landside problems of the air transport system create massive and largely un-researched issues of (...) how to connect the air transport system to other modes of transport. The airport can be regarded as essentially the location at which autos meet aircraft, and these ‘intermodal’ connections are generally ignored. ... We also wonder when airports will begin to be recognised as the new city centres, as they become central places for more and more socio-economic activity.” Amsterdam Schiphol has rapidly developed into such an airport city, with no residents but with a growing workforce and an enormous number of visitors every day.

Most European cities have poor interconnections between the various modes (air, car, rail, tram/metro/light rail). Their central areas are not very accessible for the modes with the highest share in the modal split: air and car. We have the general impression that the synergy between the urban pattern and infrastructure networks in Europe has not really improved in recent years.

## **5. Towards better integration of infrastructure networks and urban patterns**

In discussions among urban planners the city network paradigm is becoming more and more popular (Camagni, 1993; Camagni & Capello, 2000; Capello, 2000; Parr, 2004; Meijers, 2005). The European Union (1999) presents the polycentric approach as the appropriate urban pattern in the European Spatial Development Perspective. Polycentrism is defined as an urban pattern with related cities of more or less similar sizes and connected with each other.

The development of the mononuclear city into the polynuclear urban region in Europe (Batten, 1995; Kloosterman and Lambregts, 2001; Meijers, 2007) by definition means the development of more urban centres, more nodes connecting urban centres and infrastructure networks. Not only is housing suburbanising, so is employment, with secondary urban centres (edge cities) developing (Garreau, 1991). This American phenomenon fits very well into the European tradition of polynuclear urban regions. This tradition can lead to an increasing synergy between infrastructure networks and urban areas.

The high-speed rail network has recently been developed in Europe as part of the Trans-European Network (TEN), partly as an alternative to continental flights over relatively short distances. So far the high-speed rail network has many missing links. It is important for high-speed trains to stop in the centre of cities and at the major airports so as to ensure interconnectivity between continental and intercontinental air routes and rail routes (Givoni and Banister, 2007) and to improve the integration between cities and infrastructure networks. Whether this will result in substantial substitution of air travel by rail travel (as was intended from the very start) is doubtful, as the low fares charged by price-cutters such as Easyjet and Ryanair have upset the original substitution calculations.

The idea of the polynuclear urban region is a promising perspective when it comes to answering the question: How can the synergy between urban pattern and infrastructure networks be enhanced? In many cases the system will need to be redesigned at the regional level, creating or improving transfer points:

- between air and car or train;
- between car (on trunk roads outside urban built-up areas) and rail/metro/tram/light rail;
- between rail and metro/tram/light rail.

Once this redesign has been carried out, the nodes such as railway stations and airports, need to be highlighted and classified. It is also important to plot the metro/tram/light rail stops and to zoom in on the nodes where passengers can transfer from one mode to another. Special attention is being paid to the areas around railway stations where the high-speed train will stop (Pol, 2002): here major urban impacts are expected, as has previously been the case in Japan (Amano *et al.*, 1991) and France (Newman and Thornley, 1995).

Apart from the transport function, the function mix in and around each node is significant, including housing, offices, hotels, restaurants, bars, educational and cultural facilities. When analysing the functioning of and prospects for HST station areas, Bertolini (1996; 1999) distinguishes between *node value* (transport value) and *place value* (functional value) (Bertolini and Spit, 1998). In this approach it is essential that the transport function and function mix of each node be 'in balance' with each other. As a rule of thumb, the more passengers per day transfer and get on and off at a node, the more reason there is to provide a rich function mix. It is important that urban nodes be considered as interfaces between public infrastructure networks and urban functions, each with their own specific characteristics.

The development of networked infrastructures in urban areas is not without problems. Graham and Marvin (2001: 382) use the umbrella term 'splintering urbanism' to describe the dialectical and diverse sets of processes surrounding the parallel unbundling of infrastructure networks and the fragmentation of urban space.

Graham and Marvin (2001: 382): "(I)n these times of 'globalisation', those users demanding intense local and global connectivity are starting, along with the internationalising infrastructure operators, real estate developers and urban development agencies that struggle to meet their need, to pay considerably attention to how the whole of their networked urban infrastructures are configured, managed and developed. At the same time, in search of absolute security, privacy and control, local connections with the wider metropolis are being increasingly filtered through a widening array of walls, ramparts, security practices and access control technologies. In the process the relative infrastructural connections of less powerful users, and the spaces in which they live, seem to become more and more fragile and problematic". Privatisation and liberalisation lead to a transition from broadly similar services at relatively equal user charges over cities and regions towards hegemonic forms of infrastructure monopolies with unequal access.

## **6. Light rail networks and better places in urban regions**

Light rail surface and underground networks can be an important component contributing to the sustainable accessibility of urban regions. Light rail is a rail-associated transport system that can in general be positioned in the triangle between train, tram and

metro. The vehicles have ample pick up and set down points, rapid acceleration, short stopping times and adequate top speed.

Partly as a result of its exemplary public transport, the number of visitors to the central city in Strasbourg has increased (Priemus and Konings, 2000; 2001). A synergy between urban vitalisation and the improvement of public transport in Strasbourg has brought about a cost recovery level for the tram of more than 100%. Both the liveability and economic attraction of the city centre have been strengthened. Public transport has priority here. Park-and-ride areas have been laid out at some of the larger tram stops with bus stations.

In Japan the public transport operators are the owners of the rail infrastructure and the stations. This situation came about together with a strong diversification of these companies. They are very active in the development of real estate along the lines of public transport and at stations as well as in the operation of transport services (train and feeder bus services). The companies develop new residential areas, apartment complexes, department stores, shopping centres and office locations.

Public transport in Japan has a market share in the total number of passenger kilometres 2.5-3 times as great as in the Netherlands. Japanese public transport proves well able to recover most of its costs, including the cost of the infrastructure. The railway companies benefit from the increases in value of land around the railways (Cervero, 1998).

In many cities a process has been underway for years in which the city centre becomes car shy and car traffic is concentrated on the ring roads. This attitude enhances the attraction of central cities for cyclists, pedestrians and public transport. The more car use in the city is regulated, partly through physical measures and partly with the help of the price mechanism (congestion fee, paid parking), the more important it becomes for the central city to be readily accessible via public transport (Mackett and Edwards, 1998).

The endeavour to facilitate chain mobility implies a strategic location and an adequate capacity of transferia (places where passengers change mode), parking garages and bus stations and a redesign of public space. In this manner tourist and cultural facilities can be strengthened, and justice can be done to protected cityscapes and monuments.

In the central city, the customer must be able to choose and combine not only public transport, but also private transport (with a price tag) and combinations of public and private transport in mobility chains.

In addition, there are still ample opportunities for multi-modal travel information systems (navigation systems in cars, public transport information systems) to contribute to the smooth running of urban transport systems.

Cars will increasingly have to be parked on the periphery, at park-and-ride stations, from which high-quality public transport, taxis and selective (expensive) car drives take visitors to the town centre. More facilities will be added to these park-and-ride stations, e.g. filling stations, car washes, car repair facilities, florists, gift shops, cafes, and meeting rooms. In the London city centre the congestion charge has been introduced. The centre remains easily accessible, thanks partly to the underground system. Each city must have a high-quality, high-capacity, safe and secure public transport system.

Cities are ideal locations for developing better places geared to strengthening the economy. National and international companies prefer to run their operations from a city

base. Many businesses communicate with their suppliers and customers via physical and virtual global networks. Better places will emerge if businesses in the cities can be easily accessed thanks to the proximity of airports, rail networks, motorways and ICT connections.

Socio-cultural, medical and educational services will be concentrated in the urban centres. Transport nodes will make it possible to switch modes: there will be railway stations (with car parking and bicycle storage) and transfer sites where people can park their cars and continue their journey by bus and/or metro. Ideally, these sites should be located at strategic places along city bypasses to serve drivers from outside the region. The city centre can then be reached by metro, light rail, bus and/or bicycle. Parking will be expensive in central areas and a congestion charge could be introduced.

Better places also have an ecological dimension: cities are not only integrated in transport and ICT networks but also in water and green networks, which give citizens the opportunity for open air recreation close to their homes, playgrounds for children, urban agriculture, and which stimulate biodiversity in urban areas.

The increase of energy costs and the reduction of energy use in housing can, in addition lead to a more compact way of living.

Finally, better places have also an important social dimension: they promote and facilitate social interaction and social cohesion. Housing preferences and housing environment preferences differ. On the one hand households in urban areas prefer central locations, close to restaurants, theatres, museums and bars. They will often accept apartments. For other households, in particular with children or where children are expected, the ideal home is mostly the one family house with private garden, with a quiet green, suburban environment not too far from city centres. Polynuclear urban areas can offer housing opportunities for both categories of households. Parking in inner-city housing will always be selective and expensive, parking in the suburb will be more abundant and less expensive.

In particular for two-earner households the accessibility, departing from their homes, of jobs in a differentiated labour market is essential. Visser and Van Dam (2006) argue that the number of jobs that can be reached within half an hour travelling, is the variable which has the highest impact on house prices. Improvement of the urban traffic infrastructure for commuting can increase the value of residential properties. Here is a direct link between the quality of urban housing and the quality of urban infrastructure. For housing a dedicated parking place for one or two cars will remain popular, including charging points for electric cars in the future. But it will be expensive and not every-one will give this the highest priority. Also a bike storage and a short distance to a stopping place of public transport are crucial. Traffic infrastructure must guarantee accessibility of high quality without deteriorating the quality of the housing environment by emissions of greenhouse gases, particulate matter or noise.

## **7. Agglomeration economies and economic productivity**

Agglomeration economies make a distinction in positive and negative externalities of agglomerations.

The negative externalities of agglomeration are:

- *Congestion*: When infrastructure capacity is characterized by bottlenecks, agglomeration may increase congestions;
- Negative *emissions* of traffic, worsening *air quality*, which may threaten the health of people living and working in urban areas.

By making transport of persons and goods greener (less emission of greenhouse gases, the modal split in favour of high-quality public transport (such as light rail), adopting congestion charges and forms of mobility pricing, and by synchronizing infrastructure networks and urban patterns, the negative externalities can be reduced considerably.

The positive externalities are:

- *Input externalities*: proximity enables producers to save on transportation costs and share specific services;
- *Labour market externalities*: proximity and short commuting times enable knowledge workers to select the best jobs in the region. In particular for two-earner households this is crucial. Employers can improve the recruitment of talents as a result of proximity. A better matching between employers and employees can be realised;
- *Knowledge externalities*: proximity facilitates the exchange of information and knowledge, including tacit knowledge, by face-to-face contacts. It fosters a climate of entrepreneurship and innovation (Audretsch & Lehmann, 2006).

Proximity stimulates functional specialisation and strengthens a high specialisation in knowledge-intensive business services (Duranton & Puga, 2005).

The positive externalities reduce the production costs and increase the value of outputs. This means that well-functioning urban networks with mainly positive agglomeration economies increase their economic productivity and strengthen their international competitiveness.

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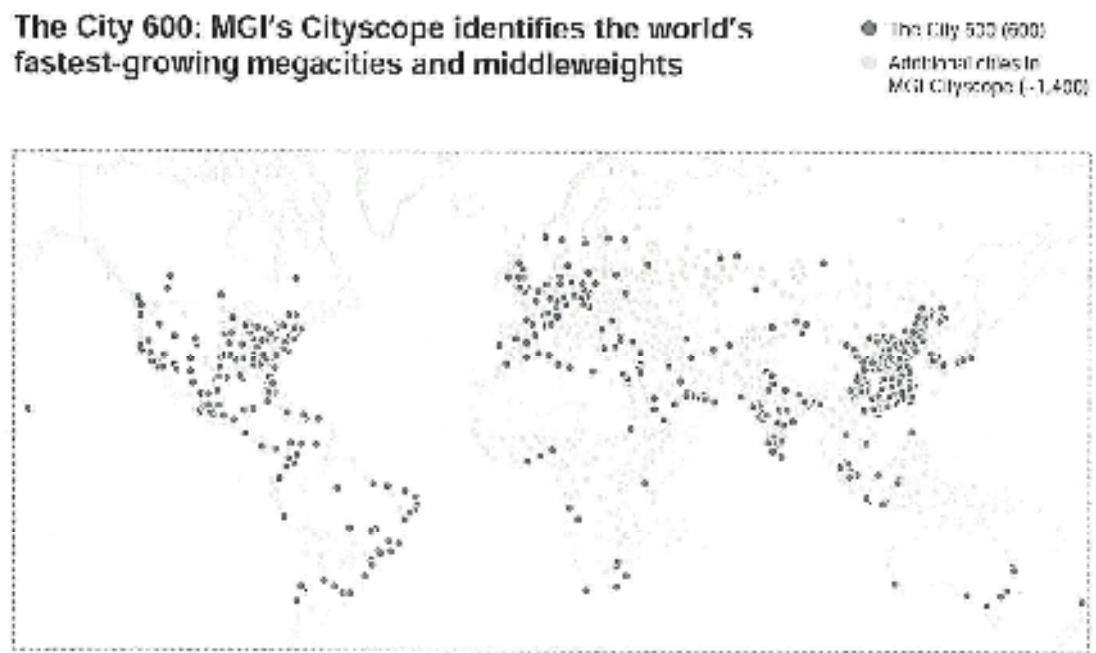
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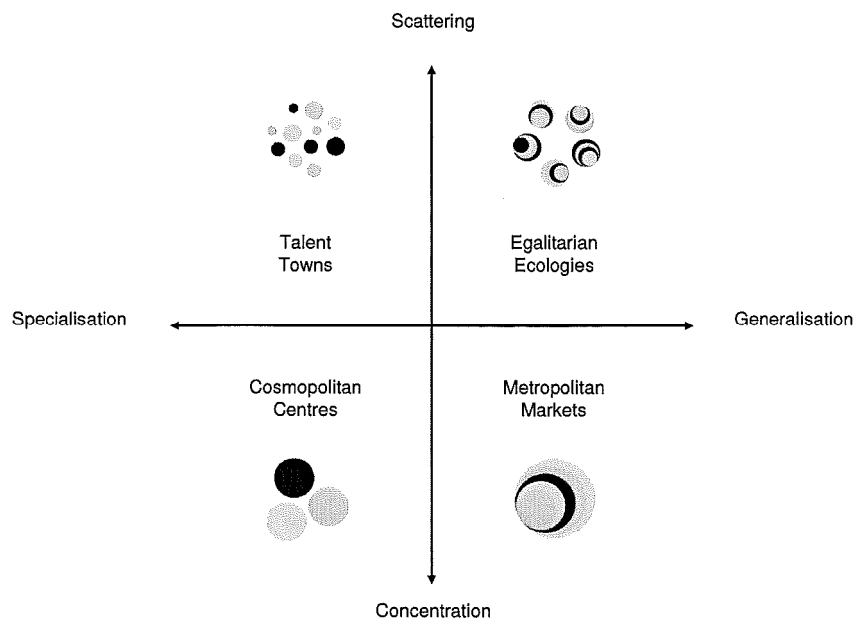


Figure 1. The City 600, according to McKinsey Global Institute



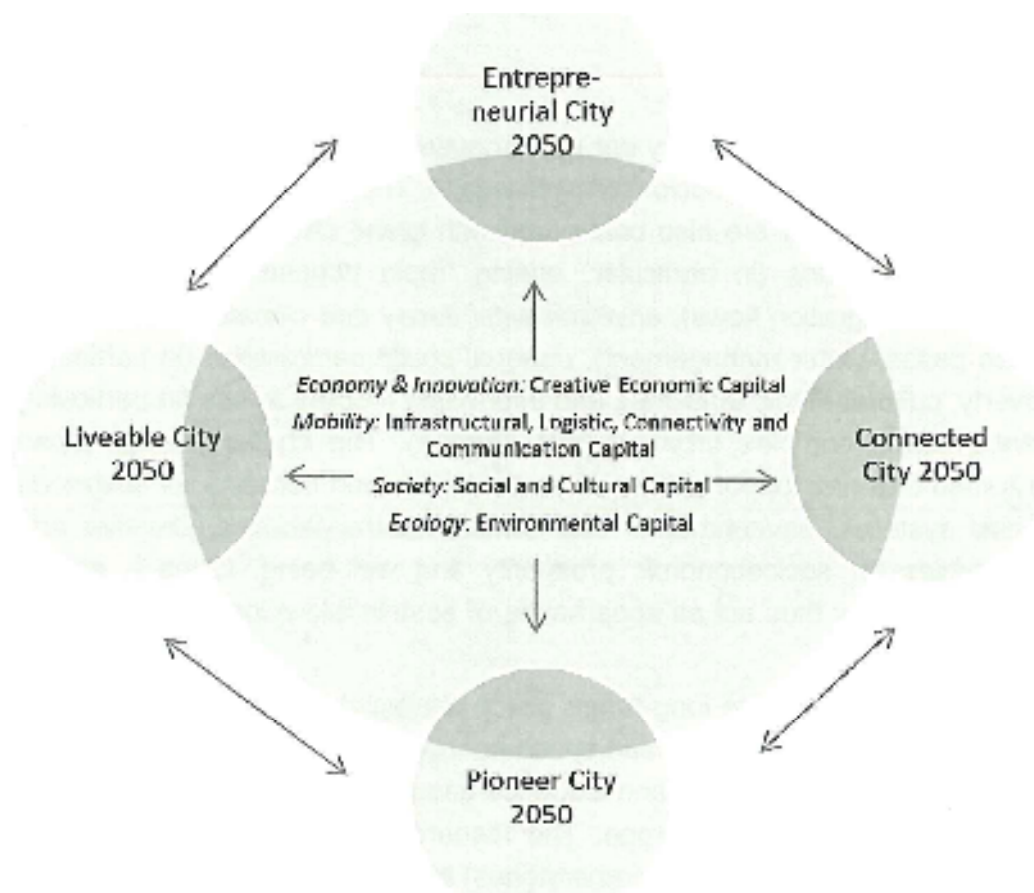
Source: Dobbs *et al.*, 2011: 8.

Figure 2. Four scenario for Dutch cities in 2040



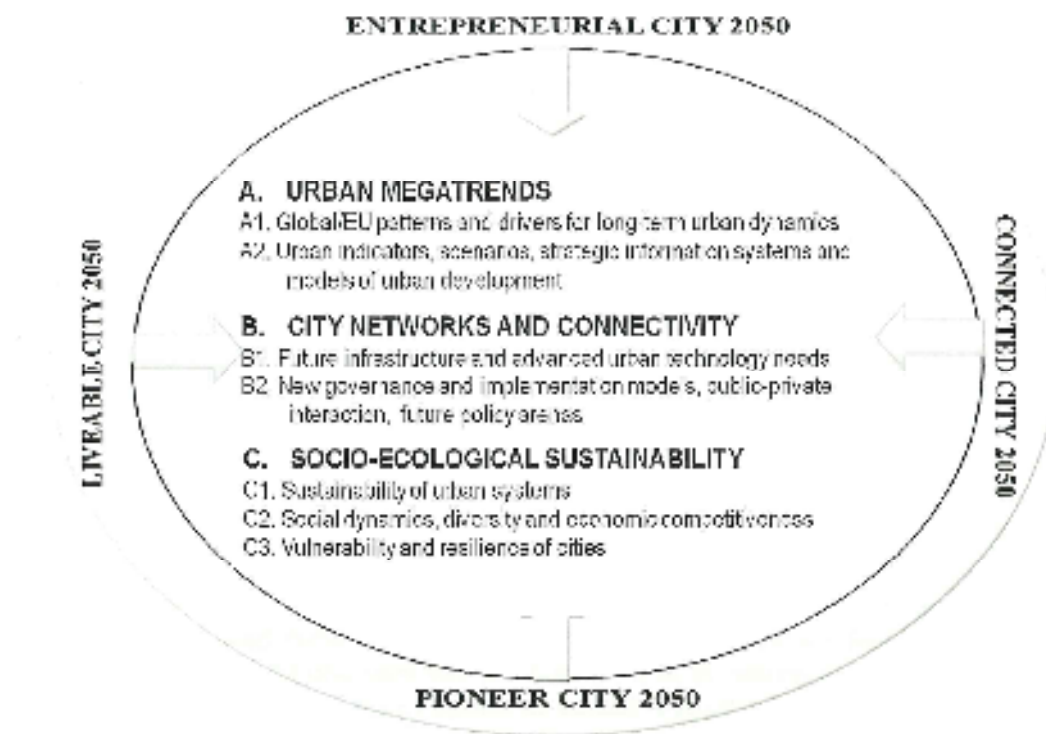
Source: Ter Weel *et al.*, 2010: 15.

Figure 3. The four urban images 2050 and their interaction



Source: European Commission, 2011: 6.

Figure 4. Knowledge Arena of the Urban Europe SRF



Source: European Commission, 2001: 13.