Regional intelligence: distributed localised information systems for innovation and development

Nicos Komninos

URENIO Research Unit Aristotle University GR-54124 Thessaloniki, Greece E-mail: komninos@urenio.org

Abstract: Technological information is recognised as an important factor shaping regional systems of innovation and innovative regions. However, little has been written on how regions set up and manage this vital resource. This paper focuses on regional intelligence: distributed information systems localised over a region allowing continuous update and learning on technologies, competitors, markets, and the environment. We start by defining regional intelligence with respect to the concepts of business intelligence, organisational, and collective intelligence. We look at a number of case studies and experiences gained in the context of EU regional innovation and regional economic strategies, which highlight early forms of regional intelligence. We examine the fundamental information modules making up regional intelligence, including, R&D dissemination, technology and market watch, company benchmarking and competition analysis, regional foresight, and regional performance. We discuss the integration of distributed information systems and solutions which may be given to consolidate public content applications with the internal information systems of companies, and the role of information integration in the continuous making and remaking of innovative regions.

Keywords: regional intelligence; organisational intelligence; collective intelligence; distributed intelligence; innovative regions; regional innovation systems; regional benchmarking; regional observatories; regional foresight; information integration.

Reference to this paper should be made as follows: Komninos, N. (2004) 'Regional intelligence: distributed localised information systems for innovation and development', *Int. J. Technology Management*, Vol. 28, Nos. 3/4/5/6, pp.483-506.

Biographical notes: Nicos Komninos is professor of Urban Development and Innovation Policy in the Aristotle University of Thessaloniki. He holds a Masters degree in architecture from the Faculty of Engineering, AUTh, and a PhD from the EHESS, Paris. He is director of the URENIO research unit and he has coordinated numerous research projects of the European R&D Framework Programmes and the ERDF Innovative Actions. His research focuses on intelligent cities and regions, including knowledge clusters, technopoles and science parks; regional innovation systems and strategies; digital innovation spaces and digital cities. He is the author of more than one hundred scientific papers and research reports, and ten books. His most recent book is *Intelligent Cities: Innovation, Knowledge Systems and Digital Spaces*, published by Routledge - Spon Press, London and New York, 2002.

Copyright © 2004 Inderscience Enterprises Ltd.

What magical trick makes us intelligent? The trick is that there is no trick. The power of intelligence stems from our vast diversity, not from any single, perfect principle. (M. Minsky, The Society of Mind)

1 Introduction and theoretical framework

A new generation of cities and regions is emerging throughout the world to meet the challenges of knowledge-based development and globalisation. They were called 'innovative', 'innovating', 'learning', 'intelligent' regions, and more recently 'regions of knowledge' [1]. Their creation started with the 'explosion' of the innovation process out of research labs and the consequent extension of the spatiality of innovation over the entire regional space.

A principal feature of innovative regions is their capacity to create environments favourable to turning knowledge into new products, disseminating information, building organisational learning, integrating skills, and in the end generating innovations. Silicon Valley, beside its cyclical ups and downs, is setting the standards for such regions, while a stopples development of technological innovation territories, under diverse conditions, is occurring all over the world: in northern and southern Europe, from Uusimaa in Finland, Stockholm and Kista in Sweden, Noord-Brabant in the Netherlands, to Sophia-Antipolis and Rhone-Alpes in southern France, Bayern and Baden-Württemberg in southern Germany; in Japan and southern Asia, from Malaysia and Singapore to benefit from the decentralisation of information technologies and the software industry. Such trajectories have rapidly gained ground, constituting the prevailing regional development model at the beginning of the 21st Century, which more and more regions are trying to copy and implement.

Literature in the fields of economic geography, urban and regional development, and technology management is persistently seeking to explain this type of territorial development, and outline policies and good practice in setting-up the motors of regional technological innovation. Different explanatory schemes were formed, built with respect to flexible specialisation theories on technology districts and innovative clusters with major contributions from Becattini [2], Scott [3], and Porter [4]; evolutionary theories on learning regions, territorial innovation systems, organisational learning and tacit knowledge, by Cooke and Morgan [5], Landabaso [6], Lundvall [7], and Storper [8]; and theories linking innovative regions and digital innovation spaces creating intelligent cities and regions [9–10]. This theoretical research on the one hand explains how the territories of technological innovation were created, the local histories and the trajectories followed in each case, and on the other hand, what the fundamental elements are, and how they combine with each other in creating a self-sustaining territorial system of innovation. Illustrating the diversity of factors involved in the 'innovation growth engine' of a leading region, Silicon Valley, Cooke highlights five critical elements [11]:

1 "Basic research, knowledge generation and application capability of the kind normally found centreed on advanced private research or leading edge public research laboratories.

- 2 Venture capital is crucial as the means by which ideas have been screened and selected are given a chance to fly as commercial products or services.
- 3 Law firms are important as gatekeepers, advising firms on appropriate investors, counselors assisting entrepreneurs to access other services, and sources of contracts for many things ranging from recruitment to contract manufacturing.
- 4 Specialist consultants in business and technological services ranging from management accountants rather than simple auditing services, head hunting services and specialist engineering, software and media, and regulatory advisers or property development services, including specialised public provision.
- 5 A local value chain of firms that can conduct, for example contract manufacturing, design and fabrication, and various fairly prosaic supplies like logistics, or exhibition organisation and specialised catering services."

This description of main factors shaping a leading innovative region coincides with what we have defined, in a more abstract way, as critical components of a regional system of innovation (Figure 1) [12]. We have argued that innovative regions and territorial systems of innovation spatially concentrating industrial clusters, research institutes, technology transfer agencies, funding organisations, and information infrastructure, are networks which work as *integrators*. Integration takes place between the separate components of the regional innovation process: R&D, innovation finance, technology transfer, new product development, and cooperative production. But integration also takes place between the physical, institutional, and digital spaces within which innovation processes occur. We used the term *intelligent cities / regions* to illustrate the multi-level localised system of innovation, which assures the coherence of practice of organisations involved in product, process, and organisational innovation.



Figure 1 Regional system of innovation



Universities /

Research

In innovative territories, research results and scientific knowledge are transformed into new products with the involvement of innovation funding, technology transfer, and product development external to the organisation concerned. No doubt, these externalities presuppose an advanced social division of labour in the field of technological innovation. This seems to be the dominant trend, creating a new logic of 'open innovation' in which R&D and creativity extends beyond the boundaries of the company [13]. Increasing 'externalisation' of innovation from research labs makes outsourcing mainstream practice for large and small firms, public or private organisations, in order to assure the critical resources of funding (through venture capital), technology (through technology transfer), and inter-firm collaboration (through institutional and digital networks). Innovative companies and organisations, networks among distributed competences, externalities in the innovation processes, integration among physical, institutional and digital innovation spaces, and political regulation, are key concepts for understanding territories of innovation.

A principal element of innovative regions is the respective *sub-system of technological information* assuring a continual flow of knowledge based on human skills, technologies embedded in organisations and R&D institutes, technology learning practices, and information infrastructure. Technological information is spread through out the innovation system by communication channels inside the technology clusters, institutional networks, and digital interfaces providing knowledge management tools to increase problem-solving capabilities [14]. This knowledge helps regions to overcome successful innovation waves. For instance, a major challenge that leading innovative territories are facing today concerns emerging markets and technologies: keeping up to date with ongoing trends in R&D and technology; the pace that markets mature in semiconductors, personal computers, servers, corporate software; the rise of high-tech markets related to smart phones, digital television, web services, and wireless communications; the significance of ongoing investments in innovative products and technologies, such as utility computing, chip sensors, sensor networks, plastic electronics, and the wireless net.

Recent theoretical research has drawn attention on the interactive and collective character of knowledge that generates the innovative capability of companies and organisations. Nonaka and Takeuchi [15] introduced the concept of organisational learning to describe knowledge generation that takes place within a community of interactions. Organisational learning amplifies the knowledge created by individuals and crystallises it into the structure of the organisation. Edquist et al. extended the field of learning interactions from inside the organisation to cooperation networks among organisations [16]. This sharing of knowledge takes a variety of forms, involving the acquisition of existing knowledge from public organisations, R&D centres, universities, licensing from other companies, or less formal types of exchange in technological cooperation networks; it takes also the form of cooperative, new knowledge creation within consortia of companies, universities and technology intermediaries. In the same direction, Keeble, Lawson, Moore and Wilkinson have shown how 'collective learning', a concept developed by Camagni and Lorenz, may contribute to the innovative behaviour of technology clusters [17]. Collective learning describes the capacity of a social environment to facilitate innovative behaviour by the firms that are members of this milieu. This type of shared knowledge facilitates establishing a common language for talking about technological and organisational problems, for effectively cooperating in a

technological project, and for managing hierarchical relations and responsibilities among different occupations assuring the consistency of collective decision-making.

Companies and organisations that are members of an innovative region have to constantly update technological information and learning capabilities to improve innovation and competitiveness [18]. Part of this knowledge is generated internally and part of it is acquired from external sources. The two dimensions are reflected in business intelligence vs. regional intelligence approaches. Business intelligence is developed by companies to monitor information related to products, markets, and technologies in which they are active. Regional intelligence on the contrary, is set-up by third party organisations (regional authorities, business associations, universities, etc.) to inform about wider trends in production, markets, and technologies. Taking this role of providing information to complement internal knowledge, regional intelligence is becoming a cornerstone for any region in which innovation and new product development is based upon cooperation networks among companies, research institutions and public administration. In small and medium-sized companies, in particular, regional intelligence is of prime importance as it opens a window to new ideas, product models, and innovative processes, exploiting creativity and know-how from the environment in which they operate.

For both business and regional intelligence, information technologies and the internet are becoming primary means. Technological information systems were fed by the internet and the dot-com revolution, allowing world-wide cooperation on the exchange of information. Today, as fast net access takes off, it is sparking new ways of using the internet that we are just beginning to figure out. However, it is not only about connectivity. Digital innovation spaces created with respect to R&D, technology transfer, and technology funding, allow for the introduction of best practice and increase creativity and problem-solving capabilities in organisations, whether large or small, in core or peripheral regions. Regions through cooperation networks and the internet are taking their first steps into regional intelligence.

2 Defining regional intelligence

Regional intelligence belongs to a new family of concepts, such as business intelligence, territorial competitive intelligence, strategic economic intelligence, distributed intelligence, social or collective intelligence, emphasising the organised and systemic collection, analysis, and dissemination of information for business and development purposes.

Business intelligence is the basis for this conceptual setting. It is defined as an activity to overview the internal and external environment of a company, with the intention of finding information that can be incorporated into management processes. It is an organised procedure in the service of the strategic management of the company, aiming to improve its competitiveness by the collection, treatment and dissemination of information useful for controlling its environment. This informed decision-making uses specific tools, mobilises employees, as well as internal and external networks [19]. Business intelligence does not include any illegal activity, it is rather a systematic method of getting information, which is exploited for a business purpose, and to that extent a deep gap separates it from its caricature of industrial espionage [20]. Business

intelligence is also conceived as a strategic approach for systematically targeting, tracking, communicating and transforming relevant 'weak signs' into actionable information on which strategic decision-making is based. 'Weak signs' are anticipatory, uncertain, ambiguous, and fragmented information, thus subject to interpretation and multiple purpose meaning [21].

Business intelligence is mainly a company activity. It has evolved out of traditional decision-support systems that gradually incorporated in-house databases (~1985), data warehousing (~1995), customer relationship management (~2000), and integrated business intelligence applications (~2003). From this evolution, it has the potential to deliver enormous payback to the company, but demands unprecedented integration of knowledge about customers, competition, market conditions, vendors, products, and the entire supply chain [22].

Business intelligence is facilitated by software tools and a number of fundamental inventions concerning the ways to deal with data. The latest solutions are focusing on the semantic exploitation of data by means of computational intelligence technologies and adaptive business intelligent applications [23]. Assigning meaning to data, delivering knowledge from data, and deriving optimal decision support are key activities for all business fields, from R&D, to technical design, production, quality control, and supply chain management. Adaptive business intelligence integrates *data mining*, using algorithms capable of discovering new or unknown facts from a dataset of information gathered into a relational database system, and *optimisation* based on input-output models [24]. On the other hand, valuable information about external business factors is readily available on the web, and web farming is an approach gaining ground for business intelligence [25]. Information assistants and information retrieval tools were developed for this purpose, which act on behalf of the user: launch the query by using an analysis of documents based on a semantic network defined by the system and visualise the results according to data presentation or data exploration techniques [26].

At the other side of business intelligence is regional or territorial intelligence. This may be defined as an informational nexus linking the actors of a locality [27–30]. It is a network allowing 'an observation strategy towards the competitors, the markets and the environment. These practices lead to an economic intelligence approach, which, when applied to the territory, is called territorial intelligence' [28].

Thus regional or territorial intelligence is distributed intelligence organised along networks of information and cooperation between actors located in proximity to each other. It focuses on the external environment of a company, though it may also include elements of internal information for comparison and benchmarking purposes. As distributed organisational intelligence, it makes a step forward from traditional strategic intelligence tools (watch, foresight, assessment) corresponding to the need of policy makers to set localised strategic intelligence activities customised to their own particular needs [31]. However, what mainly characterises regional intelligence is the fact that it is organised by third party organisations; it is not bound to the rationality or scope of a single company or organisation, but to the welfare of a territory, locality or administrative region.

Table 1Business vs. regional intelligence

	Internal company information	External company information
Business Intelligence developed by the company	Company audit	• Markets and products watch
	Relational databases	Technology watch
	• Data mining	Competition watch
	Balance scorecards	Materials prices watch
	• Modeling	• Consumer trends
	Optimisation	
Regional Intelligence developed by third party organisations	Company benchmarking	Business statistics
	Business excellence models	Regional indicators
		Regional benchmarking
		• R&D results
		• Patents
		Regional foresight

Regional intelligence is 'collective'. It is a territory-based form of intelligence allowing a relatively large number of people or organisations to cooperate in a process leading to the definition or solution of a problem. The term 'collective intelligence' relates to an extensive body of literature concerned with several subjects such as distributed cognition, distributed knowledge systems, connected intelligence, networked intelligence, reinforcement learning, distributed artificial intelligence, multi-agent systems, etc. Notwithstanding their diversity, these philosophical and scientific trends describe human or synthetic intelligence exhibiting properties, such as learning, perceiving, acting, problem-solving, and so on. In a less anthropomorphic conception collective intelligence characterises a large number of cooperating entities which work together so closely as to become indistinguishable from a single organism with a single focus of attention and threshold of action [32].

According to Levy 'collective intelligence' is a social project of varied intelligence, distributed, unceasingly developed, and coordinated in real time [33]. This definition is built upon four axioms: *It is distributed*: in the sense that nobody knows everything, everyone knows something; knowledge is in humanity and not in a transcendent entity that would organise its distribution near the company. *It is unceasingly developed*: Levy insists on the concept of human qualities; each member of a community is carrying a richness that would ensure a place and a contribution in collective intelligence. *It is coordinated in real time*: the reference here is to cyberspace, to the semantic web in particular, a tool supporting collective intelligence and allowing communication between media on a large scale. Finally, it *leads to an effective mobilisation of competences*: collective intelligence is not a theoretical or philosophical concept; it can underlie a new effective social organisation, based on competences, knowledge, and wisdom [34].

In perspective, Levy argues, the semantic web will open new horizons to collective intelligence. It will allow the creation of a virtual space where the hyperlinks do not point to documents (texts or images) but concepts. In the model he elaborated, this semantic space will be represented by a virtual architecture, a kind of 'abstract city' on several

relevant dimensions of representation. This city mirroring collective intelligence will shelter six 'districts' corresponding to mental representations referring to competences; intentions; 'declaratory', 'procedural' and 'existential' knowledge; social networks; technical networks; and social reality. Each district will shelter 'semantic zones', while each zone will be defined in the language of collective intelligence. The informational objects (sciences, arts, skills, institutions, documents, messages, people, and equipment) will be represented as beings that connect the various parts of the city while transporting resources from one zone to the other. By visiting the city, one will thus discover the structure of the relations between the semantic zones, i.e. the structure of the collective intelligence considered, on the level of a document, a company, a city, a country, covering every aspect of information that circulates on the web [35].

Putting the above dimensions together, we may define regional intelligence as a territorial information system having five characteristics:

- 1 It is a *localised network* of distributed informational modules.
- 2 It is developed by *third party organisations* for the welfare of a territory, locality or region.
- 3 It uses *human and artificial intelligence* in the collection, processing, and dissemination of information.
- 4 It communicates via the Internet.
- 5 It is *integrated* so effectively that its constituting parties become indistinguishable for the external user.

3 Early forms: outlook of selected cases

To date, applications of regional intelligence are limited and their structure is rather simple. We have identified a number of institutions (observatories, documentation centres, technology centres) that collect and disseminate information in organised ways targeted on regional audiences. Most are linked to public administrations and their operating costs are covered by public funds. We do not include 'digital cities' which represent and promote particular cities and regions on the web. Though they show some similarities, digital cities follow a radically different rationale from regional intelligence. We will discuss three cases of regional intelligence focusing on regions, industry clusters, and technology learning networks.

An organised attempt to develop regional intelligence is found in regional observatories in the UK regions of the East Midlands, East England, South East England, the South West, the North West, and Yorkshire. These observatories more or less follow the same model: they are based on a network of regional actors; collect statistical data; mainly cover the public aspects of the economic and social life in the region; and disseminate information via the web. They use advanced web applications, combining databases, automated interfaces, and provide information on many fields, sectors, and activities of the region.

• Established in 1999, the *East Midlands Observatory* is a network of organisations with an interest and involvement in information and research. The purpose of the Observatory is to provide the primary regional framework for the collection and

sharing of high quality, balanced and relevant economic, environmental, social and spatial information and research. Main activities include surveying and researching selected topics related to industries, skills, and regional economic trends, information monitoring and dissemination through a website on which one can find information and statistics on the East Midlands, discover research done by Observatory partners, learn about other organisations' research projects, and link to websites with useful information. Target audiences are the partner organisations, public sector organisations, local businesses, local and regional trade organisations, potential inward investors, educational institutions, and citizens [36].

- *East of England Observatory* provides an information gateway to this region. It is addressed to people and organisations interested in discovering more about the social, economic and environmental development of the East of England (Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Norfolk and Suffolk). Main areas of activity include research (regional census, social exclusion, policy analysis); a review of the regional economic strategy completed in 1999 with a full review every three years; follow-up of indicators on business registration, workforce, R&D, business location, gross value added and employment, manufacturing investment, and productivity. Geographical information systems facilitate mapping regional social and economic performance [37].
- Yorkshire Futures is the Regional Intelligence Network for Yorkshire and the Humber region, providing information and intelligence about the region, with the aim of improving decision-making and better preparing for the future. The vision is to set up an influential and objective network, ensuring that all regional policy decisions are based on robust, reliable and timely information and intelligence, contributing to making Yorkshire and Humber a world-class region. Main functions are to provide quicker, fuller and more accurate data; to conduct forward looking research to prepare the region for future events and trends; to undertake policy analysis improving decision-making, benchmarking and good practice dissemination. Information is organised into about 20 thematic areas, among which are strategies and policy, business competitiveness, workforce and skills, environment, business, futures. Three monthly briefings inform about economic trends, policy developments, and EU policies. A novel characteristic is the Knowledge Rich Programme (KRICH) through which regional businesses can access vital information before their competitors. Developed by Yorkshire Forward, KRICH is a business information service which provides online access to advice and expertise on innovation, research and new technology development; equipment, facilities and services to support research, testing, new product and process development; intellectual property rights and licensing opportunities; the latest technological, scientific, legislation and management developments; practical guidance on improving business competitiveness and profitability through innovation; and an online forum for sharing experience and learning best practice [38].
- The *Regional Intelligence Unit* offers organisations in the North West region access to key intelligence. The online information intelligence system enables them to find the information needed with greater ease, efficiency, and speed. The Unit supports the Regional Intelligence Network (RIN), a network of data researchers and practitioners from all interested areas in the region, which facilitates the flow of data,

information, intelligence and best practice. The Unit undertakes a process of identifying intelligence gaps in the region, in partnership and consultation with regional players who are members of the RIN. The Unit uses Geographical Information Systems that allow datasets to be analysed and displayed spatially, undertakes analysis on various economic datasets, and provides a series of regional statistics [39].

These observatories offer a standard level of regional intelligence, shaped by the target groups they focus on. There are some weaknesses in the design of the user interface, the roaming and search functions. With the exemption of KRICH, data comes from socioeconomic surveys and statistics; that limits target groups to academia and the public administration who are the usual 'customers' of such data. The scope of information is long-term planning, regional policy, and setting up strategies for employment, the environment, and living conditions. This type of data needs a low speed of information renewal, and limited internal information processing between gathering and dissemination functions.

Important work on regional intelligence is taking place in Lorraine, France. The region, with a population of 2.3 million, is located in the western part of France. There is strong presence of traditional industrial sectors, textiles and wood, though 13 technology support centres are gradually forging a change towards new industries and services in pharmaceuticals and aeronautics. Two applications related to regional intelligence have been developed: DECiLOR and EPINETTE [40].

DECiLOR is an application for economic and strategic intelligence set up by the Regional Council of Lorraine. It is the heaviest European investment in regional intelligence with \in five million spent over three years. It is addressed to companies in Lorraine in the sectors of wood, logistics, metal works, and pharmaceuticals. The aim is to provide companies with the essential means to make use of economic intelligence: personalised information, search methodologies, personalised watch corresponding to company environment. To this end, DECiLOR offers information of any type, validated, qualified, and classified in a database for use by companies in Lorraine, while employing methodologies adapted to the constraints of small and medium companies. It is based on a specialist team making up the back office cell of project control, which feeds the three sectoral watch centres.

EPINETTE was developed by CRITT-Bois, a technology centre for the wood industry, offering more focused technological intelligence for the needs of the wood cluster. It structures information elaborated by CRITT-Bois, which conducts approximately 100 and 50 studies and answers about 200 information requests regarding norms, patents, products and companies, per year. Information is organised in different sectors based on services provided to clients, including:

- A technological survey, which provides information on suppliers, products, and companies in the wood sector; research labs and research results; industry standards and patents; articles in the professional press, and technical documents and files.
- An on line audit, with modules allowing audits to be performed in different fields of the business activity.
- A search for subcontracting, which allows companies to offer products and technologies to European partners and look for partnership in Europe within the context of Innovation Relay Centres.

- A search for products and services using key words and taking back related companies, patents, research labs, press articles, and technology offers.
- Documentation, provided in cooperation with ENSTIB, the national school of technologies and industries of wood in the province of Epinal.

The interface is user-friendly with well-defined and clear information taxonomy; there are constant information renewal and search capabilities. The strengths of the application are in the bonds developed between regional intelligence, technology expertise and end-users, linking EPINETTE as an information-processing hub with a dedicated technological centre (CRITT-Bois) and the wood cluster of Lorraine.

In the context of European Regional Development Fund (ERDF) innovative actions 2001–2003, the regional administration of Thessaly, Greece, developed a digital infrastructure facilitating new product development, which includes a regional intelligence component. The application is supported by learning networks, which bring together companies, research labs, and business associations to discuss and exchange experience, expertise and best practice. Learning networks were organised in different industry sectors, such as textiles and clothing, food and beverages, construction materials, and furniture. They offer a forum of interaction, information and evaluation of products and technologies selected by company executives. Learning networks were seconded by a Regional Documentation Centre (RDC) that offers information services surveying markets and product innovations.

The *Regional Documentation Centre* processes and disseminates information having organised three parallel modules:

- 1 A technology and market watch module that searches the web and the technical press daily for new markets and product announcements in the fields of textiles, food, and metallurgy. It continuously updates a database relating to international and financial news, conferences, exhibitions, scientific studies, job opportunities, regulations, new products and technologies, which it offers free of charge to organisations participating in the learning networks.
- 2 A *business benchmarking* module allowing competition analysis. It is an assessment procedure, which compares the performance of a company against a selected group of companies, defining the strengths and weaknesses of the former. For each assessment indicator used, the application provides information about the position of the company within the comparison group and the distance from the best performance. A local network of private consultants uses the system and provides the necessary information for the operation.
- 3 A *regional innovation performance* module based on an annual report of regional innovation indicators, much like the EU innovation scoreboard. Using the Eurostat database CRONOS, 20 indicators were defined showing the performance of the Region in the new economy. The areas covered are the productive system, human resources, creation of knowledge, and innovation. Comparisons with other regions highlight the strengths and weaknesses of Thessaly and the opportunities offered by the regional environment in which companies and learning networks operate.

RDC is accessible online. In parallel, a newsletter with the latest information circulates every month. The subject structure is simple and clear, assuming that users will have

limited experience on use of the internet. It was evaluated very positively by its endusers, especially the sections offering information on emerging markets and market opportunities. The system demands continuous updates. An animation group works daily to collect, evaluate, and enter data into the databases. The information technology solutions used are rather conventional, with databases and html interface; most of the work for finding and assessing information relies on human intelligence.

4 Structuring regional intelligence

Fundamental elements of regional intelligence are the informational modules. These are entities, which gather, process and disseminate information with specific content and selected target groups. However, the major challenge is to be able to combine knowledge from different sources, to integrate information from the distributed network that collects and elaborates data, and customise information to the needs of particular users and organisations.

Based on the cases mentioned in the previous section and a survey on regional information applications presented in the European database RINNO [41], we consider that most important informational modules for building regional intelligence are those covering as much as possible the whole innovation process, including:

- Dissemination of research results (R&D outcomes, product or service concepts, prototypes, patents) that the user may consult and go on to sign an exploitation agreement, in the case where he/she is interested.
- Competition analysis and benchmarking the performance of a selected organisation, company or region with respect to a defined group of organisations who make the comparison reference.
- Market and technology watch which offers updates on technology trends, products, and innovations.
- Regional foresight about expected changes in regional markets, technologies and socio-economic conditions.

The variety of informational modules composing existing regional intelligence initiatives shows that there is no single solution to the problem of structure and content. Two directions clearly emerge: the targets on public administrations with the aim of improving regional policy and planning, while the second focuses on industry sectors, clusters and technology networks to facilitate innovation product and market access. This is a difference based on content, but content is not the only factor shaping regional intelligence. The structure and functionality of the later is determined by a number of decisions related to the selection and organisation of information content, modules and services; the integration and correlation of data from different information modules; the customisation of information; the capability of offering different content with respect to the needs of particular organisations; and the level of automation used or the combination of human and artificial intelligence in information retrieval and assessment.

Choices and alternative settings in relation to these issues define the character, complexity and friendless of a regional intelligence system, its potential users, reception, and future.

4.1 *R&D* dissemination module

This module, found in some regional intelligence applications, provides information about current state of research in public and private organisations operating within the boundaries of a region. It gathers and disseminates information on new product / service concepts produced by research projects. The regional dimension has to do with the organisations feeding the database and with the users as well. The origin of regional intelligence focusing on R&D may be traced back to a number of global technology market places developed by Cordis and Yet2.com.

Cordis Technology Marketplace is a free on line service where one can find research and technological development results and search for innovative business opportunities on emerging technologies. It includes exploitable research results stored in the Results Service; a showcase of best results is displayed as technology offers; additional information relates to innovation news, events, useful links, and local support. The information stems from public and private sector organisations, and EU and non-EU funded research (regional, national, etc.) as well. Five scientific domains are covered: Biology and Medicine, Energy, Environment, Information Technologies and Telecommunications, and Industrial Technologies. Technology offers are classified into three areas, according to the offers' marketability and closeness to market exploitation:

- 1 Business offers, which are close to market exploitation and for which a prototype has already been developed.
- 2 Science offers, which are at the research and development stage; it is highly scientific in nature and has exploitable potential for a very selective/specialised market.
- 3 Society offers, which are involved with concerns/issues that affect society at large.

All results included in the market place are awaiting further exploitation, such as production and/or marketing agreements, further development or funding. The database is updated whenever new results become available (usually on a weekly basis). Entries are comprehensive, providing information about the research result, the contributing organisation, and the type of collaboration sought, prototype availability, commercial potential, contact point information, and other details.

Yet2.com is the first global forum for buying and selling technology on the internet. It was founded in 1999. A self-portrait highlights yet2.com as a virtual technology marketplace, offering companies and individuals an unprecedented opportunity to conveniently and privately purchase, sell, license and research some of the world's most valuable intellectual assets. Spanning all industries and areas of research and development, yet2.com is a community where technology officers, scientists and researchers can unearth cutting-edge discoveries as well as new applications for tried and tested technologies. yet2.com helps companies extract value from undervalued or unused technologies by streamlining the traditionally lengthy and ineffective process of technology transfer. Many of the world's most coveted inventions are listed, sold and, ultimately, applied.

At the regional level, few R&D dissemination applications have been developed, among which are 'Madri+d' in Spain, and 'DRC of Central Macedonia' in Greece.

Madri+d is the regional information and technological promotion network of public research centres and private non-profit entities linked to the technological innovation of the region. The network is composed of 35 organisations with 14,000 researchers and it is coordinated by the Comunidad de Mardid. Madri+d focuses on the management and dissemination of intellectual capital of regional institutions and companies by intensively using information technologies and the internet. It also works on the definition of common strategies and methodologies in the exploitation of research results, the provision of high added-value services to researchers and companies, and the motivation for the creation of new technology-based firms. Overall Madri+d manages the regional scientific and technological knowledge, adding value to the territorial competitiveness, and allowing for the public to take part of Madrid's science and technology issues [42].

The Digital Research Centre for Cooperative Innovation (DRC) is a new infrastructure in the region of Central Macedonia, which supports cooperation between academic research and business through the exploitation of research results that have been produced by the Aristotle University of Thessaloniki and other research and technology institutes of the region. The structure of the Centre was defined with respect to an extended market research on technology demand that surveyed businesses in agriculture, insurance, manufacturing, energy, consulting, construction, transportation, informatics, telecommunications, banking, tourism, and health. The survey unveiled the lack of R&D departments in the majority of companies and an absence of collaborations between academic research labs and the private sector. To balance the limited regional R&D inputs, compared with global databases, DRC provides additional information related to the exploitation of R&D results and online roadmaps to intellectual property management, product prototyping, spin-off incubation, and management of quality [43].

The main advantage of regional R&D / technology market places with respect to global applications is in the cooperative exploitation of research results. Networks of cooperation between technology providers and users are more easily developed on a regional rather than an international scale. Furthermore, these networks are more effective. The reasons are well justified in the literature analysing the geographic scales of technology cooperation and transfer, and the problems produced by the geographical, cultural and linguistic distances between technology providers and users [44].

If technology cooperation is more effective at the regional level, regional R&D databases suffer from limited diversity. However, the scope of a regional technology market place is to counterbalance the lack of internal R&D departments in most companies. Providing information about research capabilities and results that are available next door is the first move for developing cooperative research and substitute internal R&D departments by external public research facilities.

4.2 Benchmarking module(s)

In different forms, this module operates in almost all regional intelligence applications allowing the performance of organisations, companies, and territories to be compared. Benchmarking is a process of identifying, understanding, and adapting outstanding practices and processes found inside and outside an organisation. It is based on the systematic comparison of indicators, which capture the essence of best practice and performance.

Company benchmarking was pioneered by Xerox in 1979 as part of the strategy to cope with international competition in the photocopier market; since then its scope has been enlarged to include business services and processes. The benchmarking process involves comparing one firm's performance on a set of measurable parametres of strategic importance against other firms known to have achieved best performance on those indicators [45]. There are many ways in which benchmarking can be applied. Competitive benchmarking is performed versus competitors and data analysis is done as to what causes the competitor's superior performance. Internal benchmarking examines differences in performance in organisations that have multiple units or branch plants operating in different regions. Process benchmarking compares discrete process performance and functionality against organisations that are excellent in those processes. Generic benchmarking looks at the way resources and technologies are used at selected companies independent of their industries. The main outcomes of company benchmarking are on the one hand, the definition of strengths and weaknesses of an organisation, and on the other hand, the precise/ quantitative definition of improvement margins in management, production, and distribution performance. The results are sensitive on the number of indicators used and the size of the databases supporting comparisons.

On the other side, regional benchmarking has evolved from the analysis of time series on regional development data. Regional statistics on resources, employment, and growth offer the basis for describing and modeling changes in regional economies. What is new in regional benchmarking is the simultaneous collection and elaboration of data from many regions and the positioning of a region's performance against other regions. Again the fundamental process is comparison: a set of regional performance indicators is defined, and data allow the changes in these indicators over time and different territories to be traced.

The first attempts to systematically compare regional innovation and development performance were made in the USA at the end of the 1990s. The *Massachusetts Innovation Economy Index* is probably the oldest exercise [46]. It is composed of 28 indicators reporting annually on the Massachusetts economy. It uses statistical data to illustrate how the State performs in the new economy, and compares this performance to selected regional economies throughout the USA. The Index is based upon the principle that innovation is a critical factor for development; it focuses on the nine most important industry clusters to better understand how innovation processes influence the growth of these heavily-concentrated clusters. All of the selected indicators derive from objective and reliable data sources, are statistically measurable on an ongoing basis, reflect economic vitality, and measure conditions in which there is an active public interest. Indicators are divided into three interrelated groups:

- 1 resources in the fields of human, technology, and investment resources, and infrastructure
- 2 innovation processes leading to results; from idea generation, to commercialisation, entrepreneurship, and business innovation
- 3 results including outcomes for people and business, job growth, rising average wages, and export value.

Monitoring the State's capacity is crucial for assessing its strength and resilience. At the same time, benchmark comparisons can provide an important context for understanding how Massachusetts is doing with respect to other regions. Massachusetts is compared with the national average or with a composite measure of six competing and leading technology States: California, Colorado, Connecticut, Minnesota, New Jersey, and New York.

The equivalent in Europe is the EU innovation scoreboard, which was launched in response to the Lisbon Council ambitious target to make Europe the most competitive knowledge-based economy by 2010. The scoreboard presents statistical data on 17 indicators in four areas: human resources; knowledge creation; transmission and application of new knowledge; innovation finance, output and markets. It shows achievements and trends; it compares also performances among EU Member States, the US and Japan. The first publication in 2001 presented data over the period 1995–2000, while the second report in 2002 included regional data as well allowing benchmarking of EU regions over seven indicators. The scoreboard provides detailed analysis by country, region, and indicator, while as a policy instrument offers new insights on innovation and growth.

The methodological basis of both company and regional benchmarking is more or less the same. The process starts with defining the indicators which we wish to compare and then this is followed by data collection, comparison with data coming from previous periods or other organisations and territories, reporting of main findings, and setting of improvement plans. Three critical elements exist in this process. First is the definition of indicators, which should reflect the underlying processes shaping the performance of an organisation or geographic entity. Second, the collection of data over different time scales and territories has to follow the same rules and quality standards. Third, the definition of comparison algorithms should lead to new variables meaningful in the context of models and explanatory schemes.

4.3 Market and technology watch module

In the simplest form the watch module appears as the collection and dissemination of information about commodities and prices. In more advanced solutions it includes product offer and demand, auctions, announcement of new products, new machinery and technology, production reports, and future estimations about prices and production volume. Because of the complexity and extent of information, market watch is better organised on an industry or cluster basis. One of the most sophisticated applications is to be found at <www.yarnsandfibers.com> that covers market intelligence on the textile and fiber industry. *Lorraine Epinette* and *Thessaly Documentation Centre*, discussed in the previous section, are mainly constructed as market and technology watch applications.

Market and product information is the most direct way to get close to innovation. This is clearly documented in the 2nd Community Innovation Survey carried out during 1996–97 that questioned approximately 40,000 companies in the EU. Improving the quality of products or services is the most frequent quoted very important objective (59% for manufacturing companies and 68% for services). Among the product-oriented objectives, also the extension of the product range (that is launching new products) and the opening up of new markets are considered as important goals for a large number of innovating companies. On the other hand, replacement of products being phased out is mentioned as an important aim by only a relatively small proportion of innovators. This

conclusion is validated by surveys we carried out during Regional Innovation Strategies (RIS), and reflects the difficulty that smaller companies face in developing original innovations and introducing new products. Table 2 shows the information fields that a market and technology watch module should take into account.

Table 2Real	asons for devel	oping innovat	ion (EU-15,	1996)
-------------	-----------------	---------------	-------------	-------

Activity	Manufacturing	Services		
Product oriented objectives				
• Improve product quality	59	68		
• Open up new markets or increase market share	52	48		
• Extend product range	43	49		
• Replace products being phased out	23	19		
Process related objectives				
• Improve production flexibility	32	40		
Reduce labour costs	40	38		
Reduce materials consumption	28	18		
Reduce energy consumption	22	16		
Adaptation to regulations				
Adoption of standards and regulations	23	18		
• Reduce environmental damage	25	18		

Source: European Commission (2001), op. cit. [18]

Market and technology watch requires three operations. First, the continuous and systematic scan of information sources to identify relevant information. Second, entry of this information into a database and preparation of reports; and third the notification of recipients about new information included in the database. Though this looks rather simple, the process is highly sophisticated. Few elements of search and elaboration functions can be automated with the use of crawlers and robots. A team of specialised personnel has to manually perform the necessary tasks and set-up intelligent search routines. The level of automation is limited to the spheres of data storage and dissemination via the web.

4.4 Regional foresight module

Regional foresight (RF) has been recently applied in a few EU regions to improve understanding of ongoing technology trends and improve decision-making [47]. These initiatives are placed among the practices for developing the innovation potential of EU regions, which started with RIS projects and now continue with ERDF Innovative Actions and the 'Regions of Knowledge' pilot action.

RF can be defined as a systematic, participatory process, involving gathering intelligence and building visions for the medium-to-long-term future, and aimed at informing present-day decisions and mobilising joint actions [48]. RF involves thinking about emerging opportunities, challenges, trends and discontinuities; however, the aim is

not to produce insights about the future, but to bring together key regional actors and regional sources of knowledge and develop strategic visions and anticipatory intelligence.

Foresight can help regions to break down barriers and to create networks sharing common visions. It can be useful to inform action at any level, from business, to academia and the regional administration; it is only worthwhile when it can be tied to such action. More precisely, regional foresight brings awareness about emerging trends in different areas of regional life, including: *Social trends*, with emphasis on human capital, covering issues such as demography, settlement, mobility, identity, citizenship, networks, social capital, education and training, healthcare; *science and technology trends*, with emphasis on emerging technologies, R&D results, but also market opportunities, social and economic needs; *business dynamics* on major industry clusters, start-ups, economic performance, competitiveness and exports; and *territorial vision*, in which the region is considered as a whole in a nexus of resources, geopolitics, economy, and development.

Regional foresight involves five essential elements:

- 1 "Structured anticipation and projections of long-term social, economic and technological developments and needs.
- 2 Interactive and participatory methods of exploratory debate, analysis and study, involving a wide variety of stakeholders.
- 3 These interactive approaches involve forging social networks. Emphasis on the networking role varies across Foresight programmes. It is often taken to be equally, if not more, important than the more formal products such as reports and lists of action points.
- 4 The formal products of Foresight go beyond the presentation of scenarios, and beyond the presentation of plans. What is crucial is the elaboration of a guiding vision, to which a shared sense of commitment can be attached.
- 5 This shared vision is not a Utopia. There has to be explicit recognition and explication of the implications for present day decisions and actions" [49].

From a regional intelligence point of view, RF contributes at two levels. First, it goes beyond conventional 'future studies' and brings awareness about long-term trends and challenges into immediate planning and decision-making; thus it links to the preoccupation of regional intelligence to produce knowledge for immediate action. Second, it recognises that knowledge in the knowledge-based economy is distributed, and delivers future estimations through networks and participatory schemes. Regional foresight stakeholders are industry associations, universities, businesses, chambers of industry and commerce, technology intermediary organisations, and citizens, and the same ones we meet in regional intelligence.

5 Integration of distributed intelligence

Looking at the most innovative regions, we find that several regional information systems have been developed including regional foresight; company and regional benchmarking; R&D databases and interfaces matching technology demand and supply; online technology and market watch; databases with skills and competences information. But,

these systems are disconnected; they are not integrated; each one is addressed mainly to a different group of end users and provides information in a specific field of interest. For instance, an application, which produces benchmarking reports on business performance in a given industry, does not give the opportunity to check what the available technological improvements in the industry are nor what the market trends and market niches available are. Informational integration, joint research capability, interoperability across locations and types of information, are qualities which miss in most existing systems of regional intelligence.

However, we cannot speak properly of regional intelligence until this integration takes place. As Minsky has shown, integration is key process for intelligence [50]. This is true for any type of intelligence, human and artificial as well. Minsky's theory of the 'Society of Mind' asserts that intelligence is the product of the interaction of a vast number of distinct and individually simple, but intricately connected, processes known as agents that are themselves mindless. In this sense intelligence emerge from nonintelligence. He calls 'Society of Mind' this structure of rudimentary non-intelligent agents, which combine and link together to form broader, higher levels of complexity. Each agent by itself can only do some simple thing that needs no intelligence or thought at all. Yet when these agents are organised in societies – in certain very special ways – this leads to intelligence. Agents are ordered in agencies that are structured sets and can carry out functions different from the parts comprising them. Agencies can use other agencies without comprehending how the latter functions. This is the most normal relationship between agencies. Intelligence then is a network and hierarchical tree; it does not arise from certain isolated, specialised processing centres but from organising a large number of non-intelligent particles.

Transferring this structuring concept to distributed collective intelligence strengthens integration as cornerstone of regional intelligence. Bridging information systems, agents and services, we may generate exceptionally complex networks and hierarchies that allow replying tricky questions and increase problem-solving capabilities.

Figure 2 shows a concept of integration to bridge distributed informational modules located into a region. A core is created with the connection of public domain databases and content, which are operated by different regional actors and providers. The regional dimension assures the compatibility of modules, the organisational base and trust that are necessary for this system. Integration is about providing common entrance gates, search functions, definition of inter-database descriptors, compatible content categories, metadata, etc. The periphery is made of individual databases belonging to companies, which perform their own data mining, scorecard, modeling and reporting functions with respect to internal data and external information from core public domains. Integration is double: on the one hand between core modules of market watch, company performance, R&D results, regional foresight, regional statistics, etc., and on the other between public content and company data.

Figure 2 Integration of distributed informational modules



Various integration strategies may be deployed to make this system happen. A ground common to all is the agreement between regional organisations to link their information resources and adopt common collection, information processing and dissemination rules. Strategies differ with respect to organisational agreements and the type of artificial intelligence applied.

Ex-ante integration is centralised integration and presupposes early stage coordination between the partners involved. The agreement starts from the design of the core informational modules in order to allow interoperability and common standards in data entry, data communication and exchange, and search functions. Ideally it would be a unique regional database with difference sections according to the modules selected. Regional organisations participating in the development of the system specialise in separate informational modules, while cooperate in the management of the global system. Specifications are communicated to companies on how to harmonise their internal databases with the core. A central coordination agency is needed to oversee integrated design and resolve problems created from differentiation, maturing, and improvement of core modules.

Meta-search integration is lower level integration, less centralised, but more open and expandable. Regional organisations develop the core information modules separately, but allow agents and integration servers to work on their system. Exploiting increasing amount of diverse web-accessible data is recognised as an important problem. In this context, data modeling and related knowledge processing need a comprehensive

representation and modeling of metadata, potential use of knowledge representation for correlating metadata from heterogeneous media, and use of ontologies to deal with terminological differences between terms in the information requests and those in metadata and data [51]. Integration servers may also contribute, enabling effective analysis covering many applications and databases, integrating a large number of databases and tables in a closed logical model, allowing the user to search simultaneously in structured information as well as unstructured information.

Creative integration is a step forward. It is based on centralised or decentralised structuring of informational modules, but also includes an active information processing team which creates new content from the combination of distributed information. The system becomes proactive with the publication of periodical reports, newsletters, personalised information bulletins, while new descriptors and indicators become available from the integration of distributed data. Creative integration uses both advanced information technology and human intelligence. From the collection and elaboration of data, it goes on to show good practice on how to use information, indicates links and associations in the interpretation of data, and develops creative thinking on how to proceed from information and learning to innovation.

A group of EU regions and organisations are actually working together, in the framework of the 'Regions of Knowledge' pilot action, to develop an integrated system of regional intelligence [52]. The project is called 'Meta-Foresight' meaning both the use and advancement of knowledge generated during regional foresight exercises. 'Meta-Foresight' aims to integrate several information systems that have been created in Europe and elaborate a common model for EU regional intelligence. Information systems under consideration include regional foresight reports, benchmarking applications, R&D databases, applications matching technology demand and supply, online technology and market watch, regional competences and technology skills information. Meta-search integration is mainly considered since the problem is to bridge existing applications than creating new content.

6 Conclusion

In August 2003, *BusinessWeek Magazine* dossier 'The Future of Technology' investigated the prospects of the next round of technology after the collapse of the dotcom boom [53]. Searching for next key players, it looked at Silicon Valley, which faced the most severe recession losing about 20% of its workforce and 22% of the employment in the software industry.

"Although it has never before been taken down so hard or for so long, the local economy has always experienced wild booms and busts. In the mid-1980s, when the PC industry consolidated around a handful of companies, the area lost nearly 10% of its jobs. It didn't dip below 5% until the month after Netscape went public. The web breathed new life into the Valley. What was followed was a historic run. By December 2002, more than 140,000 jobs had been created in the San Jose area, according to the Labour Dept. Then the bottom fell out. By April, 2003, eight years' of job creation had been wiped out." (pp.42–53)

The focus of the dossier was to elucidate 'what the next big thing' will be and whether a new round of technological innovations will lead this region to thrive again. However,

what the stories brought up was that no one could tell convincingly what the 'next big thing' will be; furthermore, whether the Valley will be part of it.

This kind of situation is typical of regions following a knowledge-intensive development trajectory. The advantages offered by innovation breakthroughs very soon evaporate thanks to duplication and relocation of the same agents who contributed to these breakthroughs. The region has to go on searching for a new round of innovation and competitive advantage. Ceaseless ups and downs are compressed in short-term cycles of technology investment and de-valorisation. Surfing on waves of innovation, an intelligent region has to assure that when something new happens companies and technology organisations will be able to respond to it.

Regional intelligence is part of the new arsenal of such regions. Integrating information, knowledge and competences distributed among organisations and individuals over a territory it ends up by opening our mind to emerging social behaviours and trends vis-à-vis technological innovations. Technologies co-exist in laboratories and research institutes waiting for the social demand to make the 'wave function' collapse and crystallise a new round of innovations.

Acknowledgments

The author is indebted to two anonymous referees for their suggestions; especially the comments on the origins of technology intelligence and its role in agro-industrial innovation systems and countries that have emerged from underdevelopment.

References and Notes

- 1 The 'Regions of knowledge' pilot action, introduced in the 2003 Community budget as a 'pilot-project' by the European Parliament, aims to support experimental actions at regional level to develop 'regions of knowledge' in the area of technological development, cooperation between universities, and research at a regional level and stimulate the integration of regions in Europe http://www.cordis.lu/era/knowreg.htm
- 2 Becattini, G. (1991) 'The industrial district as a creative milieu', in M. Dunford and G. Benko (Eds.) *Industrial Change and Regional Development*, London: Belhaven Press.
- **3** Scott, A. (1988) 'Flexible production systems and regional development: the rise of new industrial spaces in North America and Western Europe', *International Journal of Urban and Regional Research*, Vol. 12, No. 2, pp.171–186.
- 4 Porter, M. (1990) The Competitive Advantage of Nations, New York: Free Press.
- 5 Cooke, P. and Morgan, K. (1997) The Associational Economy: Firms Regions and Innovation, Oxford: Oxford University Press.
- 6 Landabaso, M. (1999) 'EU policy on innovation and regional development', in F. Boekema, K. Morgan, S. Bakkers and R. Rutten (Eds.) *Knowledge, Innovation and Economic Growth: The Theory and Practice of Learning Regions*, London: Edward Elgar Publishing.
- 7 Lundvall, B. (1992) National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning, London: Frances Pinter.
- 8 Storper, M. (1997) The Regional World, London and New York: The Guilford Press.
- **9** (2001) 'The top seven intelligent communities of 2001', *Intelligent Community Forum*, online www.intelligentcommunity.org
- **10** Komninos, N. (2002) Intelligent Cities: Innovation, Knowledge Systems and Digital Spaces, London and New York: Spon Press.

- 11 Cooke, P. (2003) 'Economic globalisation and its future challenges for regional development', *Int. J. Technology Management*, Vol. 26, Nos. 2–4, pp.401–420.
- 12 Kafkalas, G. and Komninos, N. (1998) 'The innovative region strategy: lessons from the Central Macedonia regional technology plan', in Morgan and Neuwelaers (Eds.) *Regional Innovation Strategies: The Challenge for Less-Favoured Regions*, London: The Stationery Office.
- **13** Chesbrough, H. (2003) *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Boston: Harvard Business School.
- 14 Antonelli, C. (2000) 'Collective knowledge communication and innovation: the evidence of technological districts', *Regional Studies*, Vol. 34, No. 6, pp.535–547.
- **15** Nonaka, I. and Takeuchi, H. (1995) *The Knowledge Creating Company. How Japanese Companies Create the Dynamics of Innovation*, Oxford: Oxford University Press.
- 16 Edquist, C., Rees, G., Lorenzen, M. and Vincent-Lancrin, S. (2001) *Cities and Regions in the Learning Economy*, Paris: OECD Publications.
- 17 Keeble, D., Lawson, C., Moore, B. and Wilkinson, F. (1998) 'Collective learning processes, networking and institutional thickness in the Cambridge Region', *Regional Studies*, Vol. 33, No. 4, pp.319–332.
- **18** (2001) 'Statistics on innovation in Europe', *European Commission*, Eurostat, Luxembourg: Office for Official Publications of the European Communities.
- 19 Bournois cited in Herbaux, Ph. and Chotin, R. (2002) 'L'intelligence économique, outil du pacte territorial', *Paper Presented in the ASRDLF Conference*, University of Quebec, April 21.
- **20** Simovits, M. and Forsberg, T. (1997) 'Business intelligence and information warfare on the Internet', *Paper Presented at INFOSEC' COM International Congress on Information Systems and Telecommunications Security*, CNIT Paris-La Defence, June 12–13, 1997.
- **21** Rouibah, K. and Ould-ali, S. (2002) 'PUZZLE: a concept and prototype for linking business intelligence to business strategy', *Strategic Information Systems*, No. 11, pp.133–152.
- 22 (2003) 'The top ten critical challenges for business intelligence success', *ARTE*, White Paper, ComputerWorld, online http://www.atre.com/bi_whitepaper/
- **23** Back, T. (2002) 'Adaptive business intelligence based on evolution strategies: some application examples of self-adaptive software', *Information Sciences An International Journal*, No. 148, pp.113–121.
- 24 Selby, D. (2002) 'Jotting from the business intelligence jungle', *Proceedings of the 2002 Conference on APL: Array Processing Languages, Lore, Problems, and Applications*, Madrid, pp.190–197.
- 25 Pawar, B.S. and Sharda, R. (1997) 'Obtaining business intelligence on the Internet', *Long Range Planning*, Vol. 30, No. 1, pp.110–121.
- **26** Reiterer, H., Mubler, G., Mann, T. and Handschuh, S. (2000) 'INSYDER an information assistant for business intelligence', *Processing of the 23rd Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, Athens, pp.112–119.
- **27** Dou, H. (2000) 'De l'information a l'intelligence. Les procédés de création d'intelligence compétitive pour action dans les PME et PMI', *Conférence A3F*, Sophia Antipolis, October 2000.
- 28 Bertacchini, Y. and Dou, H. (2001) 'The territorial competitive intelligence: a network concept', online: http://archivesic.ccsd.cnrs.fr/documents/archives0/00/00/04/36/sic_00000436_02/sic_0000043

6.html

29 Raison, D. (1998) 'Intelligence territoriale: le cas du Poitou-Charentes', in NET 98: Le Salon de l'Internet et de l'Intranet, Paris.

- **30** Quazzotti, S., Dubois, C. and Dou, H. (1999) 'Veille technologique, guide des bonnes pratiques en PME et PMI', *Report to the European Commission*, DG XIII, the innovation programme, Luxembourg.
- **31** Kuhlmann, S., et al. (1999) 'Improving distributed intelligence in complex innovation systems', *Final Report, TSER Project, Fraunhofer Institute, Systems and Innovation Research*, Karlsruhe.
- 32 Collective Intelligence, online http://137.122.100.152/mt/mt-weblogs/roadmap/
- **33** Levy, P. (1994) *L'Intelligence Collective: Pour Une Anthropologie Du Cyberspace*, La Découverte, Paris.
- **34** Caillard, D. (2000), 'L'Intelligence collective', online. http://barthes.ens.fr/scpo/Presentations00-01/Caillard_IntelligenceCollective/intcol.htm
- **35** Lévy, P. (2003) 'Le futur web exprimera l'intelligence collective de l'humanité', online http://www.pointblog.com/past/000232.htm
- 36 East of England Observatory, online http://www.eastofenglandobservatory.org.uk
- 37 East Midlands Observatory, online http://www.eastmidlandsobservatory.org.uk/index.asp
- 38 Yorkshire Futures, online http://www.knowledge-rich.com
- 39 Regional Intelligence Unit, online http://www.nwriu.co.uk/
- **40** (2002) 'Veille Dossier DECiLOR', *Le Magazine Professionel de l'Intelligence Economique et du Management de la Connaissance*, November, No. 50, pp.10–20.
- **41** RINNO (www.rinno.com) is a joint initiative of the European Commission's Enterprise DG and Regional Policy DG. The purpose of RINNO is to share the innovation experiences and use electronic media to allow regions to get practical help on improving their innovation practices.
- 42 *Madri+d*, online http://www.madrimasd.org
- 43 Digital Research Center for Collaborative Innovation, online http://www.vrc.gr
- 44 Gentler, M. (1996) 'Barriers to technology transfer: culture and the limits to regional systems of innovation', *Paper Presented at the Conference RESTPOR 96*, Brussels, 19–21 September.
- **45** Kelessidis, V. (2000) 'Benchmarking', *Report Produced in the Framework of InnoRegio Project*, EC, Recite II, available online http://www.urenio.org/benchmark/reports.asp
- 46 Massachusetts Technology Collaborative, online http://www.mtpc.org
- 47 Regional foresight has been exercised in Limousin (FR), Lyon (FR), West Midlands (UK), North-East England (UK), Catalonia (SP), Basque Country (SP), Uusimaa (FN), and Central Macedonia (GR).
- **48** Miles, I., Keenan, M. and Clar, G. (Eds.) (2002) 'Practical guide to regional foresight in the United Kingdom', *DG Research*, European Commission.
- **49** Gavigan, J., et al. (Eds.) (2001) 'A practical guide to regional foresight', *DG Research*, FOREN Network, European Commission.
- 50 Minsky, M. (1988) The Society of Mind, New York: Simon and Schuster.
- **51** Shah, K. and Sheth, A. (2000) 'Logical information modelling of web-accessible heterogeneous digital assets', online http://lsdis.cs.uga.edu/lib/download/SS98.htm
- **52** URENIO, Aristotle University of Thessaloniki (GR), FUNDECYT, Extremadura (SP), University of Wales, Cardiff, Wales (UK), INFYDE, Basque Country (SP), Institut Jules-Destrée, Wallonia (BE).
- **53** (2003) 'The future of technology', *BusinessWeek, European Edition*, August 18–25, special issue, pp.33–100.