IN SEARCH OF NEW CONCEPTS OF PHYSICAL AND VIRTUAL SPACE

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1 PHYSICAL AND VIRTUAL SPACE: THEIR INTERACTIONS

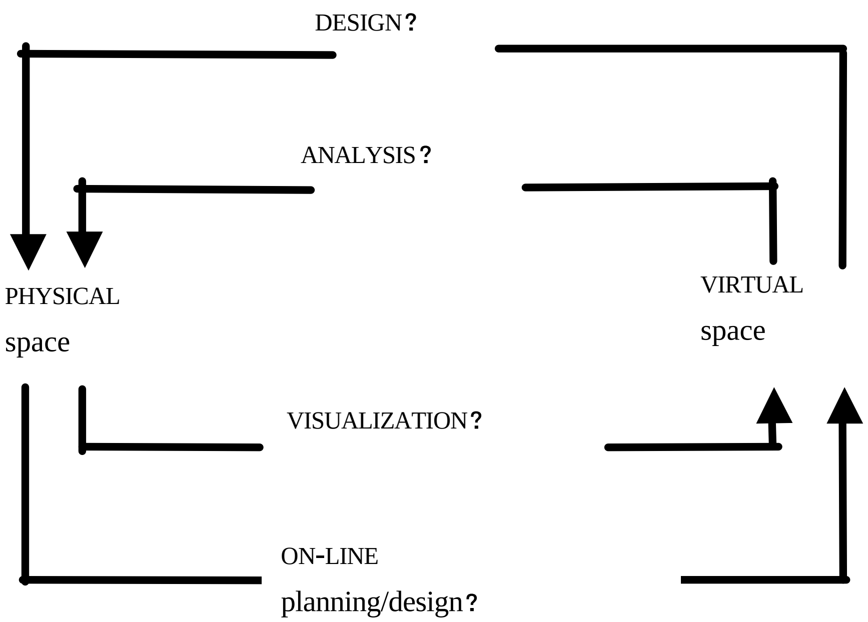
We are more familiar with physical than with virtual space both as users and practitioners.

Physical space is the material object of spatial planning and urbanism. It comprises, traditionally, zones adapted to activities and channels of communication providing links between zones, catering to transport. Or various types of buildings, if one includes architecture. Virtual space opened by ICT, still is less familiar. It is, after all, "no more than abstract flows of electronic signals, coded as information, representation and exchange" (Graham). This partly explains the frequent use of metaphors to describe it, among them spatial metaphors (Graham, 1997). In dealing with the interactions between physical and virtual space, spatial metaphors tend to obscure the issues and therefore better be avoided.

Physical and virtual space must be defined as distinct entities. After all, only utopians believe in urban dissolution with all information supposed to become available at all times and places to all people. What are the most important interactions between physical and virtual space?

Figure 1 shows four of them. Two of them, visualization and on-line planning/design start from physical space. For the other two, analysis and design, virtual space is the point of departure. In this paper, the emphasis is rather on analysis and design.

Figure 1:



2 SPATIAL ANALYSIS OF VIRTUAL SPACE

Where as visualization is about the virtual reproduction of physical space, analysis refers to the inverse process. With virtual space being a new phenomenon, it first needs to be conceptualized. The so-called urbanism of networks (Dupuy, 1991) is suited for this.

Figure 2 describes the conceptual framework in terms of three interacting levels of network operators that (re) organize the urban space.

?? **Level one** involves the suppliers of technical networks. They are specialized and organized in sectors (such as water, sewerage, energy, transport and telecommunication from conventional to ICT).

?? On **level two** one finds functional networks of common-interest users centering on production, distribution, consumption, and personal contacts. To each of these networks-specific location factors apply.

?? It is at level three that the operators of functional networks make actual, selective use of technical networks for their special purposes. Business firms, for example, arrange their logistic chains whereas households organize their action space or time space budget.

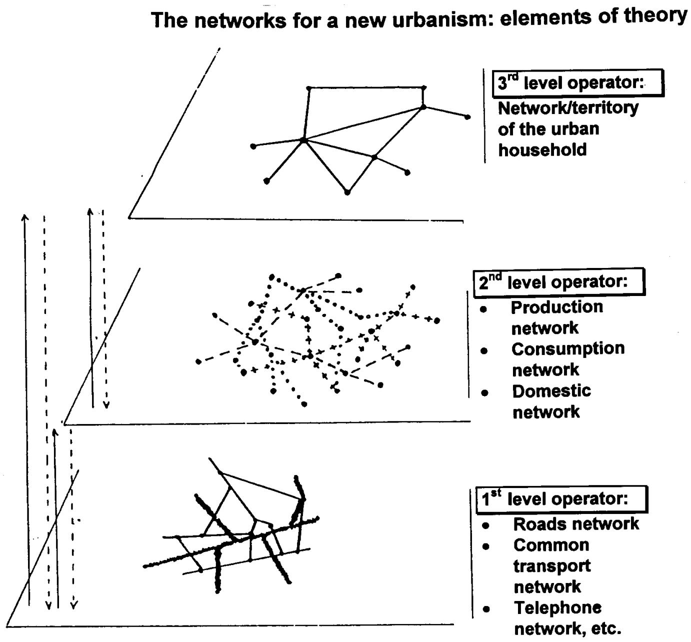


Figure 2.

The three levels can be referred to for short as hardware, software and orgware.

The usefulness of the framework has been tested for the Internet in an attempt to position the Randstad Holland in Europe (Drewe 1999a inspired by Gorman, 1998).

?? **Level one**, in this case, represents the Internet Service Providers (ISPs). In fact, the focus is on the European network of UUNET (for practical reasons).

?? **Level two** refers to the commercial domain, the 'Internet industry'.

?? **Level three** is where the actual traffic on the Internet is performed. Analyzing the transit backbones, graph theory can be applied once the technical network has been translated into a connectivity matrix comprising nodes and links. A node such as Amsterdam can be positioned using an unweighted binary matrix. Alternatively, the matrix can be weighted for multiple paths or bandwidth.

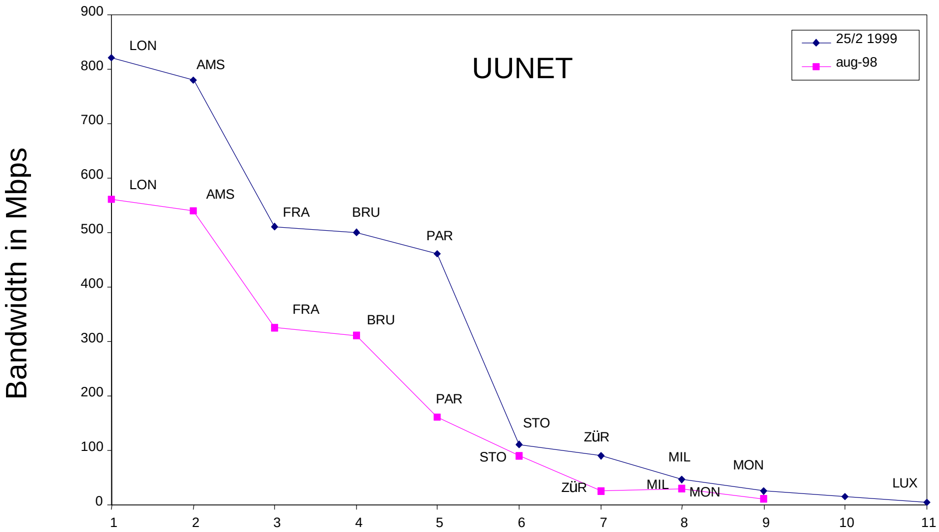


Figure 3

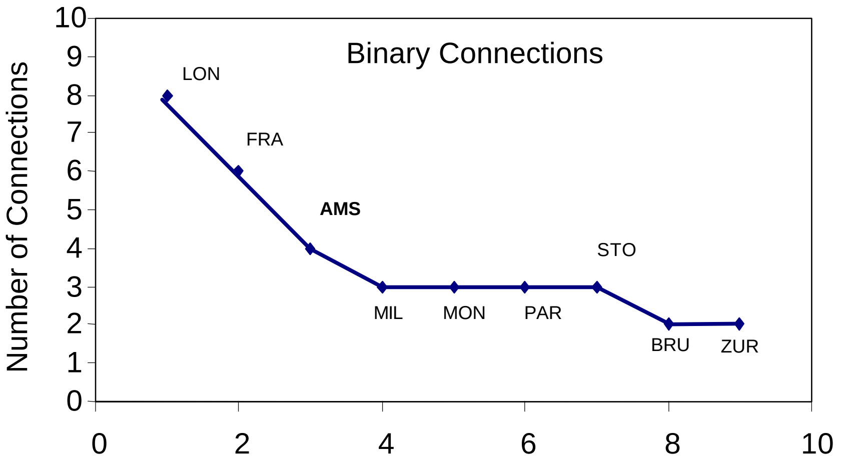


Figure 4

Comparing figures 3 and 4 shows how the position of Amsterdam is affected by the capacity of links. As to multiple paths, there is only indirect evidence available. The closer a node is to a so-called exchange point (say, LINX or AMS-IX) and the larger the number of peering ISP's connected to that exchange point, the more options on Internet user has.

According to the European Commission (1998), the Internet industry covers three layers of economic activities (figure 5):

?? 'Information Society' using the products and services of ICT companies,

?? 'Information Society Industries', i.e. content industries such as publishing, audiovisual and advertising,

?? 'ICT Industries', the suppliers of ICT products and services.

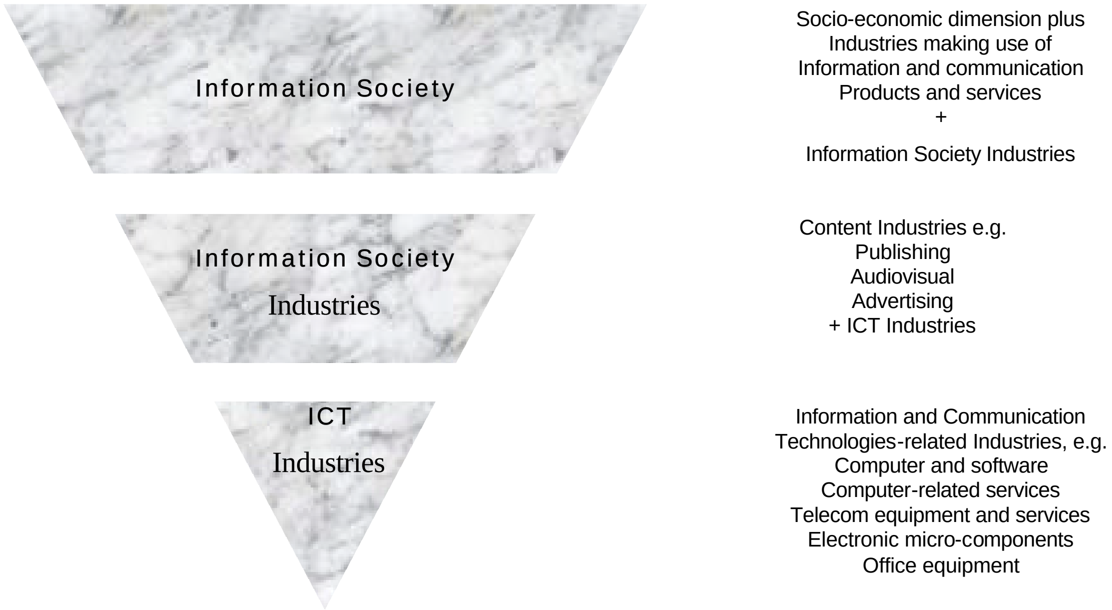


Figure 5.

The question is whether the Randstad Holland can gain an important market share in the emerging e-commerce. This depends on the interplay of the three layers within the Internet industry. It also depends on the Internet infrastructure (level one) and the performance of the Internet (level three). The latter has been measured with the use of a traceroute program. Using Delft as point of departure, banks in eight European nodes have been contacted electronically. Take for example Köln.

Report for www.ksk-koeln.de [194.77.6.28]
Analysis: node 'www.ksk-koeln.de' was found in 25 hops (TTL=111). It is a HTTP server (running WebSitePro/2.3.15).

Hop	Err	IP Address	Node Name	Location	ms	Graph	Network
		130.161.162.79	si970329	*		0 413	Technische Universiteit Delft
1		130.161.2.5	isdngw1.1	Delft, Netherlands	155		Technische Universiteit Delft
2		130.161.2.1	dunet0.ro	Delft, Netherlands	122		Technische Universiteit Delft
3		130.161.1.51	dunet3.ro	Delft, Netherlands	123		Technische Universiteit Delft
4		145.41.18.1	AR1.Delft	Delft, Netherlands	139		SARA
5		145.41.7.153	BR1.Delft	Delft, Netherlands	142		SARA
6		145.41.7.218	BR7.Amst	Amsterdam, Netherl	160		SARA
7		145.41.0.81	BR8.Amst	Amsterdam, Netherl	123		SARA
8		212.1.192. 177	surfnet.nl	(United Kingdom)	120		IP allocations for TEN-155
9		212.1.192.102	nl-se.se.t	(United Kingdom)	168		IP allocations for TEN-155
10		212.1.192.154	sw-gw.no	(United Kingdom)	171		IP allocations for TEN-155
11		193.10.252.174	ne-gw.no	(Denmark)	160		SUNET
12		195.158.226.85	stockholm	Stockholm, Sweden	223		Ebone backbone 3
13		195.158.226.69	stockholm	Stockholm, Sweden	207		Ebone backbone 3
14		195.158.226.82	copenhag	-	207		Ebone backbone 3
15		195.158.226.102	copenhag	-	206		Ebone backbone 3
16		195.158.226.114	munich-c	Munich, Germany	198		Ebone backbone 3
17		195.158.226.146	frankfurt-c	Frankfurt, Germany	233		Ebone backbone 3
18		195.158.226.165	frankfurt-c	Frankfurt, Germany	212		Ebone backbone 3
19		195.158.226.170	new-frankf	Frankfurt, Germany	153		Ebone backbone 3
20		192.121.158.182	-	Stockholm, Sweden	199		Ebone Consortium
21		194.231.40.58	cisco7.f.d	Frankfurt, Germany	189		GTN mbH
22		194.77.0.177	cisco13.n	Neuss, Germany	233		Gesellschaft fuer Telekom
23		194.77.0.19	cisco12.n	Neuss, Germany	271		Gesellschaft fuer Telekom
24		194.77.0.82.	xenologic	Neuss, Germany	224		Gesellschaft fuer Telekom
25		194.77.6.28	www.ksk-	Koeln, Germany	218		Xenologics Networks and

Box 1. Tracerouting van Delft naar Köln

The report (box 1) shows that Köln has been reached in 25 hops without losing information. Köln can be reached from Delft in 218 milliseconds ('return trip'). Physical distance is of no importance as Stockholm, for example, can be reached from Delft in 217 ms (18 hops).

But the Internet does not always perform smoothly.

?? Information (packets) may be lost,

?? There may be delays far beyond the average of 200 ms,

?? A packet, after having passed a certain network, may be blocked and therefore never reach its destination.

What are the lessons from this analysis?

It is useful to approach the Internet in terms of hardware, software and orgware:

?? Transit backbones represent 'hard' (physical) technical networks composed of nodes and links,

?? 'Soft' commercial networks exist but still need to be mapped empirically (the same holds, by the way, for other types of functional networks),

?? the organization of actual traffic on the Internet can be reproduced spatially, though traceroutes testify to the 'death of distance'.

The three levels are interacting. One way of dealing with this, related to the Internet, is the Keynote Business 40 Internet Performance Index

(see Drewe 1999 or go directly to: http://www.keynote.com/measures/business/business40.htm)

3 DESIGN AND DESIGN-ORIENTED RESEARCH

In figure 1, design has been symbolized by an arrow pointing from virtual to physical space.

This, however, does not imply that physical space is simply impacted on by ICT, let alone that it is determined by virtual space. Design is more of a search for new spatial concepts, inspired by the opportunities offered by ICT.

Whether a concept qualifies as new can only be decided after comparison with existing concepts. In the Netherlands, spatial concepts have been produced from 1920 onward, alternating and shifting over the years (Drewe, 1998c). Two main themes can be distilled out of them: concentration or dispersal, multifunctionality or monofunctionality. The compact city, the dominant policy concept in recent years, is an example of concentration combined with monofunctionality.

With ICT, however, either/or thinking is to be replaced by multiple-option thinking. At least that is part of the paradigm challenge.

Only multiple-option - say, concentration and dispersal, multifunctionality and monofunctionality-can cope with the task of organizing the increasing complexity. According to Jacobs this was already problematical in to the 60s:

"Why have cities not, long since, been identified, understood and treated as problems of organized complexity?If the people concerned with the life sciences were able to identify their difficult problems of organized complexity, why have people professionally concerned with cities not identified the kind of problems they had" (Jacobs, 1961: 434).

3.1 How to do develop new concepts

The development of new spatial concepts, inspired by ICT, requires a new approach to research, to wit design-oriented research.

Based on an exploratory study (Drewe, 1996), we have founded in 1997 the Design Studio The Network City VROM. It is a cooperation between the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM) and the Faculty of Architecture at Delft University of Technology: http://www.vrom.minvrom.nl/networkstad .

ICT is a new technology involving uncertainties. That is why design-oriented research is not focusing on feasible (probable) or desirable futures. Predictions are impossible and desirability is a political question (VROM can serve as a sounding board for the latter). Design-oriented research rather aims at possible futures as a design can demonstrate what could be.

Possible futures relate to the long term. In order to the bridge with today's practice, the most realistic near-term approach chosen is one of so-called test-beds:

?? **the future urban agglomeration** (see e.g. Caso, 1999 for social and spatial effects of telematics in residential areas, with special reference to teleservices for the elderly)

?? **the 'rest' of the Netherlands, beyond the 'periphery'**(e.g. the design of an alternative residential area in the Northern Netherland by Eisma,1998)

?? **the 'mainport' as node of a logistic network** (Drewe and Janssen, 1998a, 1998b and1999)

?? **the 'euroregion plus', beyond the Dutch border** (see Drewe, 1998b for the example of a cross border knowledge infrastructure).

Meanwhile, a number of test-beds has been added to the original ones, mainly smart homes and the future office and some attention is paid to on-line planning and design, too (Tisma, 1999).

Recently in the Netherlands proposal have been made for real-life test-beds or experiments, e.g. a sustainable, intelligent neighborhood or, focusing ICT, the so-called Giga Port (Internet 2) and a pilot project for the Amsterdam-Hilversum region.

3.2 Conceptualization

The Dutch government, in preparing a new National Policy Document on Spatial Planning, has proposed spatial concepts such as 'network cities' and 'corridors'.

The task ahead is to test the ICT sensitivity of these concepts.

It is the Design Studio that has produced ideas about how to do this.

Spatial concepts can be translated into the design language of the theory of the urban web.

According to Salingaros (1998), "any urban setting can be decomposed into human activity nodes and their interactions". The structural principles of the urban web are described in box 2.

1 **Nodes*:*** The urban web is anchored at nodes of human activity whose interconnections make up the web. There exist distinct types of nodes: home, work, park, store, restaurant, church etc. Natural and architectural elements serve to reinforce human activity nodes and their connective paths. The web determines the spacing and plan of buildings, not vices versa. Nodes that are too far apart cannot be connected by a pedestrian path.

2 **Connections**: Pairwise connections form between complementary nodes, not like nodes. Pedestrian paths consist of short straight pieces between nodes; no section should exceed a certain maximum length. To accommodate multiple connections between two points, some paths must necessarily be curved or irregular. Too many connections that coincide overload the channel's capacity. Successful paths are defined by the edge between contrasting planar regions, and form along boundaries

3 **Hierarchy:** When allowed to do so, the urban web self-organizes by creating an ordered hierarchy of connections on several different levels of scale. It becomes multiply connected but not chaotic. The organization process follows a strict order: starting from the smallest scales (footpaths), and progressing up to the higher scales (roads of increasing capacity). If any connective level is missing, the web is pathological. A hierarchy can rarely be established all at once.

Box 2: Structural principles of the urban web

By way of illustration, figure 6 shows two different ways of connecting four nodes:

?? "four nodes placed so that they look 'regular' from the air; but this regularity forbids anything more than minimal connections" (a),

?? "multiple connectivity between the same four nodes, seen in plan" (b).

?? See also figure 7:

?? "nodes are concentrated into three separate clusters, and all connections are forced into two channels. Such connections exceed the carrying capacity of the channels" (a),

?? "the same nodes distributed with connections that work much better" (b)

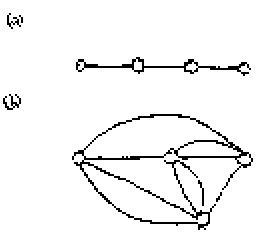


Figure 6

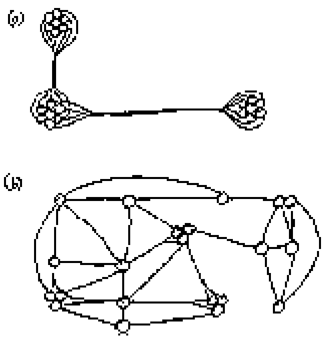


Figure 7

Each urban setting or spatial concept can be analyzed in terms of the three levels of the urbanism of networks: hardware, software and orgware.

Figure 2 refers and section 2 has shown a possible analysis albeit only at the European and the national scales and restricted to the Internet infrastructure.

Spatial planners prescribing top down concepts such as 'network cities' and 'corridors' seem to act similarly to (former?) public suppliers of urban technology networks.

It is on level two that these concepts are confronted with the functional needs of users and their locational preferences.

The actual use, manifesting itself at level three, indicates whether the top-down prescribed concepts match with user needs. The fact that there is a trend towards unbridled development of corridors, for example, indicates that the earlier policy concept of the compact city fell short in meeting the needs of households and business firms. It also testifies to the role of the automobile as a 'territorial adapter' (Dupuy, 1995,1999).

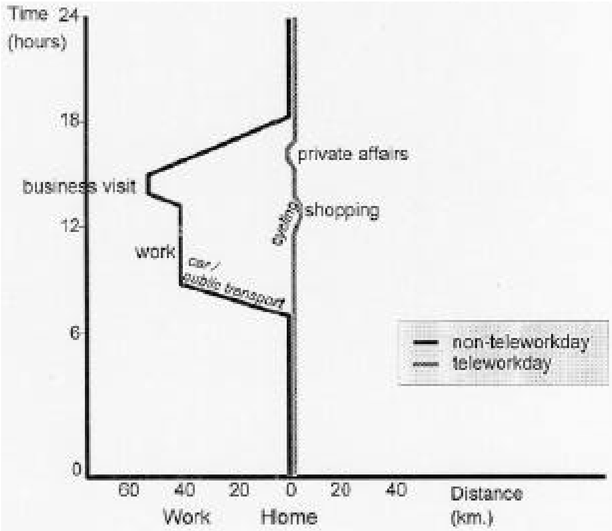


Figure 8.

Level three, with regard to companies, can best be conceptualized as in figure 8.

ICT relates to handling the mutual information flows between different locations using e.g. Electronic Data Interchange. These locations range from the origin of raw materials and semi-final products suppliers to consumers. What needs to be added to figure 8 is a time and space axis as in the time-space budget. The latter allows dealing with the usual order cycle time of 24 hours, but also with rush and stock orders.

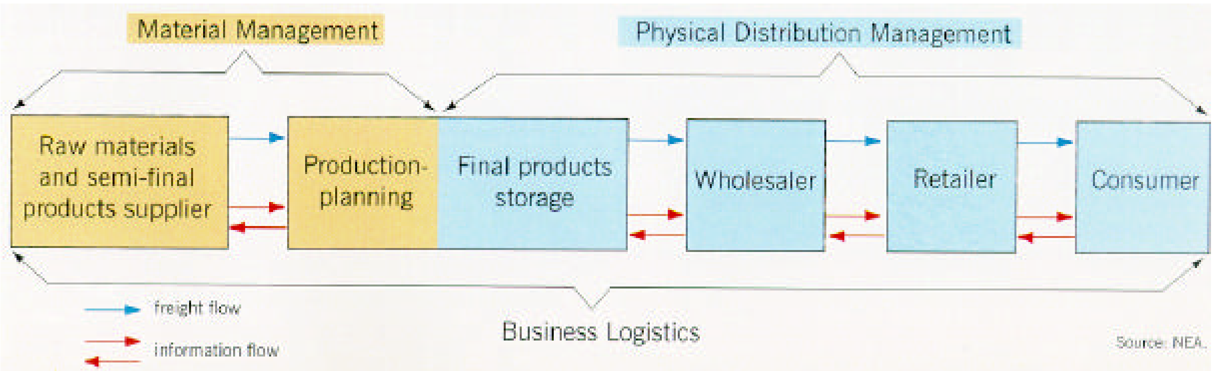


Figure 9.

Each of the three levels of the urbanism can be converted into a connectivity matrix to which graph-theoretic measures apply.

In fact, this has been shown in section 2, but only for the Internet infrastructure (level one).

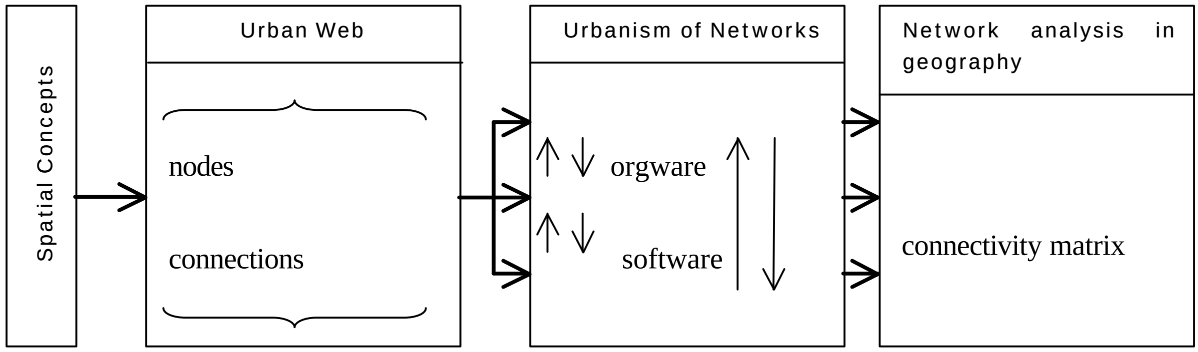


Figure 9. ICT sensitivity analysis of spatial concepts: conceptual framework

3.3 Methods and tools

“The traditional art of physical design, instead of reasserting its grounding powers is very much in danger of being relegated to a very insignificant role in the expanding, increasingly non-physical information space” (Droege, 1997:6).

Hence it is important for urbanism and related disciplines or professions to search for new concepts of physical and virtual space.

But if networks evolve as a central concept, then certain methods and tools must be mastered, too (Dupuy, 1991):

?? **Historical (diachronic) analysis of networks**
Technologies must be lived forwards, but can only be understood backwards. A lot can be learned from the automobile and conventional telecommunication.

?? **Graphical representation of networks**
Traditional manual tools in draftmanship can be enriched considerably by virtual visualization.

?? **Design of networks**
On-line planning/design offers new possibilities.

?? **Semiology of networks**
Semiology is the study or art of signs. The new media, in special, virtual visualization and the spatial analysis of virtual space offer a wealth of possibilities

?? **Evaluation of network**
If design-oriented research aims at demonstrating what could be, than evaluation is vital to probing for desirability and feasibility, even more so in the case of real-life experiments such as emerging urban ICT initiatives. Evaluation has been dealt with elsewhere in greater detail (Drewe, 1998c).

A new design brief also requires a debunking of myths of ICT and the future of cities, myths such as technological determinism, urban dissolution, universal access, simple substitution of transport by ICT and local powerlessness (Graham, 1997).

In search of new concepts of physical and virtual space, throughout this paper several 'classics' came up because they are useful shedding light on ICT as a new technology.

The urbanism of networks (Dupuy, 1991) goes back to network thinkers like Cerda, Wright and Rouge who have been marginalized by mainstream zonal thinkers of urbanism (in particular CIAM). Figure 2 is based on Fishman (1990) who, in turn, has been inspired by the 'Broadacre City' (Wright, 1943). Hagget and Chorley's network analysis in geography dates from 1969.

Salingaros, too, refers to classics from the 60s and 70s, to wit Alexander and Lynch.

And, finally, there is Jacob's far-sighted plea for 'organized complexity'.