

# Knowledge Sharing in Regional Digital Ecosystems

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The knowledge-based networked business ecosystem represents a geographical (or virtual) area where specific regional policy initiatives could foster growth and improve innovation, productivity and social aspects through the optimal use of local assets empowered by information and communication systems (ICT). Effective human interaction with ICT within such a regional digital ecosystem depends on access methods, suitability and form of content and knowledge sharing. A network of digital ecosystems, as public common resource, offers to regions and to less-developed areas opportunities to participate in the global economy.

**Key words:** digital ecosystem, regional business digital ecosystem, integrated business information, electronic content management, document management system, knowledge sharing and management;

## Posredovanje znanja v regionalnih digitalnih ekosistemih

Na znanju temelječ in mrežno povezan poslovni ekosistem predstavlja geografsko (ali virtualno) področje, kjer bi lahko specifične regionalne politične pobude spodbujale rast in izboljšale inoviranje, produktivnost ter družbene vidike s pomočjo optimalne uporabe lokalnih virov, ki so okrepljeni z informacijskimi in komunikacijskimi sistemi. Učinkovita človeška interakcija z informacijskimi in komunikacijskimi sistemi, kot je na primer regionalni digitalni ekosistem, je odvisna od pristopnih metod, usreznosti in oblike vsebine ter posredovanja znanja. Mreža digitalnih ekosistemov kot skupni javni vir ponuja regijam in manj razvitim področjem priložnost, da sodelujejo v globalnem gospodarstvu.

**Ključne besede:** digitalni ekosistem, regionalni poslovni digitalni ekosistem, integrirano poslovno informiranje, upravljanje elektronskih vsebin, upravljanje s sistemom dokumentov, posredovanje znanja in upravljanje;

## 1 Introduction

The support of knowledge sharing, of the establishment of worldwide value chains and of business networking promotes global co-operation and alternative ways of developing software applications and conducting business (Nacchiava 2004, [www.digital-ecosystem.org](http://www.digital-ecosystem.org))

Generally, it is known that a natural life ecosystem is defined as a biological community of interacting organisms plus their physical environment. In the same way, a regional ecosystem is "the network of consumers, buyers, suppliers and makers of related products or services" plus the socio-economic environment, including the institutional and regulatory framework.

The digital ecosystem approach transposes the concept to the digital world, exploiting the mechanisms of natural ecosystems. A digital ecosystem is an "evolutionary self-organising system aimed at creating a software environment for networked organisations" that supports the development of open and adaptive technologies and evolutionary business models (see Fig. 1).

The digital regional ecosystem aims to become the ICT-enabling technology for the regional ecosystem.

**The knowledge-based networked regional ecosystem** represents a community, which, in order to exploit the synergies of the systemic sharing of community's resources, should cooperate and share the following aspects:

- **Regional services:** sharing vision, decisions and solutions that are able to share the real-time infrastructure: Secure Broadband Wireless, Low-Power-Consumption Mobile/Display Devices, and transition to SOA – Service Oriented Architecture.
- **Regional business:** aggregating the offer, procurement, customer management, etc.
- **Community knowledge:** shared knowledge facilities to support a virtual learning community with training and competence centres, knowledge bases, e-learning modules, benchmarking, etc.

This article will present the evolution of the ideas related to the knowledge-based networked community as well as those ideas connected with the regional business digital ecosystem conception.

## 2 Digital ecosystem developing models<sup>1</sup>

From an initial analysis, several models seems the most suitable for the implementation to be used for different layers of the ecosystem:

- for the real-time infrastructure: an **open source model** adopting multiple business models;
- for the specialised digital ecosystem: encouraging the maximum coexistence and diversity of models and licences, supporting as much as possible the equal opportunities of "**service / solution publishing**" and fair competition;
- for the local instances of the ecosystem: the models are decided by the local community on the basis of the local conditions.
- P2P network model (autonomous nodes)

The **basic principles**, which inspire the common infrastructure, are linked to basic guarantees, such as:

- Equal opportunities of access to the infrastructure, affordability for small communities
- Self-sustainability
- Independence from a specific provider, technology, license
- Critical mass of services and of users
- Maximising the number of digital forms populating the ecosystem, maximizing their evolution

To ensure the open access, and the largest population of the digital ecosystem, it is indispensable that protocols and data formats are open and not dependant on a unique provider in order to guarantee independence from ICT platforms, the highest interoperability and the possibility of reusing the pre-existing information and services.

### 2.1 Open source, basic real-time infrastructure

To guarantee that the ecosystems attracts a critical mass of developers of services, and therefore of users, it is criti-

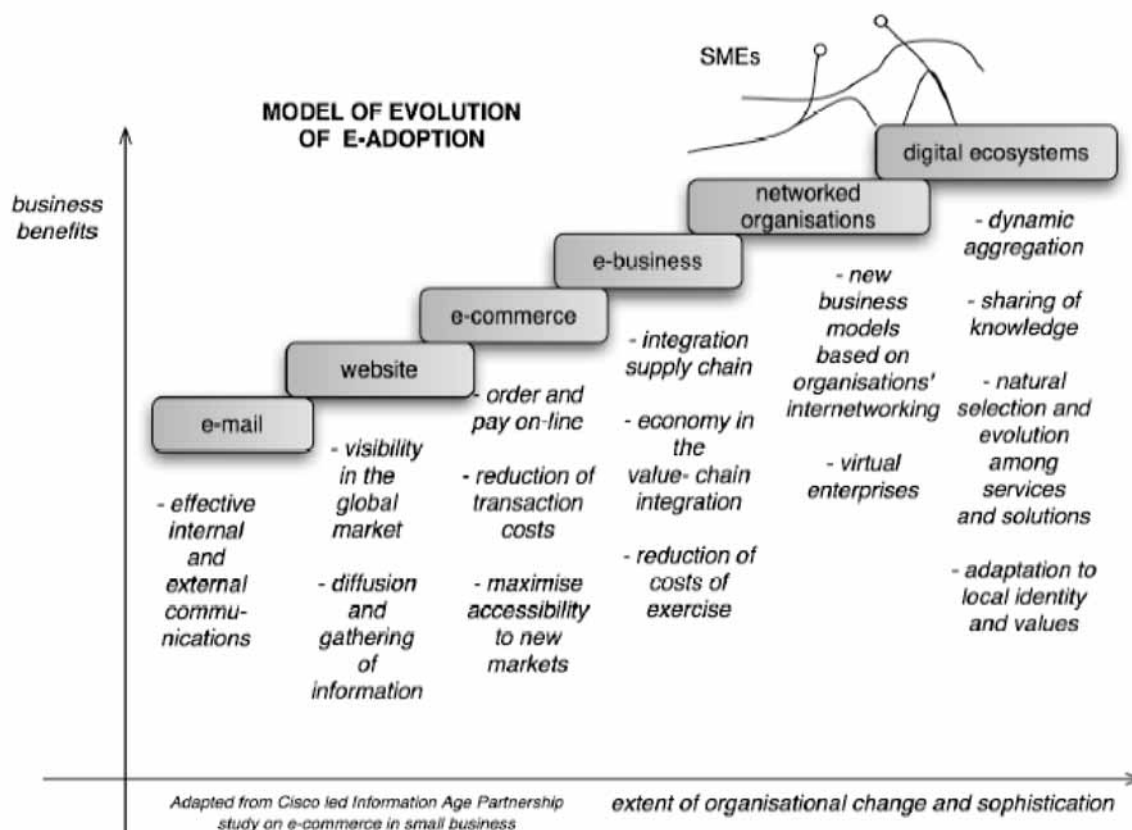


Figure 1. Evolution of ICT adoption (Nachiava 2004)

<sup>1</sup> Section 2 and 3 follow interpretation of the Digital Ecosystem – principles in accordance with the publication (Nachiava 2004) and [www.digital-ecosystem.org](http://www.digital-ecosystem.org).

cal to guarantee the evolution and continuity of services in time within an open infrastructure. **The basic real-time infrastructure represents an ecosystem that connects the applications and the services of the community; it should provide the equal opportunities of business and visibility to all participants, and therefore its mechanisms should be transparent and able to be inspected.** The basic infrastructure could not be tied to a single provider or a unique technology; it is necessary that the usability and maintenance of the infrastructure does not depend on the goodwill of the suppliers. For these reasons, the ecosystem needs a basic infrastructure the development of **which can be guaranteed due to the availability of the source code (open source).**

**The digital infrastructure of the common ecosystem environment is composed of the infrastructure of P2P network and by architectural modules, but also provides some basic eservices (e.g. electronic payment, interoperability modules, etc.), which could be used as components for developing solutions for different business sectors.** These basic e-services provided by the ecosystem, could exist in different versions, with different level of complexity and sophistication, following different license models and costs.

## 2.2 Models for sector-specific ecosystems

The user could select the more appropriate service or component (open source or proprietary), could substitute it as soon a more adequate one appears on the ecosystem, or adapt it to his needs. The broad use and the diffusion of a network of local digital ecosystems:

- provides the digital support for the economical development of regions
- fosters the private entrepreneurship on the sector of production of software components and services.

**Any player could produce components or solutions, not being forced to adapt a specific business or license mode** -- such market forces would promote a continuous evolution of components and solutions.

## 2.3 National and regional implementation

In order to support the evolution of use of ICT and entrepreneurship, European Member States have deployed a wide range of ambitious policies and instruments and have launched many different actions and initiatives aiming at fostering:

- support networks supported by national or regional authorities,
- common commitment from industrial and sector associations,
- cooperation among local SMEs, public bodies, local and regional authorities and institutions,
- consensus on standards and technical interoperability, sharing of solutions and of technical systems

To reach the goals defined by the Council of Lisbon, with regards to information / knowledge society develop-

ment, it is crucial to define and implement in each region a specific strategy of innovation and local development, focused on the identity and the strong points of the local area, in synergy with an common European global strategy, keeping in consideration the global environment. **The success of the implementation depends at local level on the consensus and the active participation of the local players:**

- universities, research organizations, innovation centres;
- enterprises (in particular SMEs and enterprise organizations);
- government and of public administration

The regions (or local areas) which succeed in the application of digital sector ecosystems, will be the ones where the above players:

- are fully committed
- work together forming a community
- a critical mass of enterprises/communities (including the small organizations) use the ecosystem as business tool.

**The regional business digital ecosystem will be an effective instrument for business when critical mass will be reached in terms of:**

- coverage of the territory (with potential to create critical mass for S/M businesses)
- number of applications and relevant services present
- diffusion and availability of the infrastructure.

## 2.3 Stimulus for small and local ICT software and service providers

Regional digital ecosystems stimulate the innovation and the competition, providing the small providers equal opportunities to offer their services and products as well as stimulating local technological knowledge and development. **A new component, although produced by a small producer in a remote area, is visible on the ecosystem and, thanks to the seamless interoperability, could replace a component in a solution.** Competitiveness and innovation is then increased, generating a supply of software with better conditions of usability, in a model of continuous improvement (Nachiava 2004):

The set-up of regional digital ecosystems, therefore offers the possibility to communities operating in the ICT field of proposing their solution to a critical mass of users. Today the jobs generated by ICT industry in most European regions, mainly concern technical tasks of little aggregate value; at the local level, the technicians who provide support for proprietary software produced by multinational companies do not have the knowledge and the possibility of high-level development.

## 3 ICT for Regional Digital Ecosystems

Some of today's ICT solutions will be the most transformational in their impact in the two-to-five year time fra-

me in terms of achieving goals of regional digital ecosystems. Section 4 is devoted to attractive technologies for regional digital ecosystem – Enterprise Content Management (ECM) and Section 5 to Knowledge Management; perhaps in the very near future one of most attractive technologies. In this section, let us focus on some others, which are equally important (Nachiava 2004):

(a) **Secure Broadband Wireless**

*Presently is one direction clear: networks are moving to wireless broadband.* There are three gating factors to widespread deployment of wireless/broadband for mission-critical applications:

- a. End-to-end security,
- b. Standardized endpoints – PCs and personal digital assistants (PDAs)
- c. Wide robust coverage areas

(b) **Low-Power-Consumption Mobile/Display Devices**

The mobile and wireless area is continue to be a strong source of innovation, including two technologies at the peak: Wi-Media – an ultra-wideband technology that operates at very low power levels, and Worldwide Interoperability for Microwave Access – an emerging high-speed wireless standard.

(c) **Real-Time Infrastructure**

If an ICT infrastructure is a collection of client devices, servers, storage, networks, databases and middleware supporting the delivery of business applications and ICT-enabled business processes, then a Real-Time Infrastructure is an ICT infrastructure shared across customers, business units or applications where business policies and service-level agreements drive dynamic and automatic optimization of the ICT infrastructure, thus reducing costs while increasing agility and quality of service.

(d) **Service-Oriented Architecture**

One feature characterizes these next-generation applications: the service-oriented architecture (SOA), which enterprises require an end-to-end view and integration across processes. These fusion principles are used like provision (build or acquire) applications software and business services. User and vendor communities must integrate these principles into three aspects of their technical environment: **architecture, infrastructure and application software.**

(e) **Collaborative commerce (c-commerce)**

Web services provide a path to Collaborative Commerce. In that case, **c-commerce** is an expansive model for business applications:

- It is driven by e-business demands and opportunities and is enabled by Internet and service-oriented technologies.
- C-commerce is the most advanced support for e-business because it achieves dynamic collaboration among and between an enterprise's employees, business partners and customers.
- In c-commerce, digital ecosystems harness the full power of the Internet by extending business relationships beyond rigid value chains, simple

information sharing and unified communications.

- C-commerce includes inter-community Internet connections and goes a step further by enabling multiple ecosystems to work interactively, often by dynamically restructuring their relationships in near real time.

- C-commerce will be enabled by Web services – functional units of application software made available through the Internet for use by other software systems.

## 4 Content Management and Regional Digital Ecosystems

The vision of Enterprise Content Management (ECM) from its initial sense fits very well to exploit the synergies of the community resources systemic sharing in a regional digital ecosystem. Users across the community will be able to create, retrieve, manage, and archive all of their content, including electronic and paper documents, email, and computer reports throughout their business and knowledge processes. We could simply see the E in ECM, as Ecosystem instead of Enterprise. Then “Enterprise/Ecosystem” content management (E/ECM) will include the needs of an entire regional business digital ecosystem rather than just the business processes of a single organization. E/ECM will support the records retention policies of the community so that regulatory systems, audit and compliance requirements are satisfied for both physical and electronic documents. Additionally, document content will be re-purposed for presentation via regional ecosystem portals and websites.

Today's “classic” ECM infrastructure technologies **evolved from the primary ECM application categories towards integration.** Let's summarize the main milestones (Burton 199).

1. Document Management (DM) - include both imaging and electronic document management. The rapid evolution of client-server and Web presentation technologies prevented DM solutions from achieving the platform stability that enterprise resource planning (ERP) applications achieved. The concepts of DM were appealing, but the tools were inflexible and the ECM infrastructure technologies didn't readily scale to the needs of the enterprise. There are a large number of departmental DM solutions that have been implemented, but very few systems that support the document management requirements of thousands of users.
2. Web Content Management (WCM) - because the initial websites had relatively small numbers of static pages, the WCM tools were more focused on the presentation than the management of content. As a result, these tools had only limited integration with the existing DM or records management (RM) repositories.
3. Records Management (RM) policies and procedures were standardized long ago. In the generation of pa-



per-based processes, RM was a very successful function. Many organizations evolved to manage records tracking and retrieval, records retention and disposition, and the user interface with file rooms and off-site storage. However, since the advent of electronic documents, RM has been dysfunctional.

4. Email has not always been considered an ECM technology, but it is clearly a content type that needs to be managed. Today there are clear consequences for not managing email with the same urgency that is applied to RM for paper and electronic documents. There are clear advantages to managing email using the same infrastructure technologies that are used for the other ECM categories.
5. Information Life-cycle Management (ILM) is a recent development in enterprise storage management. ILM takes advantage of the dramatic improvements in the price/performance of magnetic storage to enable organizations and networked communities to manage all of their structured and unstructured information based on business or regional policies.

Each of the ECM application categories has been gaining momentum, especially at a workgroup or departmental levels. **However without integration, each of the ECM categories is unable to fulfill its true enterprise/community potential. Enterprise content management includes an entire ecosystem's needs. At the community level, each of these elements takes on additional complexity, as the focus becomes all users, processes, applications, and documents in regional digital ecosystem.** The benefits of a community-wide approach to E/ECM are clear. Some of these benefits include:

- searching multiple repositories of documents
- sharing and re-using documents across community
- controlling documents on an community-wide basis
- establishing consistent document types and an community-wide taxonomy
- rationalizing and enforcing processes and policies

The new generation of E/ECM products provides a basis for the community - level integration of DM, RM, WCM, and email repositories. This integration allows people to search across repositories, present integrated information from multiple repositories in response to user queries, and personalize these responses based on the relationship of the inquirer to the community. **Collaboration, knowledge management, and work-flow management applications are able to be established based on these E/ECM products; this is becoming a strategic business requirement.** The whole of E/ECM is greater than the sum of the individual ECM application categories. But, there are important E/ECM challenges that remain to be solved. **While the trend towards E/ECM is clear, each investment needs to be justified, and especially in the regional digital ecosystems area.**

## 5 Knowledge-based management

### 5.1 The dividing line between information and knowledge

It is the distinction between information and knowledge that makes the difference. The distinction is real, substantive, and widely accepted. We want to **turn that information into knowledge**. So what are the characteristics of knowledge in the regions? The subject of "knowledge" has been treated frequently mostly in analyses of the role of intellectual assets and knowledge in community.

Let us focus on the characteristics of knowledge in regional business digital ecosystem, especially with regard to how it may influence the application of ECM technology. There are two kinds of knowledge: **tacit and explicit**. Some authors emphasize the difference between **explicit knowledge**, which can be articulated in formal language and transmitted among individuals, and **tacit knowledge**, personal knowledge embedded in individual experience and involving such intangible factors as personal belief, perspective, and values<sup>2</sup> (Nonaka 1995). They stress that **the interaction between these two forms of knowledge is the key dynamic of knowledge creation in business administration.**

Tacit knowledge must be recorded - made formal, in order to become an organizational or community resource and not just individual proficiency. What is internal must be articulated and made explicit.

**Knowledge is typically complex, often associated with "why" and "how", not just "what" (simply "know - how").** It is not a list of facts or compilation of data nor is it a description of products or services. **It is based on an understanding of what the knowledge-seeker needs to or wants to know.** It is constructed for effective and efficient communication within regional digital ecosystems. As such, recorded knowledge is not always associated with specific job roles and work processes. It addresses tasks that may be performed by many people in the community.

In the business environment in particular, knowledge is sufficient. It may have many information components, but is held together by knowledge of consequences and an awareness of completeness. Especially in networked community environments, we consider knowledge as a dynamic human process of justifying personal belief toward the truth.

**Explicit knowledge may take two forms: recorded knowledge and knowledge in action.** Technical communication experts (knowledge management professionals) are concerned with both. For example, trainers are more concerned with knowledge in action, because they interact with knowledge-seekers, help them develop mastery, observe the achievement of that mastery, and serve as

<sup>2</sup> AIIM, ARMA, and COHASSED (2004) published a detailed survey of the status of Electronic Records Management in January of 2004. The complete survey can be viewed at [www.aiim.org/industrywatch](http://www.aiim.org/industrywatch).

competent observers. Technical writers are typically more concerned with recorded knowledge.

## 5.2 Characteristics/effects of a knowledge interchange

What happens in a knowledge interchange within a regional digital ecosystem - in the transfer of knowledge from a subject matter expert or recorded knowledge resource to the knowledge-seeker? The traditional model of acquiring knowledge includes:

- **practice or usage** (action itself) - and thereby confirmation of the correctness of the knowledge and competence of the performance

- **a process of dialog**

Knowledge solves a problem, so it produces competence leading to effective action. Building a store of information is not the desired result in most cases, although identifying the relative importance of information often is. Pointers to additional information resources are also often an important part of the interchange. The interchange results in confidence in the truth of the knowledge transferred.

## 5.3 Managing knowledge in dynamic, interactive environment of regional digital ecosystems

Does ICT for regional digital ecosystems change the characteristics of explicit, recorded knowledge in particular? Most of the discussion about knowledge appears to be conducted without consideration for the impact of the all-pervasive networked ICT environment on the development, management, and transfer of knowledge itself. Similarly, much of the academic discussion about computers and knowledge seems to be conducted with little consideration for the imperatives of the business environment. Inter-personal contacts as a method of conveying knowledge are not diminishing either. However, it seems certain that the shift to ICT as a way of delivering information and knowledge resources within regional digital ecosystems has already changed the way in which we create, record, supplies, and use knowledge resources. **We are moving to interactive relationship between knowledge-holders and knowledge-seekers** (Strong 2005, Heeks and Duncombe, 2001).

In some ways, we are moving back to a so-called pre-print model of transferring explicit knowledge model that is not dependent on publications or documents. This is happening in part because of a need (the complexity and pace of change of our work environments) and in part because of a compensating opportunity (people and information are increasingly available on line.) and this movement is good for knowledge-seekers.

Print-based literacy fostered a publishing model while ICT does not. ICT breaks the publishing model - just in time for the just-in-time business organization / community.

## 6<sup>3</sup> Case Study of a Regional Services

Essential **business information and knowledge resources**, supported by ICT (Information and Communication Technologies), thus far are currently used by multinational and large corporate enterprises, and **not** by regional communities. To gain market shares or to survive in this environment, regions are equally challenged to take advantage of **ICT-driven** business process related to information, knowledge, advisory and services. Compared to large enterprises, regions only recently have begun to realize the **commercial value** of externally validated business information sources. So far they have relied on information circulated among known business partners / associations, neighbors or friends. The above-mentioned issues were stimuli for creation and raising demands for on-line access to validated **Integrated Regional Business Information, Advisory and Development Services (IRBIADS)** - For providing IRBIAD-like services, some kind of ICT-based "VIRTUAL AREA" accessible at appropriate costs for all applicants is needed.

IRBIADS are generally types of **market, business and region development services that present information, knowledge, advice and interpretations to individual or institutional clients in response to the market and a regional business-related issue**. IRBIADS create market transparency on business opportunities and other BDS (Business Development Services) and contribute to rational decision making for entrepreneurial and development issues. To create adequate IRBIADS, environment, raw data, information and knowledge are retrieved from different on line accessible resources; they are processed and tailored to commercial information products. **For the ability to provide advisories considering demand of clients it is necessary to ensure on line access to appropriate regional marketplace**. IRBIADS address a number of client groups; including SMEs and regional stakeholders of IRBIADS (see fig. 1):

- **Private Regional Enterprises** (including SMEs) - clients / knowledge and opportunity seekers
- **Regional market places and market services** providers or owners
- **Suppliers of BDS - Business Development Services** (financial and legal advisory, research, training, engineering etc.) for improved targeting of services
- **Public, government and communal authorities** to develop policies and identify, create and support programs for regional economic development.
- **Regional Utility/Subscription Computing (UC)** to provide charge-by-use practices enabling regional

<sup>3</sup> Lavrin & Delina, 2006; Lavrin et al., 2004; Lavrin & Zalko 2003

stakeholders to increase profitability, increase infrastructure reliability, protect crucial information assets, hosting services, and focus on their core business.

- **Business Process Outsourcing (BPO)** to enable regional partners to delegate an ICT-intensive business process to an external provider, who owns, administers and manages it according to a defined set of metrics.
- **Contact units of Agencies and Funds owners accessible for national and international programs/projects** to whom they are providing targeted technological, technical and financial assistance in the area of the projects oriented on market and business promotion, R&D projects (including support for technology transfer and innovation).

The significance for IRBIADS and virtual regional area creation is the design and establishment of state-of-the-art ICT-based virtual environment in such a way that it would be able to adequately achieve the required features and objectives of IRBIADS. It also involves the development of relevant tools for database and knowledge base management, information processing and adequate SW solutions for interactive regional communication and services sharing in a complex promotional venture. **The**

**previously-mentioned involved approaches are fully consistent with ideas and principles of the regional business digital ecosystem mission and the adequate ICT provision.**

**The most essential (regional) element is continuous on-line communication between the IRBIADS' bases and the regional marketplace and the stakeholders as well. It satisfies continual update of information and knowledge in accordance to real-time data generated by activities running in the framework of e-region.** Each component of IRBIADS is constantly influenced by each other and these real-time interactions are very important when we want to provide adequate advisory services to a region. However, to be able to provide such services, it is also important to have a connection to adequate knowledge, which is mostly missed by the stakeholders of region. **The information and knowledge management are open to content management that is in the background while considering providing relevant (regional) services to regions.**

To stay competitive in the global knowledge-based economy, organizations and regions increasingly need to be part of the economy-wide evolution of business clusters, from informal alliances of regional business partners to collaborative networks of regional stakeholders. To

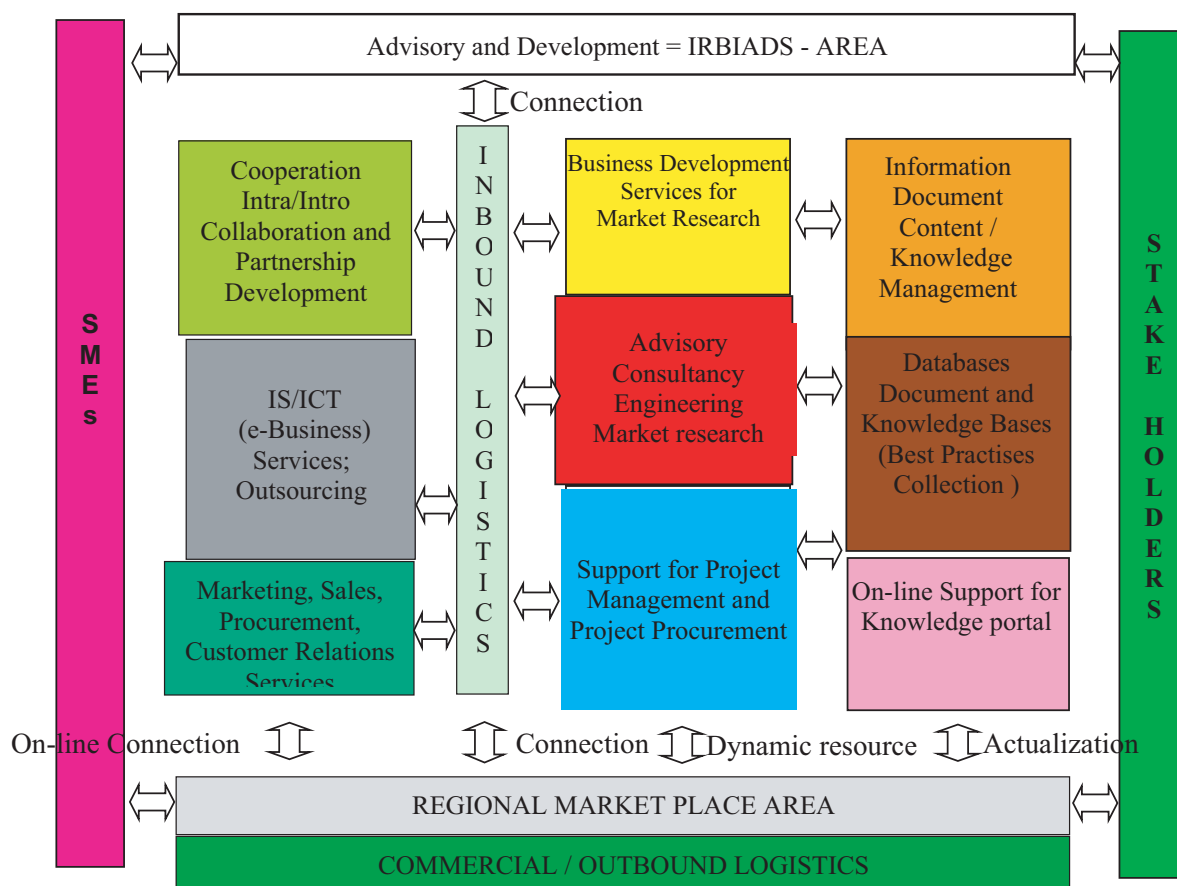


Figure 2 System Structure for IRBIADS

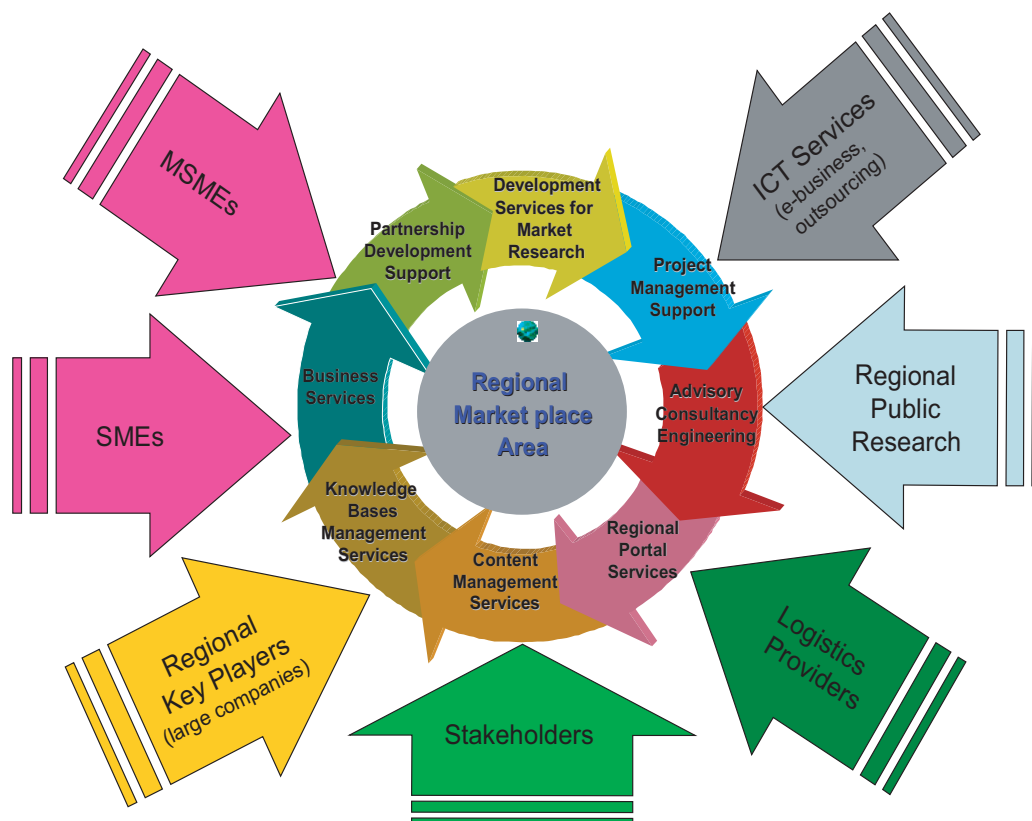


Figure 3. Concept of a development and business virtual environment based on the IRBIADS and the Regional Market Place with business networking principles

move towards more open standards in digital information systems architecture enables regions to integrate their existing information sources and by reducing costs and by multiplying connectivity, to dramatically extend their reach across regional boundaries and national borders.

The use of advanced IS/ICT can enhance the scope for experimenting with knowledge exchange among multiple network participants at distant locations. Enterprise networks and the “virtual regional network organizations” (see Fig. 2) that emerge from them have the highly inter-linked infrastructures and business processes needed to supply value-adding goods and services on demand. Small participants can contribute their specific strengths, and access the competitive advantages of a large business network.

Regions working through flexible business networks (with IRBIADSs’ functionality) will benefit from a collaborative environment, shared resources, and from the knowledge created and exchanged among stakeholders. This will contribute to increased innovation and competitiveness of European regions and industry.

Finally, the concept of such a regional (eco) e-business networking infrastructure is presented at Fig. 3. The concept is relevant to development ideas summarized by foregoing figure (2) and are displayed functional relation between both pictures by different colors.

## 7 Conclusion

When delivering solutions or services to regional digital ecosystems of communities and sharing information with partner organizations, communities, and within local ecosystems, the following and common sets of issues often arises. These include:

- **Information Supply Chains** – clustering and networking of regions, which involve delivery ERP, CRM and SCM solutions as well.
- **Content Life-cycle Management** - increasing the effectiveness of regions throughout its life-cycle and dramatically improving their business performance through its life-cycle and better management of their content.
- **E-Commerce environment** – effecting collaborative content/knowledge creation and management on such a services-oriented deliveries (SOA).
- **Knowledge management** - increasing the effectiveness of community valuable asset – information and knowledge.

On other side, the regional business digital ecosystems concept fully supports EU ideas for development of sustainable SMEs business networking activities in less-developed regions and thereby creates opportunities for regional SMEs for successful participation in the global economic environment. RTD support for above-mentio-



ned activities can be financing from the structural funds as well (Doucek 2004).

In conclusion, it is possible to say that the concept of the IRBIADS-area is a potential experimental playground for the "Regional Business Digital Ecosystem" ideas application. On other side, for successful SMEs network business activities, the concept presented by Fig. 2 and 3 is basically also concept of a relevant "living laboratory".

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