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Local or Digital Buzz, Global or National Pipelines

Patterns of Knowledge Sourcing in Intelligent Machinery and Digital Content Services in Finland

Abstract

In regional innovation systems there is a need to identify the knowledge bases firms draw upon and differentiate innovation policies accordingly. From this premise the main aim in this paper is to compare two Finnish industries, intelligent machinery and digital content services, that draw upon different kinds of knowledge bases. The three main research questions discussed here are: (a) do knowledge sources of the firms representing two different industries with two different knowledge bases differ from each other, and how; (b) how do the knowledge sources differ between different types of regional innovation systems; and (c) what kind of extra-regional pipelines do the three different cases have? The regional innovation systems under scrutiny represent fragmented metropolitan (Helsinki metropolitan area), old industrial (Tampere region) and organisationally thin (South Ostrobothnia) regional innovation systems.

1 Introduction

Innovation has been steadily climbing policy ladders and it now ranks high on public policy agendas in many corners of the globe. It can be seen that regions are important playgrounds for innovation to emerge and be shaped and coordinated. Regional innovation system (RIS) literature recognises such localised capabilities as specialised resources, skills, institutions, localised learning processes as well as common social and cultural values equally important in the innovativeness of firms and other organisations (Cooke et al, 2004; Fritsch & Stephan, 2005; Maskell et al, 1998). There is also a growing understanding that innovation activities differ strongly between many different types of regions and countries and innovation policies ought to be fine-tuned to reflect the needs of a particular region better (Tödtling & Trippl, 2005; Asheim et al, 2006a). Additionally, as pointed out by Asheim and Gertler (2005) and Asheim et al (2007), when designing innovation systems one also needs to understand more deeply the differentiated knowledge bases that firms and other organisations draw upon as inputs in their knowledge creation and innovation processes.

Asheim et al (2007) identify three different knowledge bases with varying characteristics. These are an analytical knowledge base that is essentially science-based and deductive in nature; a synthetic one that is based on novel combinations of existing knowledge; and a creativity-based symbolic knowledge base that revolves around aesthetic attributes, design and creation of images, e.g., cultural artefacts. The key assumption in studying knowledge bases in the context of regional innovation systems is that deeper insights into how the knowledge bases shape innovation processes and interactive learning patterns are needed for future innovation policies. Hence, the aim here is to follow Asheim and Coenen's (2005) argument that in regional innovation systems there is a need to identify the knowledge bases firms draw upon and differentiate innovation policies accordingly; from this premise the main aim is to compare two Finnish industries, intelligent machinery and digital content services, that are presumed to draw upon different kinds of knowledge bases.

Agrotechnology in South Ostrobothnia and mobile heavy machinery in the Tampere region represent engineering-based intelligent machinery industries with a synthetic knowledge base whereas digital content and business services in the Helsinki metropolitan area represent an industry that is likely to draw from a symbolic knowledge base. Being an engineering-dominated area of economic activity intelligent machinery is more or less self-evidently ‘synthetic’ in nature and, as Hesmondhalgh (2002, p.5) notes, media industries are ‘symbol creators’, their main task being to produce symbolic content; digital content services, being a form of media industries, are therefore well suited to represent sectors drawing upon a symbolic knowledge base.

Additionally, side by side with the knowledge bases, this paper sets out to analyse whether regional innovation systems supporting firms drawing upon different knowledge bases differ from each other. The cases under scrutiny here were selected according to the regional innovation system classification introduced by Tödtling and Trippl (2005). The three cases represent fragmented metropolitan (Helsinki metropolitan area), old industrial (Tampere region) and organisationally thin (South Ostrobothnia) regional innovation systems. As Tödtling and Trippl also remind us, increasing attention has been paid to the dangers of lock-in situations in cases where the majority of linkages are internal to the region in question (Grabher, 1993). Storper and Venables (2004) and Bathelt et al (2004) emphasise both local interaction (i.e., local buzz) and interaction through trans-local linkages (i.e., global pipelines) and hence there is a need to establish extra-regional linkages to complement localised learning. However, this literature does not provide any detailed accounts of the types of extra-regional linkages needed (MacKinnon et al, 2002; Gertler, 2008.)

Acknowledging local buzz/global pipelines dynamism and pushing it forward, Asheim et al (2007) suggest that it plays out differently in different industries because they draw upon different knowledge bases. Consequently, the main aim of this paper is to contribute to the debate about buzz and pipelines and the processes of knowledge creation in regional clusters by investigating whether knowledge sourcing differs alongside the knowledge bases as suggested by Asheim and Coenen (2005) and Asheim et al (2007) and regional innovation systems as suggested by Tödtling and Trippl (2005).

The three main research questions discussed here are: (a) do knowledge sources of the firms representing two different industries with two different knowledge bases differ from each other, as suggested by Asheim and Coenen (2005) and Asheim et al (2007), and how? (b) how do the knowledge sources differ between different types of regional innovation systems; and (c) what kind of extra-regional pipelines do the three different cases have? To answer these questions, attention is first targeted in Section 2 at the key concepts, i.e., regional innovation systems, knowledge bases, related variety and local-global knowledge links (e.g., local buzz and global pipelines). In Section 3, cases, data and methodology are introduced. Sections 4 and 5 report the main empirical observations and finally, in Section 6, wider conclusions are drawn from this exercise.

2 Theoretical framework

2.1 Towards a broader understanding of innovation systems

A simple but useful definition of innovation systems is presented by Niosi et al (1993, p. 212) who define it as 'interacting private and public firms (either large or small), universities, and government agencies aiming at the production of science and technology within national borders'. Further, according to Niosi et al (1993), 'interaction among these units may be technical, commercial, legal, social, and financial, inasmuch as the goal of the interaction is the development, protection, financing, or regulation of new science and technology'. Freeman (1987, p. 1), for his part, defines innovation system as a 'network of institutions in the public and private sectors whose activities and interactions initiate, import, modify, and diffuse new technologies'.

The above definitions reflect well the national origins of innovation system thinking in the 1980s. In the 1990s it became the practice to acknowledge also the role of regions in innovation scenes, and indeed the concept of regional innovation systems has provided many studies with a useful conceptual framework to analyse innovation processes from systemic and relatively holistic points of departure. This line of enquiry has significantly increased our understanding not only of innovation but also of regional economic development (Cooke et al, 2004; Kautonen, 2006). Consequently, there is now a fairly well established but dynamic body of knowledge on how industries are embedded in national, sectorial and/or regional systems of innovation (Cooke et al, 2004) and how regional innovation systems are constructed on knowledge-creating and knowledge-utilizing sub-systems (Autio, 1998).

In addition to reflecting well the national origin of the concept of innovation systems the above definitions by Niosi et al (1993) and Freeman (1987) reflect the technological origins of it too. They represent what Lorenz and Lundvall (2006) label as a narrow view of innovation and innovation systems. In many countries, Finland being one of the prime examples (Proposal for Finland's…, 2008), the search for new innovation policies often culminates in a need for sharpening the science, technology and innovation mode (STI) of innovation policy, while at the same time broadening policy towards doing, using and interacting modes (DUI) (see more about STI and DUI in Lorenz and Lundvall, 2006). A narrow definition of an innovation system incorporates, as stated by Asheim and Gertler

(2005, p. 300), the R&D functions of universities, public and private research institutes and corporations, reflecting a top-down and science-push model of science and technology policies. The broad definition of the innovation system emphasises the wider setting of organisations and institutions affecting and supporting learning and innovation, in practice, embracing potentially the entire society (Asheim & Gertler 2005, p. 300.) The broad definition of an innovation system stresses the additional need to study experience-based knowledge and the role of customers and users in innovation systems, i.e., all those sources of knowledge that do not necessarily have much to do with the actual knowledge-creating organisations (i.e., research organisations and universities). All this points towards in-depth analyses of learning, knowledge resources, knowledge flows and joint, as well as separate, capabilities (Jensen et al, 2007; Malmberg & Maskell, 2006; Asheim et al 2006b; Martin & Sunley, 2002).

Additionally, this points also towards increased sensitivity to varying contexts between time and place. From their extensive literature review Tödtling and Trippl (2005) identify organisational thinness (especially in peripheral regions), lock-ins (especially in old industrial regions) and fragmentation (especially in metropolitan regions) as the main generic innovation barriers in different types of regions (see Asheim et al, the introductory chapter of this special issue). In this study, the three cases were selected to represent the three types of RIS. The aim is to shed additional light on differences between knowledge sources and flows of different regional innovation systems and the ways firms try to compensate for the deficiencies in their respective regions by extra-regional linkages.

2.2 Clusters, buzz and pipelines

Since the first half of the 1990s, innovation, learning and creativity have rather generally been targeted in the context of cluster theories (Porter, 1990). The cluster concept has become rooted at the core of development work in several countries and cluster thinking has been applied in the greatest variety of ways and contexts. At the same time, it has acquired many meanings depending on what it is applied to and by whom (Benneworth, 2004). Asheim, Cooke and Martin (2006, p. 22) criticise Porter's way of distinguishing between different clusters as superficial and descriptive. In several cases, what might be described as 'clusters' on the basis of Porterian premises are comparatively modest agglomerations of functions (Gordon & McCann, 2000), from which some minor benefits may accrue from concentration, linkages between production inputs and results as well as social networks, but which are not true clusters in any sense. In this study, the concept of cluster is used fairly loosely as a metaphor to describe the economic entities revolving around the case industries.

The strong emphasis on clusters highlights both directly and indirectly the importance of regional specialisation. As Feldman and Audretsch (1999, p. 427) maintain, however, on the basis of American sector-based data, from an innovation- and knowledge-based economy perspective strict specialisation or variety is not important as such but rather the structure built on many complementary parts that share a common scientific basis, i.e., a knowledge base. Duranton and Puga (2000, p. 553) note that there are both benefits and drawbacks in specialisation. The benefits include a stronger 'localisation economy' based on geographical proximity and the drawbacks include, for example, vulnerability in the face of rapid upswings and declines in certain sectors and technologies. Indeed, high-tech industries are the most volatile of all (DeVol et al, 1999, p. 10).

As Asheim et al (2006a, p. 4) state,

'…it is not regional diversity (which involves too large cognitive distance) or regional specialization *per se* (resulting in too much cognitive proximity) that stimulates real innovations, but regional specialization in related variety that is more likely to induce interactive learning and innovation. As such, the concept of related variety goes beyond the traditional dichotomy of localization economies and Jacobs' externalities'.

Therefore, as they argue further, it is important to study '[the] mechanisms that give insights in how related variety enhances knowledge spillovers across sectors, how new growth sectors come into existence, and how economies diversify in new directions now and then' (Asheim et al, 2006a, p. 4; for more detail about related variety see Frenken et al, 2007; Boschma & Iammarino, 2009).

As Nooteboom et al (2007) argue, if firms rely too much upon local knowledge sources and/or knowledge sources of the same sector, the cognitive distance may become too short and the learning ability of the firms and other actors is hampered. Thereby the capacity to adapt to ever-changing situations may diminish and an entire region may be locked into its past (Grabher, 1993). The interplay between local and global knowledge flows and multi-scalar learning is crucial for innovation to emerge (Gertler & Levitte, 2005). Multi-scalar learning suggests that in the knowledge economy, learning, more often than not, does not have regional boundaries and it is not always possible to locate learning processes in a certain territorial level.

As Bathelt et al (2004) suggest, both local buzz (the knowledge and communication ecology created by co-location of relevant actors) and global pipelines (channels used in accessing knowledge external to a region) offer advantages for organisations engaged in innovation and knowledge creation. They push their definition further by maintaining that 'local buzz is beneficial to innovation processes because it generates opportunities for a variety of spontaneous and unanticipated situations, global pipelines are instead associated with the integration of multiple selection environments that open different potentialities and feed local interpretation and usage of knowledge hitherto residing elsewhere' (Bathelt et al, 2004). However, as Trippl et al (2009) show based on their empirical study on the software sector in Vienna, the local buzz and global pipelines dichotomy often remains at a too general level and loses the more precise mechanisms by which firms and other organizations in a cluster gain access to knowledge at different spatial scales. They reach beyond the buzz-and-pipelines and highlight the need to achieve a more nuanced view by studying knowledge linkages, different market relations, formal networks, spillovers as well as informal networks. Additionally, Isaksen (2003) suggests that especially in smaller countries the buzz and pipeline approaches need to be supplemented with better insights into the internal knowledge creation of firms, national business communities and global value chains.

At all events, in the knowledge economy, at a general level, the basic policy recipe emerging from this body of literature is that a region needs to cultivate some specific differentiated and locally rooted knowledge bases and to foster related linkages with other relevant knowledge sources wherever they are. In addition, intensifying knowledge links within a region and helping firms and other organisations to link with global knowledge sources is often emphasised. The nature and directions of ‘extra-territorial links and pipelines’ are not, however, well described in the literature.

2.3 Knowledge bases

In this study, we use two of the three knowledge bases identified by Asheim and Coenen (2005), Asheim and Gertler (2005), Asheim et al (2007) and Gertler (2008) and distinguish between analytical, synthetic and symbolic knowledge bases. The three knowledge bases are to be seen as ideal types that encompass and acknowledge the diversity of professional and occupational groups as well as competences related to them (Asheim et al, 2006a). Since the knowledge bases and the theoretical considerations behind them have already been mentioned in the introductory article of this special issue, the main ideas of the knowledge bases are only briefly introduced here.

An analytical knowledge base is based on innovation created from new knowledge, dominated by codified, mainly scientific knowledge, usually based on deductive processes and formal models that can also be relatively easily transferred from context to context. Hence, research collaboration between firms and research organisations is typical in cases where an analytical knowledge base is drawn upon (Asheim et al, 2007, p. 661) and innovation systems are usually seen rather narrowly from the STI perspective, on which 'know-why' knowledge is especially focused (Gertler, 2008, p. 211). If an analytical knowledge base revolves around new codified knowledge, a synthetic knowledge base is based on novel combinations of existing knowledge that is often constructed in interactive learning processes among firms, customers, clients, research organisations and even competitors. Here, tacit knowledge is more dominant than codified knowledge even though both may be needed. Synthetic knowledge bases stress the importance of applied, problem-solving focused knowledge that is more inductive than deductive in nature. The 'know-how' type of knowledge is in the core of the knowledge base and its meaning can vary considerably (Gertler, 2008; Asheim et al, 2007, p. 664-666.) Examples of sectors with a synthetic knowledge base include the automotive industry and engineering. Earlier studies show that the technological competitive advantage of the machinery industry in Tampere is based on synthesis of hydraulics, automation and information and communication technology (Martinez-Vela, 2007).

A symbolic knowledge base enables innovation by a recombination of existing knowledge in new ways. It introduces craft and practical skills as important sources of new knowledge and it also highlights the importance of learning through interaction in professional communities. It is clearly more culturally oriented than the other two knowledge bases and hence the importance of reusing, redefining or challenging existing conventions to create new symbols and identities becomes relevant (Asheim et al, 2007). It has a strong semiotic content and the importance of interpretation is high so meaning may vary greatly between places (Gertler, 2008). Symbolic knowledge is related to dynamic development of cultural industries such as media (film making, publishing, music, etc.), advertising, design, and fashion. Digital knowledge is a new technology-intensive element in the same industries, where the medium may be digital but the content, the value added for an end user or customer, is symbolic, artistic or creative.

It is also worth recalling here that most industries draw upon all three knowledge bases but the assumption is that more often than not one of them is at the core of competitiveness and the other knowledge bases support effective utilisation of the core knowledge base. It should also be pointed out that knowledge is not just information; in a very essential way it is culturally mediated and always presupposes a capacity for deliberation and an ability to act, and consequently the knowledge bases may have different manifestations in different countries and regions.

3 Cases, data, and methodology

3.1 The cases

3.1.1 Digital content and service business in Helsinki metropolitan area

Helsinki metropolitan area represents a complex and versatile metropolitan region that is presumed to have a fragmented innovation system. Fragmented nature of the RIS was supported by the policy interviewees. The selected cluster in Helsinki, digital content and service businesses, represents an industry that draws upon a symbolic knowledge base.

Being the only region in Finland that could be labelled as metropolitan with its population of 1,100,000 and, having a very strong institutional and organisational basis, the Helsinki metropolitan area dominates the Finnish innovation scene in many ways. The number of employees working in R&D is the highest in Finland and the educational level of the employees is similarly among the highest in the country (Prosperous Metropolis…, 2009). Knowledge generation and application, and the higher education sector are very important in Helsinki. There are nine universities and six polytechnics. Of course, these vary widely in scale, as the University of Helsinki, as a comprehensive teaching and research university, has 35,000 students whereas the Academy of Fine Arts, a specialist institution, has 246.

There is no established definition of digital content creation or digital production. They cross through three relatively different branches of business: the ICT-cluster (digital services and the channels to markets), creative industry (content and type of interaction with the customer) and knowledge-intensive business services (business services and the idea of formation of innovation systems). Digital content business can also be divided according to the distribution channel (digital television, mobile network, Internet, etc.) or the position in the value chain may be used to classify firms (Blomqvist et al, 2007). As digital content business covers a wide range of individual but closely related or intertwined businesses and industries we refer here simply to 'digibusiness'; this covers all production and design of products and services that are in a digital form. These may include music, other sound, text, images or moving images that can be loaded or distributed through digital channels including the Internet, digital television, cellular networks and physical (mobile) products containing content in some digital form. The content and service businesses are further divided into printing, marketing research, consulting, marketing, television, radio and news services (Blomqvist et al, 2007).

Finnish digibusiness firms can roughly be grouped as follows: games (120 firms), eLearning (300 firms), digital advertising and communication (3,500 firms), audiovisual production companies (1,100 firms) and multilingual communication and content management firms (1,000 firms). In the Finnish digibusiness cluster, most of the enterprises are micro-firms employing from two to nine employees. The cluster involves some major companies, whose focus is not exactly on producing digital content but rather on the creation of added value for their main products and services by digital services.[i] Most of the digibusiness firms, around 49-62% (depending on the sub-field), are located in the Helsinki region (Norrgård et al, 2009, pp. 4-7; Prosperous Metropolis…, 2009; Helsinki Metropolitan Area Business Report, 2009).

3.1.2 Mobile heavy machinery in the Tampere region

The Tampere region represents here an old industrial town; its industrial roots date back to the early nineteenth century (see Kostiainen & Sotarauta, 2003). The population of the entire Tampere region (Pirkanmaa) is approximately 480,000 and that of the city of Tampere approximately 210,000. Tampere has a share of about 16% of R&D investments in Finland and it is the second largest R&D hub after the Helsinki region. In Tampere, there are two universities and one polytechnic as well as some public research organisations like the Technical Research Centre of Finland.

Machine industry is the largest industrial branch in the region with its 17,200 employees. Machinery represents one-third of the industry in the Tampere region and its share of export is 53% of all exports from there (Harmaakorpi et al, 2009, pp. 51-52; The Intelligent Machines…, 2009). The specific case cluster, mobile heavy work machinery, is one of the largest specialised industrial clusters in Finland. Although the machinery industry has faced difficulties during recent decades, it has been able to recreate itself and key to its survival has been the infusion of new technologies into traditional machine-building by improved innovation capabilities of the companies and intensive co-operation with the knowledge-producing organisations, most notably with the Tampere University of Technology and VTT Technical Research Centre of Finland (Martinez-Vela & Viljamaa, 2007, p. 3). Some of the main machine manufacturers in Tampere region are global market-leading companies in their respective fields. Tampere is also the main centre of mobile machinery research with almost 1,000 researchers at the Tampere

University of Technology and the Technical Research Centre of Finland (VTT). Virtually all the Finnish universities with technical faculties or departments have now been integrated into the research network, as indicated by the policy interviewees.

Mobile heavy work machinery is a combination of companies manufacturing and/or developing machine industry and research organisations studying and developing related technologies. Generally speaking, the competitiveness of the cluster is based on adding 'intelligence' into traditional machines such as drilling machines, container-handling machines and safety-glass machines by integrating knowledge on respective markets, hydraulics, control systems, optical systems, automation, information and communication technology, electronics and software engineering (Tampere University of Technology/IHA , 2009.) Thus, besides the main machine manufacturers the cluster includes different engineering workshops, engineering offices, software companies and suppliers from different fields of business, like motors, components, etc.

3.1.3 Agrotechnology in South Ostrobothnia

South Ostrobothnia is one of the most rural regions in Finland and consequently, from a regional innovation system perspective, it can be characterised as an organisationally thin regional innovation system (Sotarauta & Kosonen, 2004; Kosonen, 2007). South Ostrobothnia is a region with a strong agricultural tradition and rural entrepreneurship. The region has approximately 193,000 inhabitants. Owing to its economic structure the South Ostrobothnian GDP per capita is only 74% of the national average (FINHEEC, 2009: 7.1). The region has gradually been losing its population owing to fairly limited possibilities in higher education. There are no universities but one polytechnic, and the University Consortium of Seinäjoki hosts small filial units of six different universities.

The economic strength of the region lies first of all in the food supply sector, primary production and food industry. Being the second largest sector in the region machinery, metal manufacturing and technology industries generally offer nearly 9,500 jobs. Technology industry is the major export industry and its position in exports has recently been growing (Harmaakorpi et al, 2009, p.11). South Ostrobothnia has not traditionally been among the leading technology regions in Finland. It is among the least research and innovation intensive Finnish regions (Kosonen, 2007). South Ostrobothnian companies filed annually only 20 to 24 patents between 2003 and 2007. Similarly, the regional expenditure on R&D is low compared with other regions in Finland. In 2007, South Ostrobothnia represented only 0.5% of all the Finnish R&D (Science, technology… 2007).

Producers of intelligent technology for primary production or intelligent technology for agriculture, labelled here as agrotechnology, comprise the manufacturers and developers of machinery, control and information systems (e.g., automation and software) to be used mainly in agriculture, forestry and the food industry including primary production and vehicles for those areas. Regional agglomeration of agrotechnology (ICT and machinery) consists of around 120 firms[ii] with nearly 3,000 employees (in Finland as a whole 16,900 firms with 49,500 employees. Source: Statistics Finland, 2009).

Most of the South Ostrobothnian firms in this cluster are SMEs whereas major enterprises are by-plants of the multinational manufacturers[iii] that are of Finnish origin. As the South Ostrobothnian concentration comprises various parts of agrotechnology, the firms are involved in the cluster in various ways. Additionally, firms vary according to their original industrial sector, size, export intensity and ownership. Some of the firms are traditional machinery firms and hence their contribution is not significant in high technology production. Some of the firms provide many industrial sectors with controlling, monitoring and simulation systems and hence the agrotechnology firms are important but are not the only customer-base for these firms.

TABLE 1. Population and R&D expenditure by case-region in 2007 (Source: Statistics Finland, Science, Technology…, 2007)

Region (NUTS3)	*City-Region (NUTS4)*	*Inhabitants (31.12.2007)*	*R&D-expenditure, million €*	*Share of the total R&D-investments in Finland (%)*
Helsinki Region (Uusimaa)		1,388,964	2,506.9	40.2
	Helsinki metropolitan area	1,007,611	2,472.6	39.6
Tampere Region (Pirkanmaa)		476,631	1,010.2	16.2
	City-region of Tampere	334,377	967.2	15.5
South Ostrobothnia		193,815	29.9	0.5
	Town-region of Seinäjoki	122,566	16.7	0.3
Finland		5,326,314	6,242.7	100.0

3.2 Sample characteristics

The study comprised three main phases. *First*, the three regions and the nature of the case industries were mapped for identification of firms to be interviewed as well as the main policy instruments in use. For the Tampere and South Ostrobothnian cases the samples were collected from all the identified companies in the respective clusters. The key firms in both cases were identified by drawing on existing knowledge of these clusters; membership lists of formal policy clusters, regional firm registries and cluster reports were analysed. Additionally, the programme director of the Intelligent Machines Cluster Programme was asked to name all the key companies of the respective cluster. Key firms were regarded as those with a dominant position in global markets or otherwise significant position in the development of the respective industry nationally or in a region in question. In total, the sample of the Tampere case included 37 key firms of which 26 were interviewed. The sample for the South Ostrobothnia case included 27 key firms of which 18 were interviewed. The key firms of South Ostrobothnia were identified as in the Tampere case. As the Helsinki region case is significantly larger than the two others, the sample and, most notably key firms, were chosen both by utilising the existing expert knowledge (and various cluster development programmes) and by stratified systematic sampling. For the systematic sample method four different company listings were analysed firm by firm and all the firms not fitting the definition of digital content services were removed from the sample. In total the sample of the Helsinki case included 83 key firms and 51 of these were interviewed.

Since the selected sub-branches cross the established industrial categories, there are only estimations of the entire population of firms operating in these fields. Thus, it is virtually impossible to compare the sample with the absolute target population. The main aim, however, was to reach all the key firms of the cluster in question and of the sampled key firms, 70% in the Tampere region, 67% in South Ostrobothnia and 61% in Helsinki were interviewed. In total, the empirical data adequately represents the entire firm population in question.

Second, 95 structured interviews in firms were carried out. Interviews were a combination of structured and thematic procedures. The structured interviews gathered information about the companies, their recruitment processes, knowledge flows, experience of policy programmes and innovation performance. The thematic part of the interviews focused on knowledge networks. Most of the 107 firm interviewees (65%) were entrepreneurs, owners of the firm or chairmen of the board and 8% were heads of R&D departments or the equivalent. The rest of the interviewees had miscellaneous working titles. The interviewed firms were fairly small; 45% of the intelligent machinery firms employ 50 or fewer people and the digibusiness firms were even smaller (Table 2). In the analysis of the data, we apply descriptive statistics.

TABLE 2. Employees 2005 and 2008

	South Ostrobothnia (n=18)		**Tampere region (n=26)**		**Helsinki metropolitan area (n=51)**	
	Employees 2005	*Employees 2008*	*Employees 2005*	*Employees 2008*	*Employees 2005*	*Employees 2008*
Mean	49.9	60.2	179.9	225.7	106.8	112.3
Median	41.0	65.0	77.5	107.5	12.5	18.0
Standard dev.	44.6	51.5	283.1	276.7	504.3	464.1
Minimum	1	1	1	8	1	1
Maximum	160	180	1200	900	3500	3300

In the third phase, 40 persons mainly responsible for local and regional innovation policy initiatives were interviewed in the case-regions. In addition, in South Ostrobothnia, a focus-group interview with six interviewees was organised. In all three case-locations two or three interviewees represented universities and higher education institutions, two or three centre of expertise programmes and one or two were local city officers. Four interviews were carried out at national-level institutions, i.e., Ministries and the Finnish Funding Agency for Technology and Innovation (TEKES), and two interviews with the representatives of the Finnish Strategic Centres for Science, Technology and Innovation. Here, we draw mainly on the firm interviews but use policy interviews to highlight some specific aspects of the cases in question.

4 Competitive advantage and innovation performance

To start with, it is worth noting that the competitive advantage of both digibusiness and intelligent machinery firms is based mostly on customised production for individual customers. Digibusiness firms in Helsinki emphasised marketing and design as sources of competitiveness slightly more than intelligent machinery firms in the Tampere region and in South Ostrobothnia (Table 3). Roughly one-third of the digibusiness firms highlighted design as an important factor in gaining competitiveness whereas less than 10% of the intelligent machinery firms stressed its importance. There are no major differences between the two different regional innovation system types of the two intelligent machinery cases in this respect either. These results indicate that the Finnish firms are customer-oriented, and this confirms the observations of Breznitz et al (2009, p. 4) whose study shows that any group of customers is the main source of new ideas for all the Finnish firms across the industries. The customer-orientation view will be further examined below.

TABLE 3. The main activities for achieving competitiveness (multiple selections possible) – share of firms with 'yes' answers (%) (source: own survey)

	South Ostrobothnia (n=18)	*Tampere region (n=26)*	*Helsinki metropolitan area (n=51)*	*Total (n=95)*
Customised production for individual customers	78	88	82	83
Product/process development	39	46	29	36
Standardised production	28	38	27	36
Marketing	11	8	20	15
Design	6	8	31	20

In addition to being customer-oriented all the interviewed firms also reported high innovation activity. More than 80% of all the firms have introduced new or significantly improved products and/or services to the market and, additionally, 82% of them reported that their new products or services were also new to the customer (Table 4). There are no significant differences between the knowledge bases or regional innovation systems in this respect. Firms have also been active, especially in the Tampere and Helsinki regions, in process innovation. South Ostrobothnian firms have not shown similar activity but still almost 60% of the firms have carried out process innovation there too. Over half of the firms in Helsinki and Tampere have reformed their strategy whereas South Ostrobothnian firms have focused more on improving organisation structures (Table 4).

TABLE 4. The main changes carried out in the firms to improve in the last three years (multiple selections possible) – share of firms with 'yes' answers (%)(source: own survey)

	South Ostrobothnia (n=18)	*Tampere region (n=26)*	*Helsinki metropolitan area (n=51)*	*Total*
Product / service innovation new to market	72	85	84	82
Product / service innovation - new to customer	92	77	81	82
Process innovation	59	92	80	79
New / significantly improved strategy	17	54	61	51
New / significantly improved market concept	39	38	53	46
New / significantly improved organisational structures	83	69	53	63

In spite of relatively high innovation and renewal activity the number of employees working on R&D is relatively small in all three cases and, more significantly, the majority of the firms in the digibusiness cluster and agrotechnology do not even have an R&D unit. In the South Ostrobothnian case, the average size of an R&D unit is 6.7 employees and only 33% of the South Ostrobothnian firms reported having one. In Helsinki the respective figures are 10.8 and 32%, many of the digibusiness firms considering themselves as research, development and innovation providers or marketing service providers without any clear inter-firm divisional distinctions. As Cohendet and Simon (2008) observe, many of the knowledge-intensive firms do not have large R&D units or worldwide subsidiaries to tap into external knowledge, nor do they have many other classical ways to enhance creativity. The engineering-based mobile heavy machinery cluster in Tampere represents the classical way with its strong research and development orientation that is reflected in the fact that 81% of the firms have an R&D unit and their average size is 23.2 employees (see Table 5). In the Tampere case, many of the firms still have machinery production and separate production units and plants as well as R&D units; from the customer’s point of view the products are a mixture of solutions and industrial services.

TABLE 5. Answers to the question: 'Does the firm have employees working for research and development?' – the share of firms replying yes or no (%) (source: own survey)

	South Ostrobothnia (n=18)	*Tampere region (n=26)*	*Helsinki region (n=51)*	*Total (n=95)*
Yes	33	81	32	46
No	67	19	68	54
Total	100	100	100	100

Our data suggest that the firms of the digibusiness cluster emphasise that incremental service innovation and radical innovations are not explicitly developed in co-operation with various research institutes like universities. In digibusiness, innovation activity should not be exaggerated as something separate from the continual business development but seen as a comprehensive and continuous search for new business opportunities to be exploited. Indeed, as Preston et al (2009, p. 1010) also seem to argue, the question is about intertwining sets of knowledge in continuous efforts to create something new by combining technological, intangible (e.g., tacit, creative, non-technological knowledge) and business/market information in novel ways.

5 Knowledge sourcing

5.1 Human capital and recruitment patterns

In this section we focus on the question of what are the main sources of knowledge used in innovation processes. Since absorptive capacity plays a key role in maintaining and improving competitiveness we assume that alongside monitoring publicly available information, recruitment is one of the most crucial elements in knowledge sourcing. As Table 6 indicates, employees of the two case industries as well as the three different regional innovation systems have a relatively high level of education. In the two intelligent machinery cases the educational level is somewhat lower than in the digibusiness case. This is because intelligent machinery firms also have traditional manufacturing activities with blue-collar workers whereas the digibusiness firms are drawing more heavily on intangible assets, i.e., a highly educated labour force.

Interestingly, the educational backgrounds of the employees reflect fairly well the two different knowledge bases these firms draw upon. In digibusiness only 21.5% of the employees have an engineering degree whereas the respective figure is as high as 87% in Tampere and 43.4% in South Ostrobothnia. In the digibusiness firms engineers are in a minority and the majority of employees have further education in the arts or other subjects (Table 6). These observations support Preston et al, who maintain that a key challenge for digibusiness companies is to obtain the right mix and balance of technical, creative/design and business skills (Preston et al, 2009, p.1003).

TABLE 6. Educational background (%) - averages and standard deviation in brackets (source: own survey)

Educational level	*South Ostrobothnia (n=18)*	*Tampere region (n=26)*	*Helsinki Metropolitan Area (n=48)*
Doctoral degree	0 (0)	1.7 (4.9)	0.9 (2.3)
Master's degree or equivalent	13.5 (26.6)	27.2 (20.4)	32.6 (24.5)
Bachelor's degree or equivalent	25.2 (22.4)	23.9 (20.4)	38.6 (22.5)
Below bachelor's degree	57.8 (35.1)	56.1 (32.8)	33.3 (27.0)
Disciplines of bachelor's degree or higher			
Natural Sciences	18.4 (36.6)	2.3 (3.5)	9.3 (17.8)
Engineering	43.4 (36.7)	87.0 (20.1)	21.5 (20.5)
Arts subjects	20.2 (44.6)	0.7 (2.4)	40.6 (28.3)
Other (business, social sciences, etc.)	34.8 (35.6)	9.0 (9.4)	41.4 (26.6)

The specific nature of the digibusiness cluster compared with the two other cases becomes obvious when we compare the recruitment channels. First of all, in their recruitment process, digibusiness firms emphasise other firms operating in the same field while the intelligent machinery firms do not (Table 7). This may reflect both the differences of the industries and the regions in question. In South Ostrobothnia, but also to some extent in the Tampere region, firms may be hesitant about recruiting from regional firms operating in the same field, because they do not want to compromise the regional coexistence and various forms of co-operation. Instead of other firms in the same sector, for intelligent machinery firms regional universities are the most important sources of qualified labour. Of course, the universities are important sources for digibusiness firms too but the balance is different. Digibusiness is a rapidly evolving and highly competitive field and it may be that the fastest access to competent professionals is to recruit them from competitors or other firms operating in close and related businesses. Even though the digibusiness firms stress the importance of 'firms of the same sector' at a national level, it should be kept in mind that according to some estimations 49 to 62% of personnel of digibusiness firms, depending on the sub-field, are located in the Helsinki region (Helsinki Metropolitan Area Business Report, 2009) and thus the question is clearly about local movement of human capital between firms.

What is typical of all three Finnish cases is that international recruitment is not seen as important at all. The absence of the foreign labour movement was not questioned in the policy interviews either; it was posed as a strategic challenge only in the Tampere machinery case. Speculatively, there are a few possible explanations for Finnish firms not being well connected to the global labour markets: (a) the firms have not faced 'global talent war' yet; (b) these firms are not capable of exploiting globally distributed knowledge sources; (c) the quality of Finnish labour force matches well enough the needs of the firms; and (d) firms aim to avoid 'cultural misunderstandings' internally. At all events, these observations verify other empirical studies indicating that the Finnish innovation system is essentially national by nature and that brain circulation is not as dynamic as hoped for by the innovation policy community (Veugelers et al, 2009).

TABLE 7. The importance of the three spatial levels (regional, national, international) for recruitment of highly skilled employees (their relative perceived importance from 1 [not important] to 5 [very important]) – group averages (source: own survey)

	South Ostrobothnia (n=17)			**Tampere region** (n=26)			**Helsinki metropolitan area** (n=51)		
	Regional	*National*	*Intl.*	*Regional*	*National*	*Intl.*	*Regional*	*National*	*Intl.*
Universities and polytechnics	**3.8**	2.2	1.3	**4.2**	2.7	1.5	**3.8**	2.4	2.1
Technical colleges	2.5	1.1	2.6	3.2	1.3	2.3	3.0	1.5	2.9
Firms of the same sector	1.3	2.6	2.6	1.6	**3.2**	2.0	2.0	**4.0**	2.3
Firms of different sectors	3.6	3.0	1.2	3.5	2.8	1.3	3.0	2.9	1.7

5.2 Knowledge channels

If the recruitment patterns differ from each other between digibusiness and intelligent machinery industries, so do the other sources of knowledge. There is a slight difference between digibusiness and intelligent machinery firms in their use of internal or external sources of knowledge. Digibusiness firms rely slightly more on external knowledge sources than intelligent machinery firms: 57% of the intelligent machinery firms report relying mostly on the internal knowledge sources and in the case of digibusiness firms the respective figure is 47.6%. Internal knowledge refers here simply to new pieces of knowledge generated within a firm by its own employees and external knowledge refers to all possible sources and channels of knowledge outside a firm: other firms, universities, polytechnics, fairs, journals, specialist magazines, etc.

In the interviews, the interviewees were asked to name the most important channels of both market and technology knowledge external to the firm in question. For *market* knowledge, fairs are the most important channels of knowledge for intelligent machinery firms whereas in the digibusiness cluster the most important channels of *market* knowledge are more evenly distributed between fairs, specialist magazines and market surveys. In all the three regions specialist magazines and market surveys were emphasised by roughly half of the firms (see Table 8). Additionally, as shown below, customers are highly emphasised as sources of market knowledge. Academic journals are not important channels of knowledge for these industries. Fairs are the most important channels of *technology* knowledge for intelligent machinery firms. It should be noted, however, that in the Tampere case the most important channels of technology knowledge were fairly evenly distributed, none being rated as important or very important by over 50% of the firms. This may reflect the strong internal R&D activity of these firms.

During the first interviews of the symbolic firms it became obvious that the rough division between technological and market knowledge does not capture the peculiarities of digital business well enough. In their core innovation processes, the interviewed digibusiness firms hardly ever rely on technological knowledge, technology being mainly the medium or carriage for the content and not the core of the service production. Therefore, in a set of questions on the most important channels of knowledge, 'digital knowledge' was added in the interviews for the digibusiness firms (which was the last set of industry-specific interviews). Indeed, digibusiness firms almost unanimously (86%) rated the Internet as an important or very important channel of knowledge. This points to the importance of informal ties utilising many kinds of digital spaces and communities such as bulletin boards, websites, social media, etc. These are not necessarily tied to geographical proximity but may relate more to cognitive and social proximity, although they may be reinforced by geographical proximity (Asheim & Coenen, 2005; Preston et al, 2009, 1008).

TABLE 8. Importance of the external channels of knowledge for gathering technological and market knowledge – share of firms replying important or very important (%) (source: own survey)

	Market knowledge			**Technology knowledge**			**Digit. knowl.**
	South. Ostr. (n=18)	*Tam-pere (n=26)*	*Helsinki metro (n=51)*	*South Ostr. (n=18)*	*Tampere (n=26)*	*Helsinki metro* (n=51)	*Helsinki metro* (n=51)
Fairs	89	50	51	61	42	16	33
Specialist magazines	50	38	53	33	31	24	35
Market surveys	50	46	53	28	27	20	31
Academic journals	11	0	12	17	23	10	10
Internet	NA	NA	NA	NA	NA	NA	86

To obtain a more precise view of the external channels of knowledge, we asked the interviewees to name the most important linkages to other organisations from which they draw market and technology knowledge. For *market* knowledge firms mentioned on average 4.6 linkages in South Ostrobothnia, 6.5 in Tampere and 5.0 in Helsinki and for technology knowledge the respective figures were 4.2, 7.8 and 2.1. This indicates that the most R&D intensive of the three cases, Tampere, is also the most active in sourcing external knowledge. The somewhat low figures for digibusiness firms in Helsinki, however, reflect fairly directly the nature of knowledge sourcing and innovation activity of the field, as discussed below.

The knowledge sourcing patterns of the digibusiness case differ clearly between market and technology knowledge. Whereas the 51 interviewed digibusiness firms reported 106 linkages for technology knowledge in total, there were altogether 254 linkages for market knowledge. This indicates clearly how much more important market knowledge is for these firms compared with technology knowledge. The policy interviewees indicated that the digibusiness firms source technology knowledge from relatively stable and trusted partners: other firms, centres of expertise, technology centres, branch-specific associations, etc. Mobile heavy machinery firms in Tampere reported more sources and linkages for technology knowledge than market knowledge.

In all three cases firms source *market* knowledge mainly from customers, the second most important source being other firms. In Tampere's case 53% of all the mentioned sources are customers. In Helsinki the respective figure is 44% and in South Ostrobothnia 32%. When we look at the sources of *technology* knowledge the pattern is only slightly different. Mobile heavy machinery firms and digibusiness firms highlight customers as the most important source in the case of technology knowledge whereas South Ostrobothnian agrotechnology firms utilise suppliers more than other sources. Preston et al (2009, p. 1007) reiterate these findings in terms of digibusiness. They found that customers are the most favoured partners and sources of knowledge for digibusiness in Dublin.

5.3 Geography of the knowledge sources

In further analysis of the market and technology knowledge sources some slight differences between regional innovation systems and industries emerge. Whereas digibusiness firms in Helsinki metropolitan area acquire both market and technology knowledge mainly from local sources, firms in South Ostrobothnia and Tampere rely more on national sources (see Tables 9 and 10). Out of the total of 254 market knowledge linkages of digibusiness firms, 67% are local. For technology knowledge the respective figure is 52% (total 106 linkages). In Tampere and South Ostrobothnian intelligent machinery cases the shares of national linkages for market knowledge are 42% and 54% (in Tampere 170 and in South Ostrobothnia 82 linkages in total). For technology knowledge national sources are the most important ones, the share in Tampere being 38% out of 204 linkages and in South Ostrobothnia 64% out of 76 linkages. In the intelligent machinery of Tampere every third linkage is local while the same figure in South Ostrobothnia is 20% (see Tables 9 and 10).

Of course, given the dominant position of the capital city in digibusiness local sources are in some senses national. The 'local/national nature' of digibusiness reflects the fact that Finnish customers, suppliers, partners, etc. are geographically clustered in the Helsinki metropolitan area. To some extent, the same applies to the mobile heavy machinery case of Tampere. It is a nationally important hub in the Finnish machinery industry.

As a whole, customers are the most important source of knowledge for the three cases under scrutiny (see Tables 9 and 10). The only exception is that the South Ostrobothnian firms rate suppliers, other firms, universities and research organisations as more important sources than customers in acquiring technology knowledge. Interestingly, the South Ostrobothnian firms do not report any local or regional customers that might be important for obtaining novel technological knowledge. The Tampere case differs clearly from the organisationally thin RIS of South Ostrobothnia. Customers instead of suppliers are the main source of technology knowledge. Interestingly, 44% of customer linkages are national, 30% local and 20% international whereas in the case of suppliers the figures are 12% national, 76% international and 12% local. This clearly indicates the internationally dispersed nature of supplier networks and the strong Finnish concentration of machinery industry. Additionally, local universities are highlighted in Tampere as important sources of technology knowledge with 44 mentioned linkages out of a total of 204 (Table 10).

In the digibusiness case, customer linkages are the most important (34% for technology knowledge and 44.5% for market knowledge) and as indicated above, they are mainly local (65%). The other firms feeding digibusiness with market knowledge are

43% international and 49% local. Our policy interviewees stressed that, in some sub-branches of digibusiness, such as games and movies, the social media and various Internet communities are involved as co-producers of final artefacts and hence the specific location is somewhat difficult to identify. For these reasons, the digibusiness cluster relies heavily on the competence of a variety of private actors, i.e., enterprises, consultants, private educational organisations, enterprise forums, etc.

TABLE 9. Sources of *market* knowledge (local refers to NUTS 4 and regional to NUTS 3) (source: own survey)

South Ostrobothnia	*Customers*	*Suppliers*	*Other firms*	*Competitors*	*Univ.*	*Res.org. /polyt.*	*Other sources*	*Total*
Local	12	11	38	8	17	0	27	18
Regional	8	0	6	0	0	0	0	4
National	69	56	31	17	83	100	64	**54**
International	11	33	25	75	0	0	9	24
Total (%)	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Linkages	n=**26** **(31.7%)**	n=9 (11.0%)	n=16 (19,5%)	n=12 (14,6%)	n=6 (7.3 %)	n=2 (2.4%)	n=11 (13.4%)	n=82 (100%)
Tampere region								
Local	31	20	15	17	75	40	21	27
Regional	3	10	0	0	0	0	3	3
National	40	40	40	33	25	60	52	**42**
International	26	30	45	50	0	0	24	28
Total (%)	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Linkages	n=**90** **(52.9%)**	n=10 (5.9%)	n=20 (11.8%)	n=12 (7.1%)	n=4 (2.3%)	n=5 (2.9%)	n=29 (17.1%)	n=170 (100 %)
Helsinki metro								
Local	68	80	49	56	83	65	94	**67**
Regional	3	0	4	0	0	0	0	2
National	13	20	4	0	17	6	3	9
International	16	0	43	44	0	29	3	22
Total (%)	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Linkages	n=**113** **(44.5%)**	n=15 (5.9%)	n=51 (20.1%)	n=9 (3.5%)	n=6 (2.4%)	n=31 (12.2%)	n=29 (11.4%)	n=254 (100%)

TABLE 10. Sources of *technology* knowledge (local refers to NUTS 4 and regional to NUTS 3) (source: own survey).

South Ostrobothnia	*Customer s*	*Supplier s*	*Other firms*	*Compet itors*	*Univ.*	*Res.org. /polyt.*	*Other sources*	*Total*
Local	0	19	36	0	13	18	33	20
Regional	0	0	14	0	13	0	0	5
National	83	58	50	0	74	73	67	**64**
International	17	23	0	0	0	9	0	11
Total (%)	100	100	100	100	100	100	100	100
Linkages, total	6 (7.9%)	**26 (34.2%)**	14 (18.4%)	0 (0%)	16 (21.1%)	11 (14.5%)	3 (3.9%)	76 (100%)
Tampere region								
Local	30	12	15	0	44	20	42	30
Regional	6	0	8	33	7	0	8	6
National	44	12	46	67	29	67	31	**38**
International	20	76	31	0	20	13	19	26
Total (%)	100	100	100	100	100	100	100	100
Linkages, total	**81 (39.7%)**	25 (12.2%	13 (6.4%)	3 (1.5%)	41 (20.1%)	15 (7.4%)	26 (12.7%)	204 (100 %)
Helsinki metro								
Local	44	56	50	17	67	50	89	**52**
Regional	6	0	5	17	0	0	0	4
National	14	0	10	0	22	30	0	11
International	36	44	35	66	11	20	11	33
Total (%)	100	100	100	100	100	100	100	100
Linkages, total	**36 (33,9%)**	16 (15.1%)	20 (18.9%)	6 (5.7%)	9 (8.5%)	10 (9.4)%	9 (8.5%)	106 (100%)

In all three cases together, 23% of the knowledge sources are international. Therefore, in their extra-regional linkages these cases are clearly nationally oriented. But the international sources of market and technology knowledge play to some extent a higher role than might be expected given the criticism that Finland has an excessively national and inward-looking innovation system (Veugelers et al, 2009). Recruitment is predominantly national but the firms in our three clusters are not totally isolated. In their international linkages digibusiness firms mainly target the rest of Europe (Nordic countries not included) and the USA, whereas the machinery firms draw more upon Nordic sources and the rest of Europe, Germany being the most important individual country. The policy interviews indicate clearly that the two larger cases, digibusiness and mobile machinery, are taking steps towards internationalised cluster or value-network orientation, i.e., more international recruitment, knowledge sources, collaborative funding and joint-operations and international investments.

TABLE 11. Geography of *international* market and technological knowledge sources – share (%) of total number of linkages (source: own survey).

	Market knowledge			**Technology knowledge**		
	South Ostrobothnia (n=20)	*Tampere region (n=46)*	*Helsinki metro (n=49)*	*South Ostrobothnia (n=7)*	*Tampere region (n=42)*	*Helsinki metro (n=20)*
Nordic countries	35	15	8	29	24	10
Rest of Europe	**45**	**48**	33	**57**	**62**	**45**
USA	10	9	**55**	14	12	**45**
Asia	5	0	2	0	0	0
Others	5	28	2	0	2	0
Total	100	100	100	100	100	100

6 Conclusion – local buzz and global pipelines with digital flavour AND national buzz and pipelines with global flavour

By now studies on local buzz/global pipelines dynamics have shown that there are differences between regions on how this dynamic plays out in different contexts. In his study on the Leipzig media sector, Bathelt (2005) notes that the lack of local as well as trans-local interaction is the main cause for stagnation of the Leipzig media industry after a decade of substantial growth. He argues that the firms in Leipzig do not have strong pipelines to firms and markets outside the cluster nor do they engage in intensive local networking and interactive learning. Trippl et al (2009) show how knowledge flows of the software industry in Vienna are based on informal networks crossing all the spatial levels. They also show how informal networks are complemented by formalized partnerships at the local and national levels. For his part, drawing on his study of the electronics industry in Horten (Norway) Isaksen (2003) maintains that the buzz and pipeline approach can be supplemented with stronger focus on internal knowledge creation of firms, interaction in national business communities and their involvement in global value chains. In a way, the importance of national linkages in the Norwegian electronic case, identified by Isaksen (2003), complements the strong focus on local buzz and global pipelines by Bathelt et al (2004) and Storper and Venables (2004) with additional ingredients, and so do the two Finnish intelligent machinery cases. Of course, this study does not reveal *how* knowledge is created in any 'buzzing community' or how it flows via pipelines across distances; it simply shows what the main linkages are and where the other end of the pipelines are.

The two Finnish intelligent machinery cases confirm Isaksen's observations. Both the mobile heavy machinery in Tampere and agrotechnology in South Ostrobothnia are, on the one hand, mainly utilising national pipelines in their knowledge sourcing but, on the other hand, in their recruitment they draw heavily on local universities and polytechnics. Additionally, these clusters also target, to a certain extent, global sources for knowledge and consequently it is possible to conclude that this industry shows a strong tendency toward national buzz as well as national pipelines but with some local and global flavour. Tampere differs, as assumed at the outset, from South Ostrobothnia's organisationally thin RIS in having a stronger institutional basis for machinery industry. This is reflected in stronger R&D activity and knowledge sourcing in Tampere than in South Ostrobothnia. Interestingly, South Ostrobothnian firms do not compensate for organisational thinness with extra-regional linkages. There are, however, clear signs of explicit efforts to tap more effectively into the main Finnish universities and other relevant organisations (see Sotarauta & Kosonen, 2004; Kosonen, 2007).

The digibusiness firms draw upon a symbolic knowledge base, as assumed at the outset. The interview data suggest that in the digital content and service cluster new ideas and business opportunities are often shared or jointly explored. Digibusiness areas, being low capital investment fields and heavily dependent on human capital firms can move relatively easily from sector to sector and hence test the services and products in different user and customer communities. In digibusiness, being first in the market is an advantage, but equally important, if not more so, is branding the service or product and hosting visible references from various sources (design, brands and trademarks, social media references, etc.). All this reflects the symbolic nature of the core knowledge base of digital and service businesses. The digibusiness in Helsinki seems to represent a fairly 'classical' creative industries case with local buzz/global pipelines, strong local knowledge sourcing and pipelines to elsewhere in Europe and the USA to access *market* knowledge. Given the very visible role of the Internet and the many virtual forums, however, it might be more accurate to simplify the peculiarity of the Helsinki digibusiness case by acknowledging the strong digital flavour and label it as 'eLocal buzz' and 'eGlobal pipelines'.

At all events, it is possible to conclude that the knowledge sourcing patterns and related channels of the three case clusters support the adoption of a broader view on innovation systems and it is also possible to conclude that the geographies of knowledge sourcing differ from each other between synthetic and symbolic cases, as suggested by Asheim and Coenen (2005). Indeed, synthetic firms rely more on several sources of documented, codified, engineering-based and other explicitly addressed knowledge than the symbolic firms. If the core of 'synthetic innovation process' is the synthesis of several forms of rapidly developing technological knowledge and a combination of various sources of culturally meaningful knowledge, the 'symbolic innovation process' is clearly more local, inductive, creative and conceptual, and a combination of various sources of new ideas, trends and images.

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[i] These are, for example, the Nokia Corporation, the Finnish Broadcasting Company YLE, Alma Media, the Sanoma Corporation, Telia-Sonera, Elisa, Digita, TietoEnator and Satama Interactive. Some of the most popular and well-known SMEs in the sector are, for example, Jaiku, Sulake Dynamoid, Digital Chocolate, Remedy, Aniway, A4 Media, Bob Helsinki, Laundry Helsinki, Bugbear Entertainment, Fremantle Entertainment, Broadcasters, Housemarque, Intervisio and Mermit.

[ii] Main companies are, for example, MSK Group Oy, Done Logistics Oy, Epec Oy, Exertus Oy, Antti Lindfors Oy, Rautaruukki Oyj, Lumikko Oy, Forsfood Oy, Tankki Oy, Finn-Power Oy, Formia Lakeus, Pinomatic Oy, Plantool Oy, Formia Vesme Oy, Pesmel Oy and Done Logistics Oy

[iii] Rautaruukki, Finn-Power Oy.