

The vision of the Sector “Technologies for Digital Ecosystems” and its integration within the “ICT for Business” research activities

1. Introduction

The implementation of the Lisbon strategy¹ is at the top of the political agenda of the 2004-2009 Commission. The level of achievement of the Lisbon objectives will determine the success of the new Commission, as well as the quality of life of future generations of Europeans. To which extent the objectives will be reached and what kind of reforms are deemed necessary, will determine the future of our “distinctive economic and social model that has combined productivity, social cohesion”[1] in the last half century.

But unfortunately the gap with the growth rate of North America and Asia has constantly widened from 1995 and the “Lisbon goals are still far away”[4]. Reversing this progressive decline in productivity requires an unforeseen active effort and engagement and contributions from all the Commission services.

“ICT is a key component of the Lisbon strategy” [3]. Its adoption is considered as one of the major contribution to economical growth and increase of economical efficiency. “The decline in EU labour productivity growth rates in the mid-1990s can be attributed equally to a lower investment per employee and to a slowdown in the rate of technological progress”[1]; “ICTs are central to boosting productivity and improving competitiveness. Forty per cent of the productivity growth in the EU between 1995 and 2000 was due to ICT. [3, 5].

The “European productivity growth could be significantly accelerated if organisations made more and better use of ICT in their organisations and production processes.” [4]

Therefore, DG INFSO, and specifically the Unit “ICT for Business”, thanks to its focus, are called to provide a relevant key contribution.

2. Policy Objectives

“There is no single magic bullet. Rather there are a series of interconnected initiatives and structural changes that through their cumulative reinforcement by simultaneous implementation in every Member State will provide both the comprehensiveness and force to release the undoubted potential that exists in the European economy” [1].

In order to achieve tangible effect, it is essential:

- to focus on one main strategic policy objective, promoting all the research streams and complementary initiatives² needed for developing the new knowledge and technologies necessary for reaching such objective
- to “combine the research activities with those of Member States”[17] and with those programmes and initiatives aimed at transferring the results of the research fostering innovation and deployment (e.g. FPCI, Innovative Actions, Structural Funds) [12, 16, its figure in annex I]

¹ At the European Council in Lisbon in March 2000, Heads of State and Government set the objective for Europe to become by 2010 “the most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment” [0].

² “The Lisbon objective for the Information Society cannot be reached through research alone. R&D will be useless for Europe if other complementary policy instruments are not developed and used effectively.” [11], therefore the research should be a targeted and focused research for identifying and developing the technologies necessities to reach the identified target. The results of the research activities should be transformed in innovation. This deployment should provide a rapid feedback for refocusing the research needs and priorities.

- to create synergies between European, national, and regional research activities aiming at reducing:
 - the “business digital divide” between the companies who are the leading-edge users of new ICT and those who make little or limited use of it; between the SMEs and the large enterprises.
 - the “geographical productivity divide” between regions of Europe and between Europe and more dynamic knowledge-based areas of the world.

The specific contribution of “ICT for Business”, among the broad policy priority areas identified by the Kok’s communications and by the reports related to Lisbon strategy [1 to 9] is focused on the development of the ICT technologies and models for Business which help to “Create a climate conducive to investment, innovation and entrepreneurship” [1]: a favorable “business ecosystem”.

Under this unifying framework, ICT for Business research would support the European business, making Europe place of establishment for knowledge-workers and enterprises³:

- attracting business and enterprise direct investments, thanks to conditions like availability of human capital (skilled labour force and diffused knowledge), infrastructures and communication facilities, availability of services, legal and financial framework.
- attracting SMEs, creating business environments which removes the main obstacles to their business [6], expedite procedure for new SMEs and new local business establishment [13] and support their business networking enabling them to work as a system⁴.
- attracting skilled and qualified researchers, entrepreneurs and knowledge-workers due to climate and the favourable quality of life.⁵

Europe could take the lead in the competition with US, which also has a “plan of action to make the US the most fertile and attractive environment for innovation in the world” “by optimizing the American ecosystem for innovation”[9], only turning the distinctive characteristics of the European Industry structure, culture and attitudes, now representing a disadvantage, into a competitive advantage.

Some relevant peculiarities of the European economical structure are:

1. a cultural diversity that is reflected in the richness of models of business, attitudes, approaches, models, ideas, culture, which also represent the local identity
2. a large presence of SMEs, which exhibit large flexibility, agility, innovative spirit, and which are used to work as dynamic SMEs business networks, also cooperation also with large enterprises, but can’t afford the critical mass of specialized resources and knowledge needed today⁶
3. an historical presence of “industrial districts” or “innovation clusters”, with diffused knowledge and skills, and which are endowed with supporting infrastructure, services and specialized resources which can’t be exclusive of a single enterprise of the network

³ It is extremely vital that European enterprises increase their ability to maintain a pace of innovation needed to deliver competitive products and services, else in the longer term they will disappear and with them important scientific knowledge will be lost due to brain drain to other regions in the world.

⁴ In the EU model, SMEs are the major sources of growth and employment and are the backbone of the European innovation.

⁵ Although EU lags far behind the US in term of GNP per capita, EU15 has higher quality of life [10] and the ranking in the Human Development Index of most EU countries is constantly higher than the ranking in GNP per capita. European social security and cohesion, associated with a diffused knowledge and an open and a multicultural environment, is attractive for knowledge workers and for business innovation and creativity.

⁶ With the increasing of global competition, single, limited size, organisations working in isolation will be not able to cope with challenges of this magnitude and complexity. As answer to this complexity, are emerging new business and production paradigms[17], based on open dynamic business and production networks, which allow to share the knowledge and the necessary human and financial resources.

The research activities in the “ICT for Business” should be focused on developing technologies, models and mechanisms, which exploit such peculiarities and turned into assets and competitive advantages.

The future leadership in global economy “is not about leadership in low-cost, low-wage, commodity services and products, but rather in leadership in hi-value, product innovation driven growth”[9]. The competitive advantage for Europe, should be mainly found by promoting and empowering innovation of process and product which can be created thanks to the specific and peculiar assets and culture of Europe.

In three competitive differentiators, companies can excel and gain competitive differentiation:

- operational excellence,
- customer intimacy,
- product leadership.

Bundling all these three value disciplines into a single company inevitably compromise the performance because the economics of these processes conflict. As a result of this, companies need to excel in one value discipline, and be industry-standard in the others (see appendix 2).

Due to current cost structures (especially wage levels which we would preserve), European industry will be more expensive than some of its competitors, thereby ruling out a focus on **operational excellence**. European industry today is almost forced to focus on **product leadership**. Suitable conditions for this, such as a well-educated population, are present in Europe. **Customer intimacy** is the best alternative, but today is mainly relevant only for sectors like governments and service industries. ICT is a crucial enabler for product leadership and for extending customer intimacy to other sectors⁷.

The sector “**Technologies for Digital Ecosystems**”, plays a key role in preparing the technologies needed for supporting the knowledge-based Business Ecosystems. The research activities are performed in closed interaction with the other research areas of the “**ICT for business**” Unit, and also in closed interaction with other instruments.

Indeed, whilst **digital ecosystems** activities aims at

- providing the technologies and the models for establishing ICT infrastructure which support the migration of business ecosystems from the industrial districts to the knowledge-based districts, often called “ideopoles”[1]

its research activities interact and are complemented by researches in:

1. (**extended interoperability**) aiming at providing an ICT environment which support the establishment of new knowledge-intensive SMEs; facilitate management, interaction with the global word , business networking
2. (**digital knowledge management and business models**): aiming at at providing paradigms for managing the structure, the interaction and the flow of the knowledge among any player participating in the business value chain⁸: including legal and business aspects

⁷ ICT technology is a crucial enabler that facilitates a transition from a traditional, physical resource-based products perspective towards a knowledge-intensive product/service enterprise perspective (**Product leadership**). The trend towards the integration into the design of the product also the design of the associated services plus the business models represents an opportunity for SMEs (so important in the European enterprise landscape) that can offer add-on services and make the product offer customer friendly (**Customer intimacy**). On the other hand, there cannot be service knowledge without product knowledge. Hence, the need to “co-design” both and the need to maintain product knowledge in Europe is greater than ever.

⁸ from virtual enterprises to autonomous software agents, to RFID components

3. Scientific and technological challenges of ICT for Business

ICT for Business focuses on the ICT technologies and innovative models for Business whose adoption could “Create a climate conducive to investment, innovation and entrepreneurship” [1]: a favorable “business ecosystem” which:

- are focused on few specific policy-driven long-term objectives and vision
- provide tangible intermediate results which could be exploited through European, national, and regional initiatives, in several environments and contexts
- has a continuous interaction with innovation which re-orient the specific research needs
- identifies the European peculiarities and weaknesses and turn them in a competitive advantage
- it is focused in ICT technologies fostering the product leadership, in material and immaterial products, achieving customer intimacy

The vision for the next generation of e-business architectures and solutions portrays successful networks of enterprises as being able not only to accelerate, automate and optimise their own business processes as well as the related systems of their customers and suppliers, but also to establish new synergic distributed business processes, originating new products and services. The underpinning technology necessary for realising this vision during the FP7 time span integrates aspects of network architecture (like computing⁹, compound applications, loose coupling, distributed computing, and networking technologies), with knowledge representation and management aspects (ontologies, business knowledge representation formal languages, interoperability), with legal and socio-economic aspects (business models, ownership and control of knowledge, licensing).

It requires necessarily a complex holistic research approach which take in consideration multidisciplinary researches (in ICT, social sciences, business, economics legal issues).

The three following identified research targets are not independent areas of research but simply different facets of the ICT research still needed for enabling new forms of dynamic networked co-operative business processes in the knowledge-based economy, as described in the Lisbon strategy.

- **extended interoperability and management of digital knowledge management and business models**
- **pervasive sustainable digital ecosystems**
- **smart items**
- **Pervasive sustainable digital ecosystems**: technologies and new business models for establishing a pervasive ICT environment, which exhibits characteristics and behaviour similar to natural ecosystems. This vision, based on an evolutionary and holistic approach, can only be achieved gradually. It requires focused and integrated research from several disciplines, ranging from fundamental science through computer science to social sciences. In order to develop the basic theories and technologies needed for structuring the bottom up spontaneous deployment and evolution of digital ecosystems, the work will aim at fostering the seamless integration of sustainable distributed business networks as well as the sharing of knowledge amongst all players participating in business value networks;
- **Extended interoperability and management of digital knowledge management and business models**: formalisms, ontologies and technologies for expressing, make computable and interoperable

⁹ Balanced Computing is a truly distributed applications architecture that builds loosely-coupled, compound applications that embrace and manage the heterogeneity of modern information systems. A balanced model offers the benefits of all three emerging compute models to provide greater flexibility and integration. In a balanced computing model, IT managers have the flexibility to run server-centric, network-centric, and connected PC functionality concurrently on a single client. Another key benefit of a true balanced computing environment is the ability to integrate applications running in different models.

any fragments of knowledge (including tacit knowledge, business processes, legal aspects, licenses, ownerships, rights, etc.), which could contribute to the business processes and improve the networking, exploitation and flow of the knowledge among all players participating in business value networks.

- **Smart items:** ambient intelligence technologies supporting value networks, mass customisation, improved customer service-orientated production, management of the product lifecycle (from design to components recycling) as well as 'extended products'. The work will cover notably the development of active e-tags and sensors, warehouses for collecting data and business activity monitoring for filtering out events that are urgent and important, wireless, instant messaging, location and presence technologies for helping enterprises to dynamically coalesce and respond quickly, next-generation of advanced Enterprise Resource Planning (ERP) systems to ease information sharing with key suppliers and improve customer interaction via Web services, and portals and content management systems to give decision makers access to the ancillary information they need and keep the broader workforce appropriately informed of actions and consequences;

4. The digital ecosystem initiative

The "digital ecosystem" is an abstract concept, which transposes the behaviours and architectures from natural to digital and to economic systems, exploiting the mechanisms of natural ecosystems. It is an "evolutionary self-organising system aimed at creating a ICT and knowledge-based environment for networked organisations" that supports the development of open and adaptive technologies and evolutionary business models.

Whilst a natural life ecosystem is defined as a biological community of interacting organisms plus their physical environment, a business ecosystem is "the network of buyers, suppliers and makers of related products or services" plus the socio-economic environment, including the institutional and regulatory framework.

The digital ecosystem is a pervasive "digital environment", populated by "digital components" which evolves and adapt to local conditions with the evolution of its components.

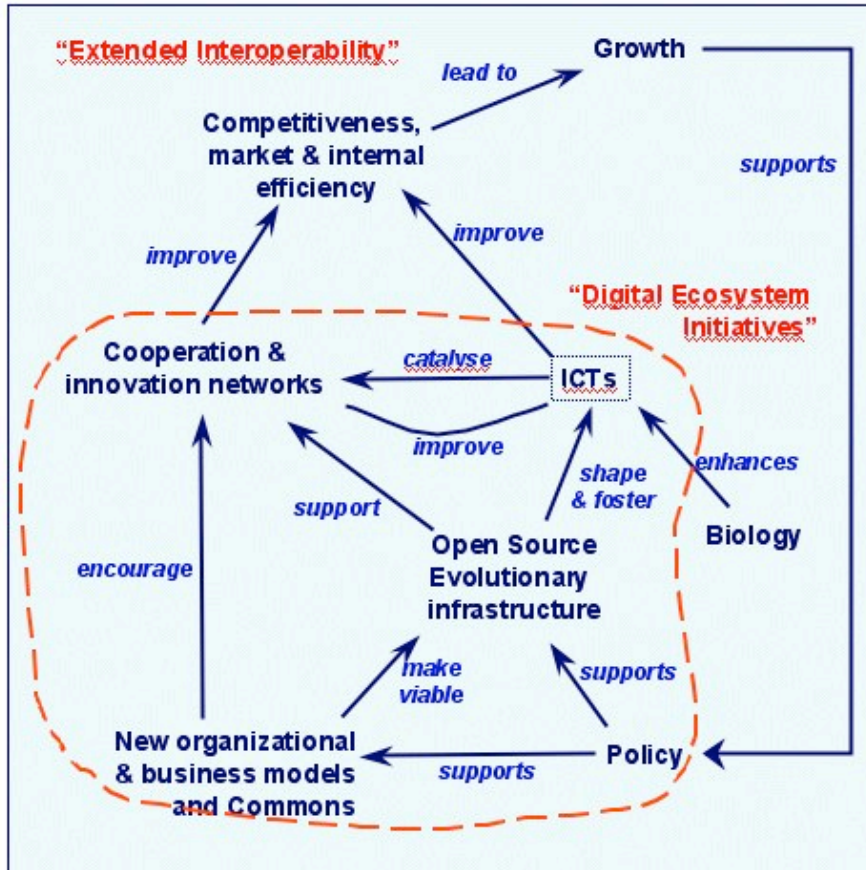
A digital component is a fragment of knowledge expressed by a language (formal or natural), launched on the net, which can be processed (by computers and/or humans). It could be: software component, application, services, knowledge, business processes & models, training modules, contractual frameworks, law.

Digital ecosystems, by providing mechanisms for spontaneous interaction, composition, distribution, evolution, adaptation among its digital components (which might be software, any formalised digital knowledge, services, products), enable to develop cooperatively - and to launch on the network - services and software components that are composed forming complex solutions or processes. It enables organisations which are too small to produce autonomously a complete complex solution, to provide a component of the solution¹⁰.

Digital ecosystem are immaterial transport infrastructures which allow the "orchestration", the extended interoperability and the cooperation of pervasive digital knowledge¹¹. A digital ecosystem could describe the future intelligent and networked product life cycle activities (with smart tags, sensors, which communicate knowledge and interact dynamically and wireless).

¹⁰ This mechanism allows SMEs closed to the customers needs, to provide or to modify a component of a complex solution, realising customer intimacy, transforming the risks of a full delocalisation in geo-distributed cooperation. A network of digital ecosystems, as public common resource, offers to SMEs and to less developed or remote areas opportunities of participation in the global economy, contributing to overcome the digital divides.

¹¹ Its support of knowledge sharing, of the establishment of worldwide value chains and of transitory business networking promotes global cooperation and alternative ways of developing software and conducting business.

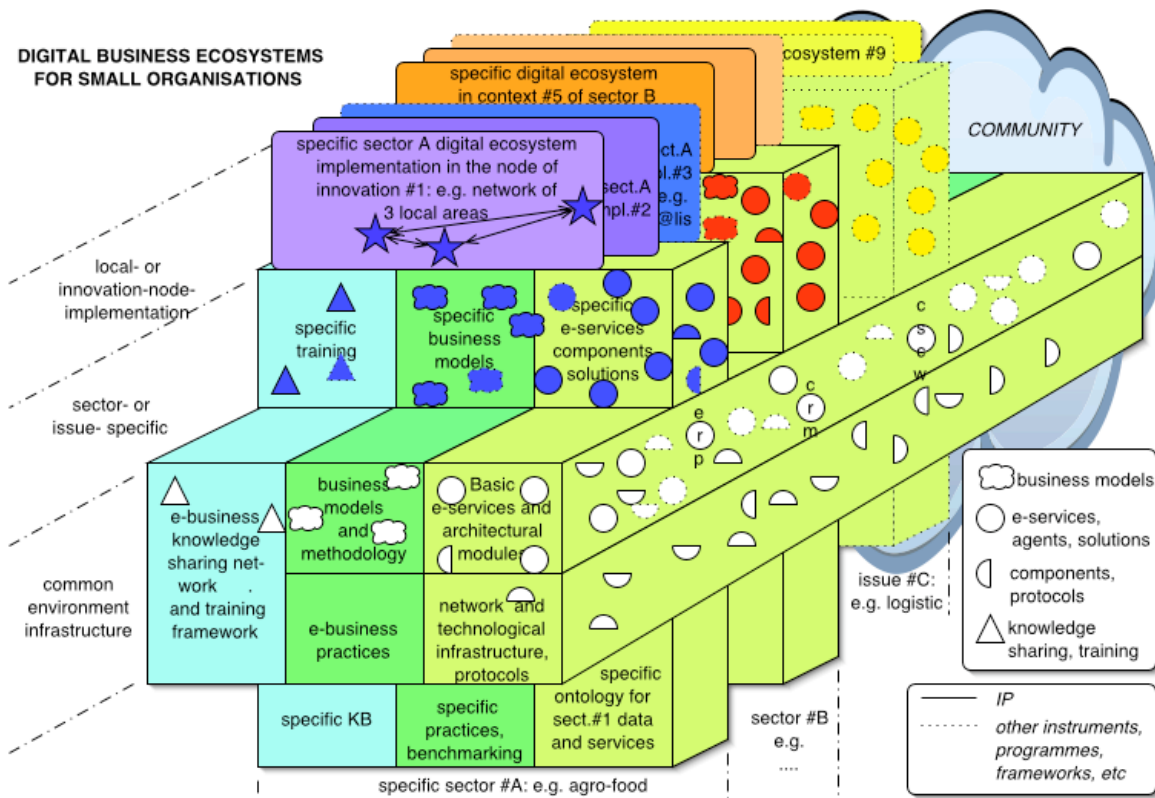


The virtuous cycle activated by the digital ecosystems

In 2002, the Unit “eBusiness”, launched a Digital ecosystem initiative through a discussion paper[19] and a group of workshop, which shaped the digital ecosystem strategy, which moves along two intermediated objectives:

- To enable European ICT SMEs to be competitive in the global software production market
- To provide e-business software solutions that are able to self-adapt to the needs of local SMEs, fostering ICT adoption in local innovation nodes.

The FP6 projects in the area (1st and 5th call) will set-up the infrastructure, the prototype of the middleware building blocks, which will allow the digital ecosystem to develop and prosper.



A representation of the digital ecosystem infrastructure as designed in 2002 [19]

5. Costituency

The constituency is represented by the actors of ideopoles, mainly:

- EU-citizens as job-seekers; knowledge-based workers
- SMEs and Individuals as Digital Knowledge Producers (Knowledge/software/immaterial services)
- LE as Digital Knowledge Producers (Knowledge/software/immaterial services)
- (Large and Small) Enterprises Producers of material goods and product-related services (including manufacturing industries)
- SME related to complex value chains, as consumers of ICT technology & services
- EU-citizens as consumers of ICT technology & digital content and services
- Focused Communities of Knowledge-based workers (e.g. Scientific Community; Open Source Developers, Jurists, Teachers)
- Actors of Local Communities interested in growth (Policy Makers, Catalysts, Trade/Industry Associations, Unions)

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