THE RELATION BETWEEN THE INTERNET INFRASTRUCTURE AND THE INTERNET INDUSTRY

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The scene is set by a survey of new location factors for mobile investment in Europe, published by the European Commission in 1993. This leads to two questions the first of which concerns the exact definition of the Internet industry in order to avoid confusion. The definitional issue appears to be far from simple. The second question is about the Internet infrastructure. This infrastructure, although new and almost invisible, can nevertheless be mapped and measured with less ambiguity than the Internet industry. How to connect the two? How to establish the importance of the Internet infrastructure for the location of the Internet industry? Technological determinism and urban dissolution are debunked as myths. A conceptual innovation is called for: to conceive of the connection between infrastructure and industry as a match between networks. By way of conclusion, this match is discussed from the viewpoint of non-hub cities or regions.

TO SET THE SCENE

Back in 1993, the European Commission has published a survey of new location factors for mobile investment in Europe on the national and regional levels (Commission of the European Communities, 1993). Mobile investment is classified in five broad sectors. Only one of them slightly refers to ICT, ie 'services including software and financial functions'. The survey still covers the pre-Internet or pre-World Wide Web era. Similarly, no reference is made to the Internet infrastructure as location factor. 'Quality of telecommunications' comes closest as one out of four infrastructure indicators.

To do a better job, one has to focus explicitly both on the Internet industry and the Internet infrastructure. There is, however, an important lesson to be learned from the past: there is no single overriding location factor, hence no simple model of location factors can be constructed. This should be taken as a warning against the ICT myth of technological determinism (Offner, 2000; Drewe and Joignaux, 2002).

1 WHAT IS EXACTLY THE 'INTERNET INDUSTRY'?

According to Castells '… it would be too narrow a vision to consider the Internet industry as made up exclusively of Internet manufactures, Internet software companies, Internet service providers, and Internet portals. The commercial Internet is not just about web companies, it is about companies in the web' (Castells, 2001, 213). This definition is not very helpful when it comes to empirical research. The European Commission has carried the definition problem, at least conceptually, a step further (European Commission, 1998, 2).

The Commission distinguishes three layers:

- the 'Information Society' includes both households and established business firms using ICT products and services
- 'Information Society Industries' produce content on the net such as publishing, audiovisual or advertising
- 'ICT industries' sell a number of clearly defined products and services.

One of the first serious attempts to measure the Internet industry has been made by Zook (1999).

According to Zook:

'… it encompasses firms from a wide array of traditional industries because the new methods for communication and distribution offered by the Internet have a wider impact than any one particular sector. In a very real sense, these firms are actively engaged with a technology that could restructure the current organization and boundaries of their industries'(Zook, 1999, 2).

Therefore it would be erroneous to refer to the Internet industry in terms of 'new economy' as opposed to 'old economy'. It is Porter (2001) who has reached the same conclusion: '.. the 'new economy' appears less like a new economy than like an old economy that has access to a new technology…The old economy of established companies and the new economy of dot-coms are merging, and it will soon be difficult to distinguish them'(Porter, 2001, 78). There are strategic imperatives for dot-coms as well as established companies. Dot-coms, for example, should create customer value and charge for it directly ('the end of free'), rather than relying on indirect forms of revenue. For established companies to be successful it is important to improve traditional activities by using the Internet and to develop new combinations of physical and virtual activities. Zook in a study of e-commerce in the US concludes, for example, "… that E-commerce is continuing to shift away from the entrepreneurial startup prevalent at the end of the 1990s to more established 'bricks and mortar' companies" (Zook, 2001, 19). What really counts are applications of Internet in the value chain. In order to identify them, one needs to 'unblackbox' any statistical aggregates of the Internet industry and shift to individual data.

2 THE INTERNET INFRASTRUCTURE

The Internet infrastructure, although new and almost invisible (see Hayes, 1997), can nevertheless be mapped and measured with less ambiguity than the Internet industry. The infrastructure serves the Internet business and consumer market, most directly through ISPs. The European transit backbone of World Com in 2002 can serve as an example. One counts 19 nodes, mainly capital cities, and 40 links within Europe. There are also 10 overseas links. The position of a given node or city on the European net depends, first of all, on the number of direct, binary connections. The core of the net is composed of 4 cities: Frankfurt, Amsterdam, London and Paris, from 12 down to 8 direct connections (counting only the European links). If one includes the oversea links (to New York,

Washington, DC and Hong Kong), London becomes the number two, at the expense of Amsterdam. In both cases, Stockholm appears as runner-up to the core group.

Of course, the importance of the links varies. To gain more insight into the position of a city, the direct connections need to be weighted for their capacity or bandwidth. And they need to weighted for multiple paths too.

Bandwidth is measured in terms of megabytes or even gigabytes per second in mbps or gbps. Total bandwidth in Europe confirms the existence of a core group, however, with two major exceptions. The German node of Hilden (near Düsseldorf) being an important switchboard, occupies the fourth position. And London drops to the seventh position. But it is the uncontested number one if one includes the oversea links thanks to a 10 gbps connection with Hong Kong.

What about multiple paths? They depend on the proximity of a node to an Internet exchange point. The more ISPs are involved, the more important the exchange point. Whether an exchange point really offers multiple paths on the net, however, depends on peering agreements between the different ISPs. To peer means to cooperate, not to compete. All of the 19 nodes have at least one Internet exchange point. Some have more in particular Paris and London. The number of associated Internet service providers (which by the way is constantly changing) varies. It does not suffice to measure the Internet infrastructure in terms of direct connections, bandwidth and multiple paths. One also has to check the endowment with infrastructure for its actual performance (the actual traffic on the Internet). The question is how the data flows between points of origin and destination. The question can be answered by traceroute (Dodge, 1999). The traceroute results can be compared to a weather report. The Internet may function smoothly in 'good weather' with physical distance between cities or nodes turning into milliseconds. But one may encounter 'bad weather' , too, such as delays. Moreover, information packets may get lost or even blocked, not reaching their destination.

3 INTERNET INDUSTRY & INTERNET INFRASTRUCTURE: THE CONNECTION

How important is the Internet infrastructure as a location for the Internet industry? How do the two connect?

Looking for empirical evidence we again come across the work of Zook. He has established statistical relations between domain name specialization ratio's and location coefficients for two clusters of industries in the United States in 1998. The strongest links occurs between domain names and the cluster of informational industries. The link with the Internet infrastructure is at best an indirect one: if the high-ranked metropolitan regions coincide with hubs in the US Internet infrastructure. San Francisco and New York indeed are both NAPs (and Los Angeles is a Metropolitan Area Exchange). But why does Chicago which is both an informational center and a NAP not figure in the top group? Could there be other location factors at work that impede a more important role of Chicago?

Some empirical evidence on the connection between Internet infrastructure and Internet industry is also available for the Netherlands. The majority of small, young and innovative ICT firms is located in the highly urbanized part of the Netherlands, the Randstad to wit 56% (with 54 firms in Amsterdam). Amsterdam, is the home of the Dutch Internet hub. Locations close to universities of technology are important in the Western part (Delft) and in the rest of the country (in Eindhoven with 32 companies and Twente. See Van Eck van de Sluijs et al (1998).

In a more recent study in the Netherlands (Louter et al, 2001) the Randstad in general and Amsterdam in particular are confirmed as favorite location of:

- so-called ICT-sensitive sectors,
- ICT services
- ICT content.

In Amsterdam for example, the ICT-sensitive sectors score more than 41%.

What do these examples tell us about the ICT infrastructure as a location factor for the Internet industry?

It is not possible to assign a causal explanation, to the relationship between infrastructure and industry. They are only coterminous, covering or involving the same area. That direct connections, bandwidth and multiple paths are a critical location factor for the Internet industry in the largest sense, appears as a plausible hypothesis though. But to assume that the new infrastructure is the single, overriding location factor for the Internet industry would amount to technological determinism. How does one explain, for example, the deviant case of Chicago? Earlier empirical evidence suggests that telecommunications rather are a complement to or, at least, not a strong substitute for face-to-face interactions (Gaspar and Glaser, 1998).

What is exchanged here is tacit knowledge as opposed to codified, routine information. This exchange serves the purpose of conceiving new products or services (conceptual core skills), efficient production (competence) and organizing networks (connections). See Kloosterman (1997). Companies that exchange only codified information using ICT regularly show a greater flexibility with respect to their location or the location of specific activities within the company (Traxler, 1999). Face-to-face interactions are more important for front than for back offices (Louter et al, 2001). Zook has found statistical evidence for Top 1000 websites and Top Internet firms in the US being related to venture capital investments. Venture capitalists rely on local networks and knowledge for their investments. 'Rather than being an easily moved and fungible commodity, venture capital investing depends upon non-monetary inputs such as knowledge about possible investments and prefers to be close to companies in order to monitor and assist them'(Zook, undated, 1). Money is also a social relation (Martin).

The issue of this kind of location factors (other than the Internet infrastructure) is also related to cities. They are related to spatial proximity which is primarily found in high-density urban environments. 'Like anything else, high tech requires infrastructure, and like any infrastructure the new tends to go right were the old was - economic logic says to minimize risk by investing in already dominant areas'(Cohen, 2000, 2). The rich get richer. That debunks the myth of urban dissolution, of the Internet making urban centers obsolete.

To deal adequately with the Internet infrastructure as a location factor for the Internet industry asks for a conceptual innovation. The 'new science of networks' (Barabási) can provide a promising avenue of research. Both the industry and the infrastructure are to be conceived of as networks composed of nodes and links. This has been clearly demonstrated for the Internet infrastructure in section 3. 'The construction and structure of graphs or networks is the key to understanding the complex world around us' (Barabási, 2002, 12). Graph theory is the basis for our understanding of the complexity of the Internet infrastructure or any other infrastructure network (see Gorman, 1998, undated; Drewe, 1999a). Similarly, the Internet industry needs to be represented as a network of companies' backward and forward linkages. This must go beyond the purely economic or monetary relations dealt with by input-output analysis. See for example Barabási (2002) on the network economy.

Networks in general (in different scientific disciplines) manifest a power-law degree distribution: very many nodes with only a few links and a few hubs with large number of links. Whether the Internet industry shows a similar distributions cannot be definitely established because of lack of data. However, a look at the spatial distribution of the top 1000 business firms in Europe suggests a distribution similar to that of the Internet infrastructure. By the way, the Top 1000 websites and Top Internet firms in the United States are strongly correlated with total employment as an indicator of size of regions or external economies (Zook, undated). Hence the issue of the Internet infrastructure as a location factor for the Internet industry can be reformulated as search for a match between the respective networks.

4 MANY ARE CALLED, ONLY FEW ARE CHOSEN – BY WAY OF CONCLUSION

If the geographic distribution of the Internet industry in the largest sense is governed by power law, then there are many cities or regions with only a few Internet firms or links. Under the influence of the paradigm of competition, those cities or regions are pressured to attract the Internet kind of mobile investment and to meet with the corresponding infrastructure requirement. Hitparades of places, produced by the 'top-of the pops school of geography' tend to put pressure on decision-makers. Who does not want to be for example, a world city if not an Alpha world city, than at least a Beta or Gamma world city (Beaverstock et al, 1999)? There is also a socio-Darwinistic undertone as only the fittest are supposed to survive. But there are different degrees or levels of fitness. As far as the match between Internet industry and infrastructure is concerned, the important thing is to achieve a balance on all levels between supply, demand and performance (as shown in figure 1). The Internet-interrelations between supply, demand and performace. Demand is the driving force, although in this day and age it is not predictable as the recent dot.com downturn has shown. Relying too much on the supply side reverts to relying on the well known structuring effects of infrastructure which is a form of technological determinism. How to deal with an uncertain future of the Internet on the local or regional level? One way of doing this is to carefully monitor the Internet industry network, for example, the degree of interregional and cross-border cooperation between companies. Scenarios, too, can play an important role in the management of uncertainties. Recently, a French group has been working on ICT (among others). This work is part of a project of prospective research for Datar. The group is convinced that, on the road to 2020, the governance of territories depends on the mastering of networks such as the Internet infrastructure network (see Musso et al, 2002 for the approach; a publication of the results is forthcoming). To date, five ICT scenarios have been elaborated. The most promising future from the viewpoint of cities or regions is sketched by the scenario of Multisubsidiarity: given its focus on territorial ICT projects. There are French examples illustrating what can be achieved at the urban/regional level: the RMT of Greater Lyon and the ICT agency in the French Bask country. See also metropolitan Chicago in its attempt to catch up with the leading metropolitan regions in the US (Widmayer and Greenberg, 1998).

In terms of the 'new science of networks' (Barabási, 2002) the question is: 'How do latecomers make it in a world in which only the rich get richer?' 'In a competitive environment each node has a certain *fitness'*. Generally speaking, preferential attachment plays an important part. It is driven by 'the *product* of the node's fitness and the number of links it has'(the so-called fitness connectivity product).

Catering to the needs of their Internet industry network, cities or regions can plan to create more direct connections, bandwidth and multiple paths to start with.

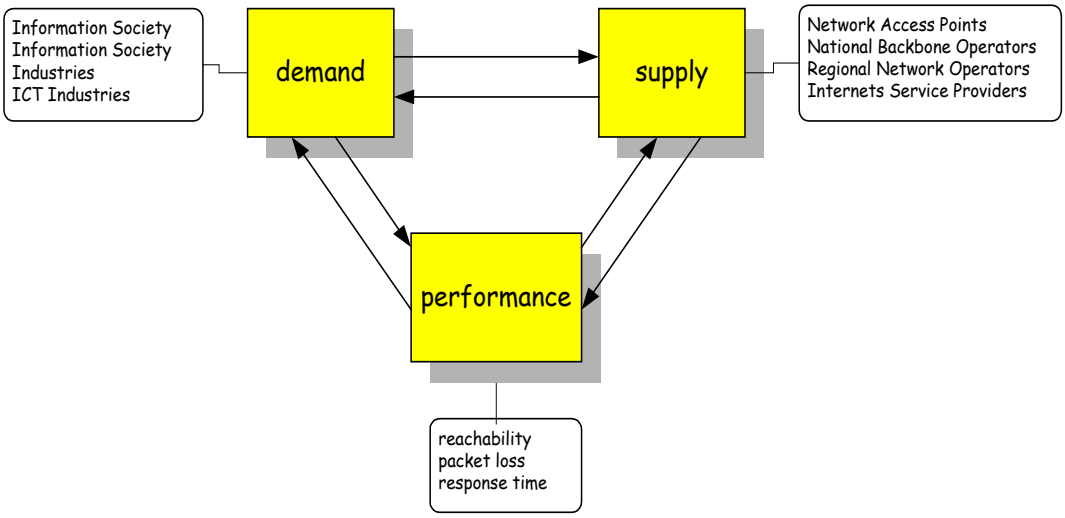

Figure 1 is figure 4.

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