CHOICE Internal report I-5

Clustering for Success:

Cluster to establish EU-China collaborative ICT R&D&I

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Abstract: A lot of work has been done which highlights the important role clustering plays in the establishment of EU-China collaborative activities in ICT R&D&I. This report reviews much of this work and in doing so provides an overview of different approaches to clustering that have been taken and their effectiveness. The review addresses the European ICT Poles of Excellence, clustering in ICT in China, cross-sector clustering in the EU, regional clustering in the EU, individual 'broadband' links, national SME clustering in the EU, and business to business clustering. Conclusions are presented and recommendations made which are targeted at organisations interested in establishing collaborative ICT R&D&I activities with China.

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The major EU clusters: European ICT Poles of Excellence (EIPE)

The EIPE project investigated the issues of growth, jobs and innovation in ICT. In [1] the following definition of EIPE was provided: "European ICT Poles of World-Class Excellence (EIPE) are geographical agglomerations of best performing Information and Communication Technologies production, R&D and innovation activities, located in the European Union, which play a central role in global international networks." Crucially, this definition while incorporating excellence in ICT R&D places it in a broader context of production and innovation in a global operational environment. This approach goes a long way to matching the Chinese vision of excellence in ICT R&D. However, the definition of EIPE also incorporates the notion of cases of excellence in ICT R&D, production and innovation activities, primarily being found within a geographical agglomeration of such excellence. The Chinese have long been aware of this phenomena and it has been a significant driver behind China's push to establish special economic zones with targeted specialisations. In [1] it is in effect acknowledged that while processes are in play driving a geographical redistribution of economic and knowledge-intensive activities, at the same time related processes have led to,

and continue to lead to, the concentration and clustering of these activities in specific zones, a phenomena known as the paradox of 'sticky places within a slippery space'. Careful attention must be paid to this phenomena when seeking to promote European excellence in ICT R&D as the target audiences are very aware of it and actively seek it out.

In [1] it was noted that: "there is only scarce data when it comes to systematically analyse Europe-wide regional and sub-regional areas, the location of ICT-specific activities or their nature (i.e. R&D related). Furthermore, methods and indicators for measuring processes, such as internationalisation or global networking, are still under development in this decade." A consequence of this observation was that the EIPE project put considerable effort into generating such data. Because the EIPE project is a recent project it provides the main source of information on excellence in ICT R&D and innovation at the European Union level. Effectively, [1] acknowledges the important role the knowledge function plays in growing and sustaining EIPE. The three leading EIPE all incorporate long established and globally recognised university and research institute ICT R&D activities.

An important contribution of [1] is to assess the quality of European Union ICT R&D and innovation both in terms of its global impact and how it compares against the world's best. However, while there is discussion of fostering and supporting clusters of European ICT excellence in [1], the issue of how to help individual European ICT related businesses outside of these clusters thrive is beyond of the scope of the work of the EIPE project.

In the context of promoting networking with China in ICT activities much of relevance is reported in [1] relating to networks where the primary outputs are knowledge integration and market reach. However, in context of networking in China, for the Chinese targeted networking activities are only merited when the proposed networking is of sufficient scale either in terms of the magnitude of the activities of the individual partners concerned or the number of partners.

The key findings of the EIPE project are reported in [2]. The findings of particular interest in the context of seeking to pursue collaborative ICT R&D&I with China are:

"Excellence in ICT is built up of high and balanced performance in all activities, i.e. ICT R&D, innovation and business, and in all three characteristics: agglomeration, internationalisation and networking." It follows excellence in European ICT R&D in China cannot be promoted outside of its context in terms of these activities and characteristics. This is a manageable constraint since the EU and China agreed at their 14th Summit in February 2012, to broaden their exchange in science and technology towards innovation ([3]).

[2]: "Only a very small number of EU regions therefore demonstrate intensive ICT activity and they represent a large share of the total EU ICT activity. This concentration is observable in all indicators, i.e. R&D, innovation and business. Their distribution shows that excellence is concentrated in a very small number of EU regions." Given that the European Commission has tacitly acknowledged that ICT R&D excellence in Chinese terms is found only in a small number of EU regions it would not be appropriate to promote European ICT R&D taking place outside of these regions as excellent in Chinese terms, a more nuanced approach is required.

“Only twelve EU Member States (Germany, the UK, France, Sweden, Finland, the Netherlands, Belgium, Italy, Ireland, Denmark, Austria and Spain) host all of the top 34 regions” This emphasises the lack of critical mass of excellence ICT R&D in new member states. Just how difficult this is to address is emphasised by the finding reported in [2] that:

“Key locations of ICT activity in Europe like Inner London East or Paris exhibit very rich and diverse ICT R&D landscapes with large numbers of universities with high scientific output. ICT innovation and business activities also exhibit very strong agglomeration characteristics.”

Unsurprisingly, [2] goes on to observe that: “Improving the performance of Eastern Europe appears to be on another scale, where probably another rationale should be applied (e.g. cohesion policies).

Furthermore: “No homogeneous policy has emerged as the optimal path towards improving performance.”

In [2] it is noted that a significant feature of Europe’s leading ICT poles of excellence is their diversity in specialisation, with each region showing one or several specific strengths. China has long recognised this and its bilateral ICT R&D agreements with member states strongly reflect the specific strengths of their ICT R&D poles of excellence. This raises the question as to the role of the EU in promoting European excellence in ICT R&D.

The results of the EIPE project show that [2]: “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 very well connected with each other. This reflects how agglomeration forces influence the location of ICT-related activities and the structure of the global ICT networks.” It follows that the most effective way to promote ICT R&D collaboration with China is to make these forces work for Europe. Support for this approach is provided by [4] which reasons that: “If networks become the dominant form of organising economic and innovative [activities], one can expect that network viability and countries' positions in this network will depend on their ability to develop collaboration mechanisms that support co-dependencies between them.” The potential impact of the proposed approach is emphasised by the conclusion of [4] that: “the expansion of the R&D network is driven not by the large and industrialized countries, but rather by the entry of smaller countries, which become niche players.” It follows that [4]: “A country's attractiveness as a location for R&D activities and hence its bargaining power will strongly depend on its technological uniqueness.” A crucial point to pay attention to when designing programmes to promote such networking.

From [5]: “One of the reasons why there is no complete picture of the position and dynamics of China in the process of international technology transfer is lack of information.” And “between 1990 and 2007, Chinese entities owned nearly two thousand inventions that were developed by foreign inventors. In the same time period, nearly six thousand inventions developed by Chinese inventors were owned by foreign applicants. Thus, in the language of international trade, China recorded 300% deficit in the international technology transfer.”

This should be accounted for when considering the real extent of reciprocity on the part of China in EU-China collaborative ICT R&D. However, the direct impact is that activities undertaken to promote collaboration in ICT R&D&I should as far as possible not be seen to have the potential to contribute to a worsening the EU-China imbalance in international technology transfer if they are to be well received in China. This means there should be a focus on promoting mutual ICT R&D excellence through its relationship to market opportunities. The upside of this is that [6]: "China is turning into one of the most prolific countries in terms of applications for and grants of patents." "For China between 2000 and 2008 the three fastest growing technological classes, i.e. nanotechnology, IT methods and digital communication, maintained a CAGR of over 50%." "All this confirms a relatively strong development of Chinese R&D landscape and a sound diversification of the technological portfolio." This points to there being excellent opportunities for mutually beneficial EU-China collaboration in globally leading ICT R&D&I.

Clustering in China: The absorptive state and clustering

A UK Nesta report of 2013 [8] explored the prospects for China-UK collaboration and concluded that collaboration with China could only be achieved through clustering. Accordingly the report is reviewed with respect to what it can tell us about achieving clustering around ICT R&D.

"The UK has now overtaken Japan to become second only to the US in the number of its joint research publications with China" ([8]), therefore, the 2013 Nesta report [9] on the prospects for UK-China collaboration in research and innovation is an important contribution in the context of EU-China collaboration in ICT R&D because the work reported was funded in part by the UK government Department of Business, Innovation and Skills (BIS), and The Foreign Office, with funding also coming from the BIS Science and Innovation Network, and Research Council UK (RCUK) in China. The central message of the report that: "China is an absorptive state, increasingly adept at attracting and profiting from global knowledge and networks" has profound implications for the EU-China collaboration in ICT R&D.

"The report shows, a distinctively Chinese approach to innovation can now be seen in many sectors. It involves not only absorbing the best ideas from around the world but also recasting them and recombining them through 're–innovation'. Some of that is the result of classic R&D. But much involves what Nesta has called 'hidden innovation' – the innovation in design, processes and organisational models in manufacturing and services which isn't captured by the traditional measures of R&D."

The importance of appreciating this when pursuing EU-China collaboration in ICT R&D cannot be understated as ([8]): "One way of understanding this trajectory is through the concept of 'introduce, digest, absorb and re–innovate.' This concept featured prominently in China's Medium and Long–term National Plan for Science and Technology Development (MLP), which was published in 2006 and remains the primary blueprint for innovation policy until 2020."

It is recommended in [8] that: “China’s innovation system is advancing so rapidly in multiple directions that the UK needs to develop a more ambitious and tailored strategy, able to maximise opportunities and minimise risks across the diversity of its innovation links to China. For the UK, the choice is not whether to engage more deeply with the Chinese system, but how.” This recommendation applies was much to the EU as a whole as it does to the UK.

The Nesta report states with respect to Chinese national policy ([8]) that: “absorption will remain a core strand of national research and innovation policy, and Chinese firms’ impressive ability to rapidly absorb and re–innovate, while adding novelty and value to ideas and technologies in the process, is crucial to understanding their competitiveness.” In particular, the report emphasises that research collaboration in innovation “should encompass the full breadth of potential innovation links between the two systems, from research through to the commercialisation, demonstration and scaling phases of new technologies.”

Furthermore, the report also emphasises that ([8]): “For any country seeking to collaborate with China, ensuring a density and diversity of connections will be crucial, spanning the academic, research, commercial, trade and cultural spheres.”

It is important to note that with respect to China ([8]): “There is very little evidence available on the effectiveness and economic impact of different models of support for international innovation collaboration. Each county’s strengths and modes of engagement are unique, …, the transfer of ‘best practices’ in collaboration is rarely straightforward.”

A recommendation of [8] with respect to UK-China collaboration that carries over directly to EU-China collaboration is: “sophisticated methods and metrics for identifying … innovation opportunities and for evaluating impact” should be developed. The potential benefits of engaging with China’s strengths in developing, iterating and scaling technologies is emphasised as is the need to develop approaches to collaboration in R&D that support ecosystems of collaboration rather than individual companies.

Chinese priority themes spanning research and innovation, mentioned in [8] which encompass ICT R&D&I include: Ageing and healthcare, and Smart and sustainable cities. The first theme is a natural area of collaboration for the EU because of its ageing populations. The second theme has been explored in CHOICE Internal report I-4 [9].

Breznitz and Murphree go so far as to argue that ([8]), “China has been sustaining its long run of economic growth ‘by innovating in many stages of production, but not in novel product R&D’.”

More pointedly ([8]): “The 2006 Medium and Long–term National Plan for Science and Technology Development (MLP) 2006–2020 describes one of its central objectives as strengthening indigenous innovation by “enhancing original innovation, integrated innovation, and re–innovation based on assimilation and absorption of imported technology.”

The 12th Chinese Five Year Plan identified ‘seven strategic emerging industries’ of which Next generation IT is the most obviously relevant to ICT R&D&I but Energy conservation and environmental protection is also highly relevant through aspects such as smart grids and eco-friendly smart cities underpinned by Internet of Things applications.

The importance of a diversity of connections when pursuing ICT R&D collaboration with China is apparent from Chinese government policy ([8]): "The latest policy guidance for indigenous innovation talks of stepping up efforts to 'improve innovation capabilities in key social fields' – with an emphasis on education and digital technology, healthcare systems and technologies, public safety and disaster management and the 'modern cultural industry system', which covers industries ranging from publishing and printing to online games and animation."

With respect to the case made by the EIPE project for paying due attention to the importance of EU poles of excellence in ICT R&D and innovation (I), it is striking that in 2013 the Chinese central government announced ([8]): "the first batch of ten pilot innovative industrial clusters to stimulate innovation and industrial competitiveness within clusters and stimulate industrial upgrading of the industries located there. The plan states that a new batch of innovation clusters which are to be based within existing national high–tech zones will be announced each year." This is significant in that it not only recognises the economic importance of clustering but highlights that there will be, in effect, Chinese poles of ICT excellence that can be networked to EU poles of ICT excellence for their mutual benefit. The first batch of innovation clusters includes a cluster In Mobile Internet in Beijing Zhongguancun (北京 中关村), a cluster in Next-generation Internet in Shenzhen (深圳, Guangdong Province) High-Tech District, and a cluster in Cloud computing and smart terminals in Huizhou (惠州, Guangdong Province), as well as other clusters of relevance to ICT R&D. The focus on ICT related clusters reflects China's relative global strength in ICT related manufacturing and the importance of R&D to this sector which is evidenced by the fact that ([8]): "a tiny number of Chinese companies, concentrated in the ICT equipment industry, accounts for the largest share of the dramatic increase in United States Patent and Trademark Office patents held by Chinese residents."

The growing importance of networking corresponding clusters rather than individual companies was highlighted by Denis Simon who ([8]): "describes five shifts in China's approach to international cooperation since the publication of the 2006 Medium and Long–term National Plan for Science and Technology Development (MLP):

- From general international S&T cooperation to proactive, targeted cooperation focused on the needs and mission of the MLP;
- From project–based collaboration to 'the integration of projects, talent and R&D base's';
- From an orientation to technology imports to a combined process of 'inviting in' and 'going abroad';
- From cooperation driven by government to cooperation driven by multiple players;
- From bottom–up to top–down project identification and approval in line with the requirements of the MLP."

Parallel UK policy development

On 31 March 2014 the UK Minister for Universities and Science, David Willetts, chaired the 7th UK China Joint Commission on Science and Technology in London with his Chinese

counterpart Minister Wan Gang.[1] "Ministers discussed the new UK-China Research and Innovation Partnership (known in the UK as the Newton Fund), £200m joint funding over five years for cutting edge research and innovation collaboration between the UK and China, which was announced during the China Summit in December 2013. It comprises three strands: people exchanges; research partnerships; and innovation and translation partnerships." The proposals for the partnership include: "using China's network of science parks and national high tech zones". More formerly the new partnership is known as: Newton UK-China Research and Innovation Partnership.

Cross-sector clustering in the EU

Given that majority of existing international cooperation within the EU in ICT R&D is based around poles of excellence it is extremely important for any member state that does not host a ICT pole of excellence to explore any emerging paradigm outside of this established model for cooperation. In the following the national level cross-sector approach to clustering is considered.

Cross-sector clustering at the national level

Of particular interest in this context is the Finland-China Memorandum of Understanding (MoU) on co-operation in the Built Environment signed on the 15 May 2014 [10]. This MoU followed a meeting between the President of Finland and the President of China, the participants to which formally recognised the need for smart and sustainable cities and to find energy-, resource- and cost efficient solutions through cooperation. The MoU is based on an emerging Finnish paradigm of cooperation with China that has its basis in a long history of Finland-China cooperation and a realisation by Finland that historically there had been very little business involvement in this co-operation accompanied by an increasingly strong desire on the part of the Finnish government to address this deficiency.

Tekes the Finnish Funding Agency for Technology and Innovation is the main public funding organisation for R&D in Finland. In September 2012 it appointed TIVIT, the Finnish Strategic Center for Science, Technology and Innovation in ICT to coordinate and further develop the China-Finland ICT Alliance. It responded by publishing a substantial report on new opportunities for China-Finland R&D&I cooperation [11]. The starting point of the report is the recognition that: "China is heavily modernizing its innovation system by structural changes, new international partnerships and huge financial investments in R&D&I activities. This development is happening simultaneously with big societal changes and challenges: rapid urbanization, aging population and rising awareness on environmental protection. This development offers new possibilities for R&D&I cooperation and business between China and Finland for the mutual benefit of both countries." The report recognises that in China's 12th Five-Year Plan (2011-15), there are many cross-cutting themes that create

[1] https://www.gov.uk/government/publications/china-david-willetts-hosts-uk-china-joint-commission-on-science-and-technology-april-2014/china-david-willetts-hosts-uk-china-joint-commission-on-science-and-technology-april-2014

new business and research opportunities which include ICT-enabled intelligent services. It goes on to acknowledge that to address these themes, "Multi-disciplinary approaches are typically needed as well as better linking of relevant sectors of industries and government entities at different levels (municipal, provincial, state and inter-governmental levels)", and that "In such a complex environment, the potential value of business-oriented R&D results and developed technologies and solutions may be best put in practise when their integration to the industry and society, for example in China, is facilitated in a strategic way." To meet these challenges ([11]), "The Tekes strategy specifies three horizontal drivers, including business in global value networks; value creation that is based on service solutions and intangible assets; and the renewal of services, production and products by digital means." In the context of EU-China ICT R&D collaboration it is important to note that the report [11] makes clear that: "In this framework it is evident that ICT and digital services will play an essential role, when not regarded primarily as a technology focus area but recognised as the key enabler of global business, value creation, and the renewal of services, products and production."

The Finnish report [11] contains a number of observations that are of fundamental importance for the future of EU-China ICT R&D cooperation, including that, "There are several 'hot' technology research topics in the 12th Five-Year Plan that are commonly included in the plans across provinces and municipalities. These include Internet of things, cloud computing, next generation wireless and broadband technologies, and tripleplay, i.e. the convergence of television, telephone and Internet, as well as IC technologies, where original Intellectual Property (IP) is being developed. These are the underlying technologies that provide the basis for creating new intelligent solutions and services in various industries." The real differentiation in the ICT R&D pursued comes from the applications and industry sectors in which these technologies are deployed thus is cannot be decoupled from innovation. Application areas given as examples in [11] are manufacturing systems, logistics, e-business, services industry, and public sector services. More specifically, research is increasingly geared towards supporting a move towards digitalisation through the creation of intelligent products and services. Inevitably such research involves not just identifying and integrating the enabling ICT technologies for the new services but also dedicated user-needs driven research on the actual services. Of the globally recognised areas of Finnish competence in the context of Eco-cities the obvious one to focus on is Energy efficiency. Because of its cold climate, relatively large size and energy intensive main industries, Finland has invested in energy efficiency for decades. Finland has globally recognised competence in various areas including combined heat and power generation, district heating and cooling, and smart grids and power electronics. Furthermore, Finland is one of the world's leading users of renewable energy.

In China R&D on smart city concepts is being undertaken through Digital Shanghai (services anywhere), Digital Zhejiang (浙江 province) and "Intelligent City Wuxi 无锡" in Jiangsu (江苏) province. Public services to address key challenges related to urbanisation such as traffic management, health and wellbeing issues, aging care and limiting CO_2 emissions are also being developed. While requiring technology realising the Smart City also requires research at the systems and services level. This provides opportunities for international

cooperation to realise the required integration of interdisciplinary research and accompanying cross-sector development. In purely technical terms topics explicitly included in provincial level plans include the Internet of things, cloud software, data to intelligence, and digital services and next media.

Crucial to an appreciation of the background to the Finland-China Memorandum of Understanding (MoU) on co-operation in the Built Environment [10] is the acknowledgement in [11] of traditional areas of globally recognised Finnish competence including ICT. In essence in [11] these globally recognised competences are seen as potential gateways to international cooperation in cross-sector areas that encompass them such as environmental solutions and smart city concepts, which require expertise from several different domains, when they are offered as part of a complete package of required cross sector expertise. This can be viewed as the state of the art in clustering. Interestingly this form of clustering should be easier to coordinate and more agile in smaller member states which are otherwise disadvantaged by a lack of scale when it comes to establishing conventional poles of excellence. In this way cooperation in areas of existing globally recognised competences that is of benefit to business can be achieved while at the same time these competences can be used to leverage cooperation in other areas when they are collectively needed to address a cross-sector challenge.

Finland is actively positioning itself for cross-sector cooperation. In [11] two forums are quoted as illustrating: "a national aim to create a high-level foundation for over-lapping cross-sectoral cooperation in technology applications, industrial needs and business models." Both these forums are in the area of ICT ([11]):

"The Future Mobile Communication Forum (Future Forum) is directed towards the future technologies of telecommunications and information services. Through its working groups it supports technology exchange and international technological cooperation. It has about 50 key partners in research and technology, such as China Mobile, Nokia, Ericsson and France Telecom. Significantly, Future Forum has a mandate from The Ministry of Science and Technology of the People's Republic of China (MoST), is supported by NDRC and MIIT, and cooperates closely with China Academy of Sciences, Beijing University of Posts and Telecommunications (BUPT) and the China Academy of Telecommunication Research (CATR) of MIIT.

Future Forum has a role in formulating and promoting national R&D&I policy initiatives in telecommunication and information technology areas. For example, Future Forum integrates its activities and working groups to support the implementation of Chinese national strategies, such as the National Science and Technology Key Special Project (the 863 Programme)." In an EU context it is notably that Finland has been looking to cooperate with its neighbours to strengthen its clusters global competitiveness. For example, Sweden has been active in the Future Forum's international activities.

"Ubiquitous Networks Industry Technology and Development Forum (United Forum) has as its main objective promoting the interests of and development of the industry as a whole. Its main focus areas are key technologies, service architectures and future business models. It

has three working groups and another three groups are under specification on smart city concepts, elderly care and education.

United Forum is a network for knowledge and technology transfer among industrial and academic partners in China. It has about 25 key partners representing the whole R&D and business sector, such as Huawei, Intel, China Mobile, Samsung and Alcatel. United Forum is affiliated by MIIT and it works closely with CATR, BUPT and China Communication Standards Association (CCSA)."

To highlight the potential of this approach a table of example topics in ICT-related areas in provincial and municipal R&D plans in China is reproduced from [11] below, which notably includes several that are 'cross-sector'. N.B. Beijing-city (北京市 direct-controlled municipality), Shanghai-city (**上海市** direct-controlled municipality), Yunnan (**云南 省** province), Xaanxi (陕西 省 province), Hubei (**湖北 省** province), Jiansu (**江**苏 省 province), Chongqing (**重**庆 市 direct-controlled municipality), Zhejiang (**浙江 省** province)

Beijing	Shanghai	Yunan	Shaanxi	Hubei	Jiangsu	Chongqing	Zhejiang
Internet of things	Digital Shanghai (services anywhere)	Next generation Internet	Next generation communication networks	Communication and networks	Cloud computing	New generation Information terminal and related key tech	Smart city, Smart Zhejiang
Cloud computing (esp. virtualisation, security)	Smart Harbour	3rd generation mobile communication	Tri-networks convergence	Electronic materials and devices	Internet of things	Cloud computing	Manufacturing industry IT
Wireless mobile communication network	Smart agent services	Network convergence	Internet of things	Software and information services	Track traffic	Communication key technologies	Improve traditional industry R&D level, innovation platform building
LTE core chips	Intelligent home devices	Modern services	High end software	Innovation platform for building	Electronic information	Internet of things	Service industry digitalisation
Triple play, three networks convergence	Smart community	E-payment	High performance IC design		Smart travelling	IC design and manufacturing	Cloud computing
Very large scale integrated circuit	Smart traffic and logistics	Internet of things	Beidou GPS navigation systems		RFID	Modern logistics	Internet of things
High speed optical access chips	Smart city security	Modern logistics	New display tech		Tri-network convergence	Traffic key technologies	Wireless digital communication
IT services operation platform	IT industry foundation strategic products	Digital traveling	Antique / cultural heritage services			National largest offshore data development processing centre	Tri-network convergence
	Microchip	Communication and cooperation tech			Mobile Internet	Tri-network convergence	E-business
	New wideband mobile communication	Information transfer and exchange security			Next wireless LAN	Authentication and testing	Optical communication industry
	New human-machine environment and smart monitoring				Smart search engine	IC industry clusters	Digital traveling
	Smart home device and network convergence tech				Massive data storage		Antique / cultural heritage services and protection
	Embedded technologies						Modern logistics
	Trusted systems						Smart traffic

It is too early to state definitively whether or not the Finnish approach of cross-sector clustering can be considered effective in fully engaging industry in Finland-China R&D&I but initial indications are that it will be. The China – Finland Strategic ICT Alliance website[2] contains up-to-date information on its projects and newsletters on its activities. China-Finland

[2] http://ictalliance.org/

ICT Alliance: Newsletter: January-March 2014[3] reports a MoST-Tekes call in ICT and applications which opened in March and closing at the end of April 2014 and related cooperation with Jiangsu and Zhejiang provinces. This call was specifically aimed at industrial partners and SMEs in particular. The overall theme of call, cleantech and its applications, fitted with Chinese strategic priorities identified by Tekes.

Closely related to this in March 2014 the Alliance together with Chinese geoservice company Geostar (Wuda-Geo) and Finnish air quality monitoring and modelling companies initiated a China-Finland proposal for an "Air Quality Monitoring Platform", to synchronise cross-sectoral China-Finland cooperation, a meeting hosted by CLEEN[4] on business and R&D opportunities for monitoring and improving outdoor and indoor air quality in China was held; CLEEN facilitates and coordinates world-class, industry-driven research in the energy and environmental fields with shareholders that include major international companies with significant energy- and environmental-related R&D activities in Finland.

The best evidence of significant industry engagement is provided by one of Alliance's most recent (Phase II) projects: Finland's Enhanced Navigation using COMPASS/Beidou Signals[5] the partners of which include the Finnish companies Nokia Ltd., Vaisala Ltd., and Roger-GPS Ltd.

Importantly the activities of the Alliance clearly demonstrate that Finland seeks the breath of a density and diversity of connections, spanning the academic, research, commercial, trade and cultural spheres that is so clearly desired by China.

In addition to funding a number of 'traditional' university and research institute driven cooperative R&D projects indicative of the diversity of the Alliance's activities are initiatives in education such as the "Sino–Finnish Learning Factory" (SFLF). This initiative is particularly interesting because although as would be expected it is driven by the Finnish Ministry of Education and Culture it's activities draw on expertise from companies, research institutions and organisations with a particular effort being made to involve education technology and services companies under the theme of a theme of "Education-as-a-Service" thereby linking the initiative to innovation. In support of this effort EduTech business ecosystem workshops were organised at Digile[6], which coordinates the China – Finland Strategic ICT Alliance, on 11 March 2014 and 1 April 2014.

To give an appreciation of where the SFLF initiative fits within the Finnish strategy for R&D&I cooperation with China it is acknowledged by the Alliance in the January-March 2014 newsletter that:

"financing international R&D&I cooperation still remains a challenge. This is particularly true when considering public funding for university research but similar challenges also appear when companies search for financing for cooperation in new areas.

[3] http://ictalliance.org/china-finland-ict-alliance-newsletter-january-march-2014/
[4] http://www.cleen.fi/en/news?type=n&item=49
[5] http://ictalliance.org/fincompass/
[6] www.digile.fi

In this situation it becomes even more important to be able to link complementary activities and resources as well as different modes of operation together (e.g. cooperation in research projects, education and business pilots)."

The implications of this for the future of EU-China cooperation in ICT R&D&I are that funding models for 'traditional' R&D cooperation cannot be decoupled from funding models for educational cooperation and more importantly business pilots.

Regional clustering in the EU

At the level of the individual EU member state the cross sector approach to clustering really only makes sense in those advanced economies with a broad base of internationally competitive commercial sectors. One possible alternative approach, particularly for smaller member states, that has been explored is to reach out to neighbouring countries and cluster at the regional level. In the following a transnational regional approach to clustering is considered.

Lessons from the BENCH project

For EU member states without a broad base of internationally competitive commercial sectors inward investment from China is more likely to be a higher priority than collaborative R&D&I with China. To pursue collaborative ICT R&D&I with China in an environment where the resources available at the national level to support such activity are limited clustering at the regional level may be a way forward.

An interesting example of an EU funded regional clustering initiative is the BENCH project[7]: 'Beneficial Business Relations between the Central Baltic Region and China'. BENCH was a pilot project within the European Union Regional Development Fund Central Baltic INTERREG IVA Programme 2007-2013. The regions involved were Päijät-Häme and Uusimaa in South Finland, Östergötland in Sweden, and significantly the whole of Estonia. The Estonian Chamber of Commerce and Industry (ECCI) was an active partner within the project.

BENCH specifically sought to answer the question of how Finnish, Estonian and Swedish regions could cooperate on contact with China and how established contacts and exchange with could China be utilised more efficiently for the benefit of trade and industry. Although the main focus of BENCH was on attracting inward Chinese investment some of its findings have a direct relevance to the promotion of collaborative ICT R&D&I with China. For Estonia, 3 sectors were the priority: Cleantech, logistics and tourism where Information and Communication Technology (ICT) is reflected horizontally.

Estonia, situated at the heart of the Baltic Sea Region, has a relatively small population of approximately 1.3 million inhabitants. It is not part of any EIPE nor given its size is cross sector clustering at the national level viable and yet [12]: " 'e-Estonia' is a term commonly used to describe Estonia's emergence as one of the most advanced e-societies in the world.

[7] http://projektwebbar.lansstyrelsen.se/benchproject/En/Pages/default.aspx

This success story grew out of a partnership between a forward thinking Government, a proactive ICT sector and a switched-on tech-savvy population. Thanks to this Estonians and the Estonian state enjoy an unusually wide range of e-solutions, and the nation has become an example for other countries that wish to follow the same path." Furthermore, Estonian ICT solutions were reported as gaining great recognition in China as a result of the Estonian presence at Expo 2010 which was hosted by Shanghai.[8]

However, the above remarks have to be qualified by the observation that [12]: "Companies in Sweden, Finland and Estonia are at different development stages in general. In Finland and Sweden, they are mostly at the highest level in the value chain. Estonian companies are still rather subcontract-oriented." It is therefore not surprising that a BENCH case study taken to illustrate a common pattern among Estonian SMEs entering the Chinese market concerned a logistics company with net revenue of 1.8 million Euro in 2011 entering the Chinese market through a joint venture with a Finnish company. It was observed earlier in this report that with respect to EU-China collaboration in ICT R&D the biggest challenge is actually the wider fundamental challenge the EU faces of enable enterprises outside of EIPE to network globally through them and that this is as much an intra EU challenge as it is an EU-China challenge. The case of Estonia suggests that open recognition of this challenge may well be welcomed by SMEs in member states that do not host EIPE as it can reflect business realities.

To understand the direct significance the results of BENCH have for EU-China collaborative R&D it is important to be aware that another question that BENCH was seeking to address was: "How can universities support small and medium-sized enterprises (SMEs) in the Central Baltic region in developing business with China?"

For collaborative ICT R&D&I the conclusions of BENCH are somewhat circuitous [12]: "stakeholders and project partners have developed an increased understanding and knowledge about business relations with China by utilising the benefits of cooperation in the European Union common market. Especially the SMEs in small EU regions and countries can obtain a lot of support from such collaborations. It is not an exaggeration to say that many companies and supporting organisations have not yet understood the full potential of the EU community." This only gives rise to the question: has the full potential of the EU community for providing such supporting been realised?

The BENCH website contains some useful resources for stakeholders in collaborative ICT R&D&I with China and although it will not be updated with new information it will be available until the end of 2018, in particular, it provides a link to the interactive digital handbook[9]. The BENCH Digital Handbook[10] [12]: "takes the viewer through several steps of a typical entry process to the Chinese market of a small business. It focuses on a set of questions important to companies deliberating on a potential expansion to China. In several

[8] http://e-estonia.com/estonian-ict-solutions-gain-great-recognition-shanghai/
[9] http://projektwebbar.lansstyrelsen.se/benchproject/En/information-material/Pages/bench-handbook.aspx
[10] http://prezi.com/hheqzylletnc/bench-handbook/?utm_campaign=prezi_landing_related_author&utm_medium=prezi_landing_related_solr&utm_source=website

video clips questions are raised, such as: What are you planning to sell in China? Who and where are your main clients? Have you drafted your entry strategy? Who is helping you? How will you get your product or service to your clients? Will you hire Chinese nationals to work for your business in China? Are you planning to set up a manufacturing facility on the mainland? Who does your accounting? How do you plan to finance your operations?"

The BENCH project made one recommendation at the European Union level relevant to promoting EU-China collaborative ICT R&D&I [12]: "The European Union should map different EU countries' activities in China, increase the joint activities and provide access to existing support structures for companies from other EU countries. Larger European countries present themselves in China through various organisations, but they are not sharing the opportunities with other EU Members."

Whilst the observation that larger European countries present themselves in China through various organisations but they are not sharing the opportunities with other EU Members needs to be qualified by saying that rather than larger countries the statement really applies to those member states hosting EIPE, or with highly developed national level cooperation programmes with China. Nevertheless, the broad thrust of the argument is undoubtedly correct. However, China is rapidly becoming a market of such fundamental national importance to EU member states it is unrealistic in most cases to expect that those member states with significant presence in China will 'share opportunities' with other EU member states. Irrespective of this, it is critically important that the European Union should increase the joint activities and provide access to support structures, for those member states that currently do not have significant presence in China, which address the fundamental challenge of networking organisations from these member states to China through clustering. It should already be apparent that there are a variety of strategies that could be adopted to do this. The observation made by BENCH that [12]: "the EU funded 'Understanding China Programme' is an excellent opportunity for companies interested in China. However, the programme is marketing Europe as a whole, not as regions." is just making a case for one particular approach to clustering. Even though a regional approach is viable for Estonia it is not clear that it is the best approach. More generally it is not always obvious how regions should be defined and even when they can be defined the local actors may not wish to cooperate in this way. In any case the Understanding China Programme[11] is a platform for business and policy dialogue on EU-China relations which seeks to address difficulties faced by EU businesses, especially SMEs, in trying to enter the Chinese market. As such it is seeking to develop policies that either clarify or support the development of the business models needed by EU businesses to enter the Chinese market.

The Central and Eastern European Countries (CEEC) Cluster

A Meeting of the Heads of the Government of China and Central and Eastern European Countries was held in Bucharest, Romania, 26 November 2013. The meeting reviewed the achievements made in cooperation between China and CEECs and commended the important

[11] http://www.understandingchina.eu/

contribution of China-CEEC cooperation. It was stressed that China-CEEC cooperation is in concord with the China-EU comprehensive strategic partnership and all parties expressed their readiness to strengthen and deepen China-CEEC cooperation. To advance China-CEEC cooperation, parties at the meeting jointly formulated and issued the Bucharest Guidelines for Cooperation between China and CEECs[12]. Interestingly, these guidelines support the establishment of a China-CEEC association of chambers of commerce, joined by chambers of commerce of China and CEECs on a voluntary basis, and crucially the strengthening of cooperation in the information and communications sector.

Individual 'broadband' links

To place Estonia's involvement in BENCH in the broader context of the Baltic states cooperation in ICT R&D&I with China it is noted that Lithuania, the largest and most populous of the Baltic states with a population of around 3 million, has one significant ICT R&D&I collaboration initiative with China the Chinese-Lithuanian IT Innovation Centre[13]. The members of the Centre are Chinese global ICT solutions provider Huawei and Lithuania's Vilnius University and Omnitel the leading Baltic telecommunication company owned by Scandinavian TeliaSonera. The Chinese-Lithuanian IT Innovation Centre is a research centre of information technologies the activities of which include the implementation of research programmes, traineeships for researchers, and the development of modern technologies to promote more rapid development of innovations by opening new possibilities in the global IT market. In this way this single Centre provides a diversity of connections spanning the academic, research, commercial, and trade spheres. As training in the Chinese company is provided for Lithuanian students through the Centre it could even be argued that the Centre provides connections in the cultural sphere. The Centre is therefore an interesting example of clustering through one extremely strong link between two internationally significant ICT industry players.

Perhaps unsurprisingly [13] identifies ICT as a priority area for cooperation with China for Lithuania but not for Estonia.

In light of the difficulties experienced in BENCH in establishing substantial long term collaboration through regional clustering the case of the Chinese-Lithuanian IT Innovation Centre suggests that despite the limitations of company to company based collaboration a logical starting point for ICT R&D&I cooperation with China in smaller member states is to identify any internationally significant ICT industry players with a strong business link to a major Chinese ICT industry player and then provide high level political support at the national level for developing long term strategic company to company collaboration where such a link exists. Efforts promoting regional level clustering to broaden collaboration with China to other organisations could then follow.

[12] http://gov.ro/en/news/the-bucharest-guidelines-for-cooperation-between-china-and-central-and-eastern-european-countries
[13] http://vilnews.com/2011-11-10457

National SME clustering in the EU

COOPOL Innovation is a program established in 2008 by the Service of Science and Technology (SST) of the French Embassy in China after the signature in 2007 of an agreement between the French competitiveness clusters and the Chinese science parks. As such it is an interesting initiative in support of clustering. Its goal is to facilitate the cooperation between French innovative SMEs of the competitiveness clusters and their research partners with their Chinese counterparts. The program has two parts: 1) An exploration mission of one week organized by the SST, for two persons (one from the SME, one from the partner research institution), to meet potential collaborators, both academics and industrials; 2) A subvention to a R&D collaborative project. This program has been made to support R&D projects and not only commercial projects.

Business-to-Business clustering

From June 11, 2014 to June 21, 2014, a European Trip 2014 of Technology-based Enterprises was carried out in Belgium, Czech Republic and Germany under the organization of the Science and Technology Bureau of Hi-tech District, Chengdu, the Economic and Trade Development Bureau of Hi-tech District, Chengdu, and the EU Project Innovation Centre (Chengdu), which received support from the CHOICE project.

Ten cases of EU-China ICT Research and Development and Innovation (R&D&I) collaboration resulted from the European Trip 2014 which collectively illustrate the diversity of links needed for collaboration to be realised. The ten cases span almost purely commercial links to cooperation in fundamental research. It is again emphasised that collaborative research links with China will not be forthcoming unless there is a willingness to engage in a diversity of connections, in particular, including innovation. Importantly all of the ten cases come under the umbrella of Research and Development, and Innovation (R&D&I).

What is most significant is that of the ten cases presented one involves a French partner, one Belgian, one Polish, and one Hungarian; two involve Czech partners, and four involve German partners. As has already been highlighted it is difficult to establish cooperation between Chinese and east European partners. The cooperation agreements involving Polish and Hungarian partners highlight the benefits of clustering them in a block of neighbouring European, in particular German participants, through the organisation of the trip; what is referred to in the CHOICE project as Business-to-Business (B2B) clustering. All the cooperation agreements reported are a testimony to the efficiency and effectiveness of face to face, business to business, networking in the context of realising collaboration with China.

Conclusions

Excellence in ICT is built up of high and balanced performance in ICT R&D, innovation and business, and in all three characteristics: agglomeration, internationalisation and networking, It follows excellence in European ICT R&D in China cannot be promoted outside of its context in terms of innovation and business. Accordingly, the focus needs to be on ICT R&D&I rather than simply ICT R&D. Furthermore, I in this connection means innovation for business opportunity.

For an organisation to stand the best chance of success in obtaining partners and funding for ICT R&D&I it needs to present its pitch for partners within a cluster of such offers presenting a diversity of potential links; that is the organisation needs to present itself a participant in a cluster.

As clustering implies a diversity of links funding models for 'traditional' ICT R&D&I cooperation should not be considered in isolation from funding models for educational cooperation in ICT and more importantly ICT business pilots.

In 2013 the Chinese central government announced ([7]): "the first batch of ten pilot innovative industrial clusters to stimulate innovation and industrial competitiveness within clusters and stimulate industrial upgrading of the industries located there. The plan states that a new batch of innovation clusters which are to be based within existing national high–tech zones will be announced each year." This is significant in that that there will be, in effect, Chinese poles of ICT excellence that can be networked to EU poles of ICT excellence for their mutual benefit. The first batch of innovation clusters includes a cluster In Mobile Internet in Beijing Zhongguancun (北京 中关村), a cluster in Next-generation Internet in Shenzhen (深圳, Guangdong Province) High-Tech District, and a cluster in Cloud computing and smart terminals in Huizhou (惠州, Guangdong Province), as well as other clusters of relevance to ICT R&D&I.

At the regional level in China, as different regional centres have different priorities at the municipal level and a focus on distinct markets activities, the promotion of EU-China ICT R&D&I cooperation at the regional level in China needs to be targeted at those localities and regions that have an identified demand for the specific type of globally recognised excellent expertise being offered on the EU side.

If Chinese organizations are to be convinced that there could be long-term benefits to collaborating with EU organizations outside of Europe's main ICT poles of excellence there needs to be a clear EU strategy in place for connecting these EU organisations to the global ICT networks relevant to them. Given the structure of these global networks it can be argued that there is a need to establish ways of networking of organizations involved in ICT R&D&I outside of Europe's main ICT poles of excellence with particular European ICT poles of excellence so they can access the global ICT networks most relevant to their activities through them. However, it is not clear how this could be done except in entirely national contexts in specific cases by a national government agency or a national chamber of commerce or industrial association of an EU member state that hosts EIPE.

Member states bilateral programmes funding ICT R&D&I collaboration with China in effect cluster programme participants in areas, which are often cross-sectorial, in which the member state is recognised as having internationally significant expertise.

Dedicated business-to—business clustering events offer an excellent opportunity for organisations from East European member states in particular to establish cooperation in ICT R&D&I with China.

For internationally excellent companies and research institutes that do not already have links with China in the area of ICT R&D&I, in EU member states with commercial ICT R&D&I recognised as excellent by China where the scale of such activity does not merit a national agreement with China with an accompanying funded bilateral programme, it would make sense for such organizations to be directly supported by, for instance, a national government agency in networking with China, for example, for business to business networking. Participants in this group could, for example, be expected to disseminate their experience to their national ICT industry and research institutes and relevant national government agency. This could provide useful information and contacts to national policy makers seeking to intensify export trade with China, and possibly through these policy makers to the European Commission in order to network such companies within European funded programmes with a view to achieving the critical mass of excellence required to establish collaborations in ICT R&D&I with China.

Drawing on the finding of the EIPE project that the three leading EIPE all incorporate long established and globally recognised university and research institute ICT R&D, the natural starting point for long term promotion of ICT R&D&I collaboration with China in member states with limited commercial ICT R&D infrastructure recognised as excellent by China is for the national government concerned to making financial support available to universities and research institutes of the member state that undertake high quality ICT R&D for networking with leading Chinese universities and research institutes. The purpose of such networking would be for the European organisations concerned to experience the relatively high standards in China of ICT R&D in leading Chinese universities and research institutes to gain a real appreciation of what the Chinese expect from formal ICT research links. Participants in such networking could be expected to disseminate their experience to their national university and research institute systems. However, the final beneficiaries of such networking activities would be organisations and companies benefiting from any support for commercial EU-China ICT R&D&I cooperation that the participating universities and research institutes would subsequently provide.

Some EU member states that do not host an EIPE should consider whether or not they have the resources to be able to actively positioning themselves for cross-sector cooperation; it is too early to state definitively whether or not the cross-sector clustering can be considered effective in fully engaging industry but initial indications are that it can.

The COOPOL Innovation program between the French competitiveness clusters and the Chinese science parks is an interesting initiative in support of clustering of SMEs which other member states with such industrial clusters may benefit from emulating.

The Chinese-Lithuanian IT Innovation Centre provides one possible alternative model to regional clustering for smaller member states, this single Centre provides a diversity of connections. It follows that a logical starting point for pursuing ICT R&D&I cooperation with China in smaller member states is to identify any internationally significant ICT industry players with a strong business link to a major Chinese ICT industry player and then provide high level political support at the national level for developing long term strategic company to company collaboration where such a link exists.

Recommendations

For an organisation with internationally recognised ICT R&D&I related expertise interested in collaborative ICT R&D&I with China that is located in a member state that hosts an EIPE it is worth investigating if the EIPE relates to the organisation's interests. If so, it may be possible to approach a national industrial association or Chamber of Commerce with a view to getting support for clustering through the EIPE.

For an organisation with internationally recognised ICT R&D&I related expertise interested in collaborative ICT R&D&I with China that is located in a member state with a bilateral programme of ICT R&D&I cooperation with China it is worth investigating if that programme relates to the organisations interests. If so, pursuing funding through the programme should be considered. For an overview of member states bilateral programmes with China see [14].

For an organisation with internationally recognised ICT R&D&I related expertise interested in collaborative ICT R&D&I with China that is located in a member state with very limited collaborative ICT R&D&I links with China it is worth considering participating in appropriately targeted business-to-business matching events.

The membership of the EU-China expert groups on ICT R&D&I should reflect the important roles played by the relevant EIPE and Chinese innovation clusters and the experts on both sides should include representatives of these clusters.

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