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European ICT Poles of Excellence

The Geography of European ICT Activity and Its Policy Implications

The European Commission is trying to increase the EU's competitiveness by building on its assets, particularly its many ICT industrial clusters. The Commission is seeking to strengthen the role of European ICT poles of excellence (EIPEs). But where are EIPEs and what are their characteristics? This paper reports the results of a project that casts more light on the geography of European ICT activity and indicates the key ICT locations in Europe. The project results show that excellence is scarce and is built on solid foundations in science and technology and industrial activity. We discuss the challenges to the EU's ambition to nurture five additional EIPEs within the next few years and present policies which could strengthen the position of existing EIPEs and improve the performance of potential candidates so that they play a stronger role in European ICT activity.

Information and Communication Technologies (ICT) undoubtedly constitute one of the key innovations of the last century. In most advanced economies, an ever-increasing share of economic inputs and outputs takes the form of ICT and knowledge.[1] As a result, the traditional determinants of industrial location – access to raw materials, transportation networks, low costs, a large pool of general labour – are becoming less important in these economies. Instead, locational choice is increasingly governed by access to particular skills, technology, knowledge, entrepreneurial talent and financing. Against this background, the European Commission's Communication entitled "A Strategy for ICT R&D and Innovation in Europe: Raising the Game" proposes ways to reinforce Europe's industrial and technology leadership in ICT.[2] Building on Europe's assets, particularly its many ICT industrial clusters, the strategy seeks to step up efforts in ICT research, development and innovation (R&D&I). The Communication anticipates a landscape in which, by 2020, "Europe has nurtured an additional five ICT poles of world-class excellence".[3]

1 G. Bristow: The implications of the new economy for industrial location, in: D.C. Jones (ed.): New Economy Handbook, London 2003, Academic Press, pp. 269-287.
2 European Commission: A Strategy for ICT R&D and Innovation in Europe: Raising the Game, European Commission, 2009.

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But what are European ICT poles of excellence (EIPEs)? Where are they? What are their characteristics? Can we observe their dynamics? How can we distinguish them from the many European ICT clusters? In order to answer these questions, DG CONNECT together with the Joint Research Centre's Institute for Prospective Technological Studies set up a project to map European ICT assets and to identify the key ICT activity locations in Europe.[4] This paper summarises the main results and policy implications of the EIPE project.

This paper first describes the characteristics of EIPEs and proposes a methodology to empirically identify them. It then reports the main findings of the geographical mapping of ICT activity in Europe. Finally, the article describes the main characteristics of best-performing locations in Europe's ICT landscape and discusses the policy implications.

What are EIPEs and how can we identify them?

The first step in identifying current and emerging EIPEs was to define them and establish a sound quantitative methodology. This was achieved by first carrying out

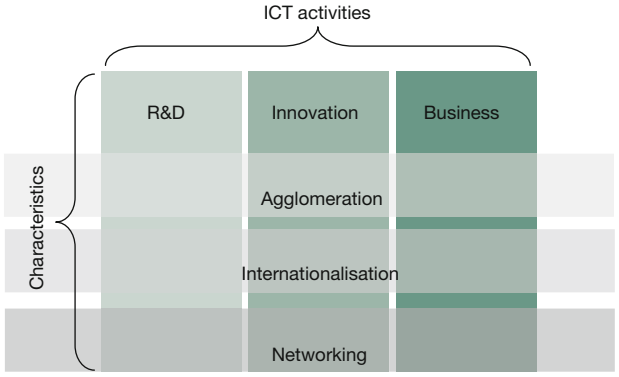
3 Ibid., p. 11.
4 Project No. 31786-2010-06.

an extensive scientific literature review that described, analysed and mapped the spatial concentration of economic activities over the last century, as well as more recent knowledge-intensive and ICT-related activities at local and global levels.[5] This review shows that the concept of EIPEs can be associated with many existing views and formulations, e.g. industrial districts, clusters, centres, etc. As a result, the definition of EIPEs takes into account the main modern concepts and models emerging from the existing academic and non-academic literature. However, the concept of poles of excellence is different from neighbouring concepts such as industrial clusters, innovative regions or centres of excellence, to name but a few. None of these concepts, theoretical or empirical, fully meet the requirements and specificity determined in our study that a location must have to be considered an EIPE. In particular, we find that an EIPE needs to perform well in business and knowledge functions, both of which must be characterised by strong and observable agglomeration, internationalisation and global networking. Hence, in contrast to the approaches and definitions encountered in this literature review, we propose the following definition of EIPEs:

European ICT poles of world-class excellence are geographical agglomerations of best performing information and communication technologies R&D, innovation and business activities, located in the European Union, that exert a central role in global international networks.

This definition of EIPEs recognises that R&D&I activities are interlinked with business activity. In other words, in an EIPE neither of these activities is likely to exist in a vacuum. Instead, they will be embedded in common spatially agglomerated industrial and business activity, supported by and forming the basis of inventive activity. There is a mutual interdependency between R&D and business activities, which implies that these are often co-located. Moreover, this view has something in common with the concept of industrial clusters but is broader in several essential aspects. First, it expands the scope of the observed activities from business to knowledge-related activities, thus acknowledging the contemporary importance given to the knowledge function in advanced economies (high performance is expected in both activities). Second, it assesses the global internationalisation of production and R&D&I activities. Third, it puts additional emphasis on the network position of any individual location: centrality in a network is taken as an indicator of the strategic role played by a location in the global landscape of production and R&D&I activities.

Figure 1
A visual approach to the definition of poles of excellence



Source: Authors' illustration.

Moreover, the above perspective echoes two theoretical approaches that articulate the two dimensions of the EIPE measurement framework. The first is the Crepon, Duguet and Mairessec (CDM) model,[6] a structural model designed to explain innovation output by R&D investments and, in turn, productivity by innovation output, reflecting the interdependencies of knowledge and business activities. The second relates to the "buzz versus pipelines" balance, observing the differentiated and mutual benefit of proximity and global networking for agglomeration economies.[7] In addition, because of the policy purpose of the study, the proposed definition of EIPEs is explicitly technology specific: it focuses on ICT and its supply side.

The second step towards developing a methodology to identify EIPEs was to make this definition operational.[8] The selection of indicators for identifying ICT poles of excellence took into account both R&D performed in a given location and the business activity. In other words, we observed three activities in the EIPE, echoing the CDM model, which acknowledged that the innovation stage comes between R&D and business activity on the market. Second, the definition points to three important

5 D. Nepelski, G. De Prato: Defining European ICT Poles of Excellence. A Literature Review, JRC-IPTS, Seville 2013.

6 B. Crepon, E. Duguet, J. Mairessec: Research, Innovation And Productivity: An Econometric Analysis At The Firm Level, in: Economics of Innovation and New Technology, Vol. 7, No. 2, 1998, pp. 115-158.

7 H. Bathelt, A. Malmberg, P. Maskell: Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation, in: Progress in Human Geography, Vol. 28, No. 1, 2004, p. 31-56.

8 G. De Prato, D. Nepelski: Identifying European ICT Poles of Excellence. The Methodology, JRC-IPTS, Seville 2013.

Table 1
Data sources used in the EIPE study

Name of data source	Description	Used to proxy the following ICT activities
Venture capital: Venture Source by Dow Jones	This database contains information on venture capital transactions, the financed companies and the financing firms.	Innovation Agglomeration
Regional patent data: REGPAT by OECD	Patent data that linked to NUTS 3 / TLS3 regions according to the addresses of the applicants and inventors. Over 2,000 regions are covered across OECD countries.	Innovation Agglomeration
		Innovation Internationalisation
		Innovation Networking
European Investment Monitor by Ernst & Young	Information on international investments in Europe by companies from all over the world. Since 1997, data has been collected for all European countries and as of 2011, it included over 40,000 observations.	Business Agglomeration
Company level information: ORBIS by Bureau Van Dijk	ORBIS (Bureau Van Dijk) contains comprehensive information on companies worldwide, with an emphasis on private company information. Orbis contains information on both listed and unlisted companies and has information on 120 million private companies.	Innovation Agglomeration
		Business Agglomeration
		Business Internationalisation
		Business Networking
ICT R&D centres locations: Design Activity Tool by IHS iSuppli	A company-level dataset including a list of R&D centres belonging to a number of high-tech companies together with their exact location and additional information on the type of R&D activity performed in these centres.	R&D Agglomeration
		R&D Internationalisation
Bibliometrics: Web of Science by Thomson Reuters	An online academic citation index designed for providing access to multiple databases, cross-disciplinary research and in-depth exploration of specialised subfields within an academic or scientific discipline. It encompasses over 11,000 journals selected on the basis of impact evaluations. Coverage includes the sciences, social sciences, arts and humanities, and across disciplines.	R&D Agglomeration
FP7 database by EC DG Connect	The analysis of the Framework Programme 7 programmes and participants is based on the database provided by the DG Connect in November 2011. Information on the FP7 is used and concerns only the information and communication technologies (ICT) areas.	R&D Agglomeration
		R&D Internationalisation
		R&D Networking
QS World University Rankings by QS	Formed in 2008, the QS World University Rankings currently considers over 2,000 and evaluates over 700 universities in the world, ranking the top 400.	R&D Agglomeration

Source: G. De Prato, D. Nepelski: Identifying European ICT Poles of Excellence. The Methodology, IRC-IPTS, Seville 2013.

characteristics of these activities, acknowledging the literature on various aspects of proximity and a location's global assets, i.e. agglomeration, internationalisation and networking. These assets can be observed and measured for each type of activity, i.e. R&D, innovation and business. This approach creates a matrix of activities and their characteristics, as shown in Figure 1.

Finally, on the basis of the framework of activities and their characteristics described above and the discussion on their empirical measurements, a list of 42 indicators was compiled for the EIPE project.[9] Altogether, eight different data sources were used to elaborate these indicators (see Table 1).

The selected indicators, their measurement and the resulting multiple rankings represent an abundance of diverse information that cannot be analysed at first glance. In order to provide synthetic comparable results for further analysis and interpretation, the information contained in the individual indicators had to be aggregated. First, all the indicators formed three sub-indicators (ICT R&D, innovation and business), which were then aggregated into one EIPE Composite Indicator (CI). This approach allowed us to generate an EIPE Identity Card (ID) for each of the 1,303 European NUTS 3 regions.2

In addition, the EIPE study distinguishes three main types of regions according to the intensity of ICT activity:

9 Ibid., Table 3, p. 17.

- 1st tier regions, i.e. those scoring between 81 and 100 on the EIPE CI;
- 2nd tier regions, i.e. those scoring between 61 and 80 on the EIPE CI;
- 3rd tier regions, i.e. those scoring between 41 and 60 on the EIPE CI.

The geography of European ICT activity

Using the empirical framework and the set of elaborated indicators, the map of Europe divided into NUTS 3 regions, i.e. altogether 1,303 units of observation, was scanned in order to identify EIPEs. This exercise produced the Atlas of ICT Activity in Europe.[10] In addition, the ranking of regions according to their score on the EIPE CI revealed that only a very small number of EU regions demonstrate intensive ICT activity.[11]

The landscape of ICT activity in Europe is often dominated by small areas with highly concentrated activities. The geographical concentration of high scoring regions and the high concentration of ICT activities do not come as a surprise. It is the predictable result of agglomeration, a process widely described in economic literature and also observable in the US (Silicon Valley, North Carolina knowledge triangle, Boston Route 128) and elsewhere (Bangalore in India or Changzhou in China). Factors such as the spatial proximity of similar and related firms and industries and the general tendency of people and economic activity to locate in large cities and economic core regions all lead to agglomeration. The agglomeration of R&D, innovation and business activity facilitates local knowledge spillovers and fosters the local business system. This is reflected in strong co-location patterns of production and research units in close proximity.

Table 2 shows the ranking and score of these top performing 34 regions out of the 1,303 NUTS 3 level regions of the European Union. The following three regions were assessed as 1st tier EIPEs:

1. München Kreisfreie Stadt (DE212), Germany (EIPE CI = 100)
2. Inner London East (UK12), UK (EIPE CI = 98)

Table 2
Top performing regions according to the EIPE Composite Indicator

Level	EIPE rank	NUTS 3 code	Region name	EIPE CI
1st tier	1	DE212	München, Kreisfreie Stadt	100
	2	UKI12	Inner London – East	97
	3	FR101	Paris	95
2nd tier	4	DE122	Karlsruhe, Stadtkreis	80
	5	UKH12	Cambridgeshire CC	78
	6	SE110	Stockholms lan	77
	7	DE711	Darmstadt, Kreisfreie Stadt	73
	8	FI181	Uusimaa	70
	9	NL414	Zuidoost-Noord-Brabant	70
	10	NL326	Groot-Amsterdam	64
	11	BE242	Arr. Leuven	61
3rd tier	12	DEA22	Bonn, Kreisfreie Stadt	59
	13	FR105	Hauts-de-Seine	59
	14	ITC45	Milano	59
	15	DE300	Berlin	58
	16	IE021	Dublin	57
	17	DEA21	Aachen, Kreisfreie Stadt	55
	18	NL333	Delft en Westland	55
	19	UKJ14	Oxfordshire	51
	20	UKM25	Edinburgh, City of	51
	21	DE111	Stuttgart, Stadtkreis	50
	22	DE125	Heidelberg, Stadtkreis	49
	23	DE21H	München, Landkreis	49
	24	BE100	Arr. de Bruxelles-Capitale	48
	25	DK011	Byen Kobenhavn	48
	26	UKJ11	Berkshire	48
	27	AT130	Wien	47
	28	ES300	Madrid	46
	29	UKJ23	Surrey	45
	30	DE712	Frankfurt am Main, Kreisfreie Stadt	44
	31	UKJ33	Hampshire CC	43
	32	DE252	Erlangen, Kreisfreie Stadt	42
	33	FR103	Yvelines	42
	34	DED21	Dresden, Kreisfreie Stadt	41

Note: The table includes the ranking of the 34 best scoring European NUTS 3 regions, i.e. those scoring above 41 points on the EIPE Composite Indicator. The scale of the EIPE Composite Indicator represents a normalised scale with minimum 0 and maximum 100.

Source: G. De Prato, D. Nepelski: Identifying European ICT Poles of Excellence. The Methodology, JRC-IPTS, Seville 2013.

10 G. De Prato, D. Nepelski: Mapping the European ICT Poles of Excellence. The Atlas of ICT Activity in Europe, JRC-IPTS, Seville 2014.

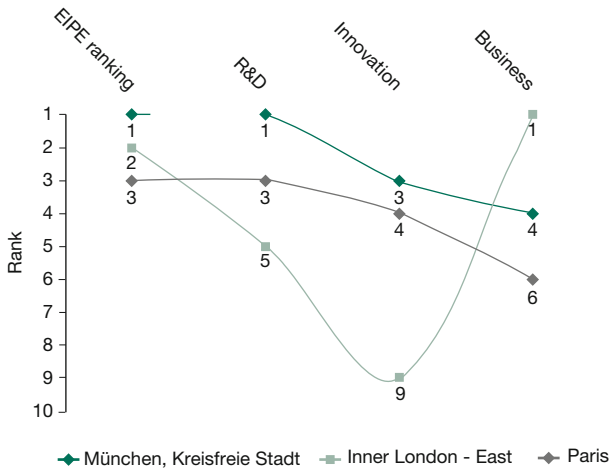
11 Figure 3 in ibid. illustrates this geographical concentration of ICT activity across the EU.

3. Paris (FR101), France (EIPE CI = 95).

There are eight 2nd tier regions and 23 3rd tier regions. Thus, only 34 EU regions scored 41 points or more on the EIPE Composite Indicator. These regions can be considered as the key places for ICT activity in Europe. Furthermore, these 34 regions are themselves concentrated in a small number of countries. Only 12 EU member states (Germany, UK, France, Sweden, Finland, the Netherlands, Belgium, Italy, Ireland, Denmark, Austria and Spain) host all of the top 34 regions.

The study also observes that 2nd and 3rd tier regions tend to be geographically clustered. Some of these clusters may include a 1st tier region. Half of the top 34 regions are located in these clusters. The other half, including eight capital cities, several important locations of ICT R&D and a few remaining regions, appear isolated (in geographical terms).

Figure 2
Performance of the top three EIPEs across ICT activities



Note: The figure represents the performance of the top three regions in the EIPE Composite Indicator and three sub-indicators, i.e. ICT R&D, ICT innovation and ICT business. The scale represents a rank among 1,303 European NUTS 3 regions.

Source: G. De Prato, D. Nepelski: Identifying European ICT Poles of Excellence. The Methodology, JRC-IPTS, Seville 2013.

What makes an EIPE

Transformation of R&D to market performance is key

A deeper level of data analysis carried out in the case studies shows that excellence in ICT is built upon high and balanced performance in all activities, i.e. ICT R&D, innovation and business, and in all three characteristics: agglomeration, internationalisation and networking. This is illustrated by the top three EIPEs and their performances across the sub-indicators. As Figure 2 shows, the performance of the individual regions across the three dimensions is quite balanced. For example, München Kreisfreie Stadt, number one in the overall EIPE comparison, ranks first in ICT R&D, third in ICT innovation and fourth in ICT business. Similarly, Inner London East holds the fifth, ninth and first positions in the individual sub-indicators. This observation is supported by an in-depth analysis of the EIPEs.[12] Key ICT activity locations in Europe like Inner London East or Paris exhibit very rich and diverse ICT R&D landscapes with large numbers of universities with high levels of scientific output. ICT innovation and business activities also exhibit very strong agglomeration characteristics.

It is worth noting that these locations' high scores are driven not only by sheer numbers, but they also reflect the high quality of the activities performed there. For example, computer science faculties at universities in Munich, Paris and London are widely recognised by the business and academic world. The inventive output and products developed by start-ups based in these locations are very attractive from the business point of view. This is exemplified by the fact that London and Paris are Europe's largest recipients of venture capital funding and that they are among the most important destinations for new business investments by ICT firms, mainly in the software, electronics and computer sectors.

Another important feature of some of the high-scoring regions is that although they may not be the main locations of, for example, R&D or innovation activities, they are the key locations of global corporate control of these activities, which usually take place outside the region. The prime example is London, which has relatively little R&D infrastructure and inventive output, but as it is the key place to "do business", it hosts a number of headquarters of multinationals and affiliates of foreign firms. These linkages and control over R&D, innovation and globally dispersed business activities turn these regions into melting pots with high levels of internationalisation, which in turn translates into strong positions in the global networks of economic activity.

12 D. Nepelski, G. De Prato: Analysing the European ICT Poles of Excellence. Case studies of Inner London East, Paris, Kreisfreie Stadt Darmstadt, Dublin and Byen Kobenhavn, JRC-IPTS, Seville 2014.

One size does not fit all

As noted above, EIPEs share several commonalities. However, they also have pronounced differences.[13] The regions are very diverse as regards size (e.g. population, area), status (e.g. global cities, capital cities, regional capital cities), and institutions and policies (e.g. at the national, regional and local levels). Not all the regions are neighbours to one or more similarly ranked regions. Proximity is unevenly distributed, with some regions more isolated than others. Local industrial composition varies, favouring the development of ICT activity in close relation to specific vertical sectors. The current assets of each region appear to be historically rooted, with their current activities and profiles resulting from several decades of experience: industrial structure, policy decisions, institutional settings, migration and education outcomes, etc.

Regions have various levels of endowment in ICT R&D, innovation and business. Most of the EIPEs have global reach, with intense cross-border activities, and have gained a strong hub position in a usually very complex web of network connections. However, the internationalisation of each activity follows different patterns. Some regions have a more local orientation (within the EU), e.g. Byen Kobenhavn, while others, e.g. London, have far-reaching connections (US and Asia). Each region has developed a different portfolio of partners, resulting in the emergence of different network structures for activities, locations, etc.[14]

All of the above aspects contribute to diversity in specialisation, with each region having specific strengths and weaknesses. This impacts the region and results in very differently balanced EIPE profiles. These differences in individual rankings across the sub-indicators give some hints as to the composition and details of the European ICT landscape. In particular, it shows how different and unique each location is.

Strategic networking pays off

The results of the project show that all types of networks of ICT activity – i.e. R&D, innovation and business – are sparsely connected, and the differences between regions are very pronounced. There are only very few locations which play central roles in these networks. In addition, these central locations are usually well connected with each other. This reflects how agglomeration forces influence the location of ICT-related activities and the structure of global ICT networks.

At the individual level, regions exhibit structural differences and hence differ in the role they play in the network. In general, we can distinguish different types of nodes in the analysed networks. While some locations play an important role in the network because they host much of the corporate control over certain activities, others are central to the network because they host intensive R&D activities. In all cases, being well connected allows a region to benefit from the flows of ideas and knowledge that are transmitted among different actors and locations. For example, the French capital is directly connected with 541 individual regions, or 71 per cent of the regions present in the full ICT R&D network. Altogether, these regions form nearly 25,000 linkages, i.e. 90 per cent of the linkages present in the entire network. In this way, Paris is directly exposed to the majority of R&D activities carried out in any location, which allows it to tap into resources located in distant regions.

The analysis of the networks of ICT activities also shows that, often, not only the number of connections but also their quality matters when judging the performance of a region. For example, looking at the ICT R&D network, one finds that Inner London East is one of the top hubs.[15] Interestingly, its importance comes more from being connected to other key nodes and less from the overall number of connections. This is mainly the result of the composition of its direct neighbourhood that consists of regions that themselves are very well connected and embedded within the ICT R&D network. As a result, together with its direct partners, London forms a densely connected web of linkages that, in practical terms, covers the lion's share of the entire network.

It is particularly evident that the quality of connections matters quite a bit for smaller regions. For example, Byen Kobenhavn has a strong position in the ICT business network.[16] Its high score results from the fact that the capital of Denmark is an important business destination for large ICT multinationals, and it seems to play an intermediary role between different parts of the network. This is illustrated by the strong connection with Scandinavian countries, on the one hand, and the US, on the other. As a result, the city can be considered to be a medium-sized node which plays a specific role in linking various parts of the network.

13 D. Nepelski, G. De Prato: Analysing the European ICT Poles ..., op. cit.
14 Ibid.
15 Ibid.
16 Ibid.

Summing up, being connected globally is recognised as a crucial determinant of the position of individual locations in the global hierarchy. Being central and well connected in the ICT networks has two implications. One concerns the nodes, i.e. individual regions, and the other the entire network. Regarding an individual region, being well connected exposes it to a variety of information and ideas that flow between the nodes with which it interacts. Thus, the region is exposed to a wide range of opportunities and has potential access to resources and capabilities that can be combined with its own resources. Regarding the entire network, by playing the role of a hub, the strength and the quality of a node's connections influence the integrity and robustness of the entire network. This, in turn, facilitates the flow of information and the combining of resources in different parts of the network. In other words, there is a reciprocal feedback effect between the node and the network.

Policy implications

Increasing globalisation and the pervasive role of knowledge in the economy is changing the spatial distribution of economic activity. The roles countries play are mutating, and different productive realities are also emerging within them. Analysts have observed parallel, yet opposite, forces pushing the geographical redistribution of economic and knowledge-intensive activities as well as the concentration of these activities in limited spatial areas or regions, particularly in large metropolitan areas. This has been referred to as the paradox of "sticky places" within "slippery space".[17] European policy makers have recognised this, stating that "Europe has relatively few world-recognised ICT poles of excellence".[18]

The policy context of the present study, reflected in the EC Communication,[19] is rooted in a strong location-focused assumption. There has been a tradition of cluster-based policies and also much debate on the role of European regions in innovation policies. As a result, regional policies and regional funding of innovation, technology transfer and, more generally, technology-driven economic growth have been rethought. Location is considered of priority interest for both regional and national policy makers, the challenge for policy being to foster a business environment with spatially anchored resources and capabilities that would be perceived by national and international businesses as attractive complements and/or substitutes to those available in other regions or countries of the world.

The evidence collected by the EIPE study confirms that excellence is scarce and that Europe hosts few locations intensively engaged in ICT activities. There are only 34 out of a total of 1,303 European regions that perform relatively strongly in ICT. This "scarcity of excellence" poses a challenge to the ambition held by European policy makers that five additional EIPEs should emerge.[20] It is not so much the required level of performance that makes this goal difficult but rather the foundations on which excellence is built. Both the EIPE general ranking of all EU regions and the cases that were observed more closely in the study show that excellence builds on long-standing assets that may vary from region to region but always reflect a history of decades. The exclusive assets of global or capital cities, deeply rooted industrial tissue, the long-term outcomes of policies, the presence and development of major players such as educational institutions and large firms – all these long-standing aspects have combined over time to produce the intense ICT performance of just a few regions today.

Considering this, what policy options are there that would help to reinforce Europe's industrial and technological leadership in ICT? Let us start by discussing the feasibility of the "EIPE nurturing" option. Scientific literature and local stakeholders usually claim that the emergence of industrial clusters, poles or centres of excellence is not a matter of policy making but of business, including the existence of one or several vertical markets to serve. This does not mean, however, that policy has nothing to offer to ICT poles of excellence.

First, ICT poles of excellence emerge from the study as important, if not essential, to ICT activity in Europe. Paradoxically, these world-class locations usually receive national and local acknowledgement and support but much less at the European level. Thus, the main ICT activity locations in Europe deserve at least some policy nurturing at the EU level, for which there are a range of options:

- acquire a much deeper knowledge of each EIPE's performance, profile and dynamics;
- foment strong and public acknowledgement and public image of their high level of excellence;

17 J. Dunning: Regions, Globalization, and the Knowledge-Based Economy, Oxford Scholarship Online Monographs, Oxford 2002.
18 European Commission, op. cit.
19 Ibid.
20 Ibid.

- include EIPEs in European ICT-related growth strategies;
- provide specific business conditions, including those related to human resources and mobility;
- give priority support to global reach and networking;
- put in place supportive demand-side policies.

This range of policies must be tailored to the specific characteristics of each existing EIPE, while acknowledging and supporting an EIPE vision that is mainly justified by the efficiency benefits expected from agglomeration and the role of global hubs.

Second, efforts to improve the performance of the 31 2nd and 3rd tier EIPE regions might also be rewarding. Returning to the ambitions of the 2009 Communication, there might be room for the progressive emergence of additional top-ranking 1st tier EIPEs. These 31 regions often have unbalanced or "average" strengths and weaknesses. Deeper knowledge of their performance, profile and dynamics could enable tailored support to push them up the EIPE excellence scale.

Aspects of geographical proximity, global reach and selective networking will probably also be key. The "raising performance" option might be seen as an optimistic bet, but considering the importance of historical assets in the building-up of EIPEs, it seems reasonable to exploit and improve existing foundations rather than start from zero.

As regards the aforementioned "nurturing" option, the policy rationale relies on the expected gains in efficiency from agglomeration and network centrality, and as such it opts for concentration. However, policy support could be given across a wider geographical spread. It could also be beneficial to investigate some aspects of the top 34 – for example, the weak performance of Madrid, the claimed emergence of Berlin, the linkages between capital cities of the Nordic countries, the reinforcement of the South-East corridor in France or the Ruhr region in Germany, etc. As regards Eastern Europe, improving performance there appears to be necessary on a greater scale. For these regions, a different policy strategy (e.g. cohesion policies) should be applied.

Still, it is important to note that, at least as far as the EIPE case studies show,[21] no homogeneous policy has emerged as the optimal path towards improving performance. The policies observed range from hands-on sectoral pushes to hands-off image-supportive policies, and from the improvement of business conditions to spatially bound efforts. Usually, these policies are themselves anchored in strong national and local institutional frameworks, which explain at least partly the policy options available. The scarcity of policy impact evaluations makes it even more difficult to choose.

Leaving aside the two policy approaches described above, both of which focus on nurturing the existing EIPEs as individual locations, the same EIPE observations could be beneficial within a more systemic perspective that questions the pattern of the overall European ICT innovation system and its position at the global level.

The fact that the 34 EIPEs have been identified mainly in Germany, the UK and France, and to a lesser extent in nine additional western EU member states, gives rise to several competing interpretations. For example, one could say that several "national ICT champions" continue to compete on the European market. Alternatively, several separate global networks could be seen to co-exist, with visible and active presences in Europe, developing independent capacities and products for separate markets. Finally, EIPEs could be seen as the main hubs of a global multi-centred network, with internal interdependencies within one global market.

The data on EIPEs is inconclusive on these aspects, but by investigating the whole of Europe and identifying EIPEs and their hosting regions, the study offers a unique set of insights into the pattern and relations within the European ICT innovation system. It identifies its main players, their performance, their distribution and their networks. This information can be used to support European policies which aim to reinforce research and innovation at the European level. As expressed in the 2009 Communication:

> A more efficient and systemic strategy for ICT R&D&I must address both supply and demand, cutting across the innovation cycle and "knowledge triangle" with more user-producer interactions and better interlinking of policies at regional, national and EU level – in line with the EU's broad-based innovation strategy and building on the European Research Area.[22]

We can confidently say that the EIPE study results contribute to this ambition.

21 D. Nepelski, G. De Prato: Analysing the European ICT Poles …, op. cit.

22 European Commission, op. cit.