TOWARDS A NETWORK OF DIGITAL BUSINESS ECOSYSTEMS FOSTERING THE LOCAL DEVELOPMENT

Discussion Paper

Bruxelles, September 2002

Disclaimer:

The views expressed in this paper are of the authors and do not necessarily reflect the official European commission's view on the subject.

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1. OVERVIEW AND RATIONALE

Small Organisations and e-business

The SMEs are the backbone of European economy (there are now over 19 million SMEs in Europe) but they are lagging behind in the adoption of e-business as a strategic distribution channel. In most EU Member States, SMEs make up over 99 % of enterprises and do generate a substantial share of GDP, are a key source of new jobs and, as well, are a breeding ground for entrepreneurship and new business ideas.

SMEs and ICT

However, in the new globalised business scenario, European small organisations are not ready to use the Internet more intensively as a business tool, except for a few start-ups which are at the leading edge of the IT revolution, the major part of SMEs still have some reservations that prevent them from jumping easily into the digital age. These barriers are well-known: lack of resources, lack of skilled employees, lack of easy to use technology adapted to SMEs, and also lack of awareness of the potential benefits for them.

Being more follower than leader of the change process, small organisations seem to need favourable conditions to accelerate the diffusion of the Internet and adoption of ICT technologies and thus to avoid a digital divide between larger and smaller enterprises and among geographical areas.

The two digital divides

goal of Lisbon

At the Lisbon summit in March 2000, the European Union representatives set the goal of becoming the world's most dynamic and competitive knowledge-based economy by 2010 with the need to promote an 'Information Society for All', and to address the issues of the digital divide in the adoption of Internet and e-business use.

The statistical evidence points to two main digital divides on e-business issues within European Member States:

regional divide

▸ The regional digital divide arising from the different rates of progress in e-business development within the EU, generally perceived as between the Nordic/Western and the Southern European Member States. While Nordic and some Western European countries are fast and sophisticated adopters of e-business – in some cases perceived as the worldwide benchmark – the situation is entirely different in regions with less developed economies, particularly in Southern Europe.

size-based divide

▸ The digital divide by company size arising from the significant 'gaps' between SMEs and larger enterprises in the more advanced forms of electronic commerce and particularly in terms of e-business integration and associated skills. This is set out clearly in the Eurostat "e-commerce and ICT usage by European enterprises" survey of 2001[1]

The effect of the two digital divides is cumulative and gaps therefore tend to widen. Thus SMEs, in the less advanced regions, are likely to become the focus of policies to promote ICT and e-business adoption at the EU level.[2]

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[1] This major survey covered SMEs with 10 - 249 employees, in 13 EU Member States plus Norway (the gross sample was 100,000 enterprises), and reflects the situation in the period November 2000 and June 2001. It was conducted by Eurostat together with the National Statistics Institutes and sponsored by DG Enterprise. This covered the adoption of ICT and ecommerce in all sectors of the economy.

a [2] Benchmarking national and regional ebusiness policies for SMEs Final Benchmarking report 12 June 2002

Background

The challenge is to achieve widespread and effective take-up of ICT to enable SMEs to become more innovative and competitive in global markets. "Widespread" means technology take-up actions must address every industry, sector and region, while "effective" means that actions must reflect SMEs particular circumstances and needs.

A wide variety of initiatives and actions are underway in Europe aimed at helping SMEs access the benefits of ICT. These range from specific R&D projects, technology transfer of research results, awareness-raising, and basic ICT help and advice, through to more focused support, such as subsidised consultancy. Real life business cases based on novel technologies, solutions and business practices can offer SMEs important insights into the change process and provide impetus for more widespread adoption.

Recently the awareness that several important technological advances (e.g. Internet, Web) are the results of Research and Technological Development (RTD) programmes funded by public programmes has grown. RTD is also important in terms of informing future policy development. For example, it is necessary to consider the way in which new technologies might affect current and future legislation, and, conversely, how legislative developments might influence technology. Interoperability and standardisation are also important factors to be taken in consideration. Moreover, since e-business involves significant cultural change, it is necessary to study the socio-economic impacts of new technologies, working practices and business models. This interplay between RTD, policy, and implementation affects the business environment for all enterprises, but is of particular relevance in informing future policies for SMEs.

The European Commission, through the Directorate General Information Society and the IST FP5 programme[3], has launched several projects, which involve directly hundreds of SMEs throughout Europe together with many "catalysts": local or regional organisations that work with SMEs to facilitate the change process.

A recent assessment report[4] launched by the European Commission, Directorate General Information Society, shows that IST projects with an high involvement of SMEs are generating a diverse set of "showcases" – examples of successful practice – that show current projects focus on the e-commerce or e-business stages of the SME evolution of ICT adoption (figure on section2). This ladder is not static, however, but is continually being extended upwards as new technologies and approaches enter the mainstream. The next generation of IST SME support measures should continue to drive up the value chain, from e-commerce and e-business today, to e-business and networked organisations to business ecosystems in the next four years.

The assessment of current projects funded by IST programme - and where SMEs are main beneficiary of results - shows positive impact on their competitiveness. However, it is clear that sharpened and tailored technology need to be identified and transferred to Small businesses by using new and more effective business models.

Three main key issues should be addressed to effectively support Small Businesses evolution toward the knowledge economy:
▶ funding of longer term risk projects that will feed the Small Business cycle on an iterative basis;
▶ ensuring the research results generates actionable collateral innovation and added value services aimed at creating innovation and synergies at local level among several local realities.
▶ the development of a policy of knowledge sharing for SMEs, their organisations and local government

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[3] IST FP5 = Information Society Technology Specific Programme under the 5th 4-years Framework Programme of Research and Technological Developement

[4] KAII Status Report SME Take-up Projects, European Commission – IST Programme May 2002.

Major obstacles

Small organization, in coping with the digital technologies, should be supported in removing a set of obstacles. This requires a strategic long-term vision and planning. The key challenge for policy makers is to identify the European and national policies which directly address the removal of these obstacles, through specific actions.

The *e*Europe 2002 Action Plan was endorsed by EU Member States at the Feira European Council in June 2000. The Action Plan's objective includes an action to encourage SMEs to 'go digital'. Within this action, main obstacles SMEs face as they engage in e-business has been identified[5].

Shortage of knowledge, skill, entrepreneurship

The lack of suitable technical and managerial staff with sufficient knowledge and expertise is a major barrier.

This shortage affects technical knowledge related to ICT, but also entrepreneurial and managerial expertise needed for operating in a networked economy.

SMEs critically depend on "on-the-job competence". Although primarily financial, these limitations also extend to the use of valuable time and management and personnel resource constraints. Large firms, because of their size, will more easily be able to organise within their own structure expertise to continuously improve, maintain and upgrade their e-business activities. SMEs will have to rely much more heavily on expensive outside contractors who might be less directly committed to the business activities of the firm. Europe's shortage of skilled ICT and e-business professionals is now estimated at approximately 1.9 million. This could rise to as much as 3.8 million in 2003. Some Member States have taken action to attract ICT experts from third countries. Bringing in outside expertise is costly, and in today's very competitive market for ICT specialists, big companies and fast-growing ICT start-ups have a clear advantage over "traditional" SMEs. The key challenge for policy makers is still to lower barriers to market access and foster entrepreneurship[6].

Lack of technological solutions and interoperability

More than any other business users, SMEs have a strong interest in standardised and fully compatible open inter-operable ICT solutions that stay relatively stable over time. At present, the complexity and the lack of robustness of many ICT solutions are discouraging many SMEs. Yet they often have to follow the technology and business standards set by major clients, and hence are exposed to the risk of becoming "locked-in" to a specific technology, used by one contractor but not by others.

Investments/Costs

The costs of the introduction of e-business practices for a single small organisation, although have dropped in recent years, exceed the resources of a small organization and usually can't be afforded automously. The cost of setting up an e-business includes preliminary planning, procuring hardware and/or software tools (installation, training, and subsequent reorganisation), continuous maintenance, servicing costs and telecommunications charges. However, getting the right ICT equipment is only part of the equation.. SMEs often have very limited resources for experimentation; they can rarely afford to make expensive mistakes, therefore uncertainty about the viability of the initial investment and the rising cost of maintenance services may reduce their willingness to undertake the necessary investments. In addition, SMEs have to be

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[5] See for example ENSR Enterprise Survey 1999 as used in The European Observatory for SMEs – Sixth Report, European Commission, 2000

[6] Brussels, 13.3.2001 - COM(2001)136 final -Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions *helping SMEs to "go digital"*

prepared to outsource ICT services and to acquire professional skills and use consultants to help prepare for the organisational changes required by e-business.

Complexity of regulations

Although today's regulatory environment seems to accommodate ebusiness satisfactorily at national level, problems may emerge when SMEs participate in e-business across borders. Unlike larger companies, with their teams of lawyers and consultants, SMEs tend to avoid the legal risks of engaging in cross-border commerce. Readily available basic legal information, and in particular semi-standardised legal advice, is therefore of crucial importance for SMEs who, more than any other business, need simplicity and predictability. Similarly, low-cost access to effective alternative dispute resolution mechanisms is widely perceived as a key prerequisite for engaging in crossborder e-business.

Shortage of Capital

It's well known that the European small organizations have difficulties of access to financial resources, since the traditional finance providers of the day-to-day funding for SMEs are commercial banks that remain some of the most conservative investors. Economic failures are an intrinsic element in a fast-changing environment like the Internet. Small organisations are reluctant to invest in ICT rather than concentrating the investments in their core business.

2. THE DIGITAL SYSTEMS EVOLUTION AND THE ADOPTION PHASES

Status of digital adoption for small organizations

E-business is often described as the small organisations' gateway to global business and markets, and the success of the adoption of digital technologies in Europe is critically dependent on whether the small organisations are fully engaged in the strategic adoption process

Because SMEs are more flexible in their internal organisation than larger companies, they may often be able to adapt to changing market conditions more quickly and efficiently. However, although Internet use figures differ among Member States and sectors, there is generally a positive correlation between the size of an enterprise and its Internet use for business, i.e. the smaller the company, the less it uses ICT[7]. As a result, the preponderance of SMEs in Europe's economy is not matched by their use of digital systems.
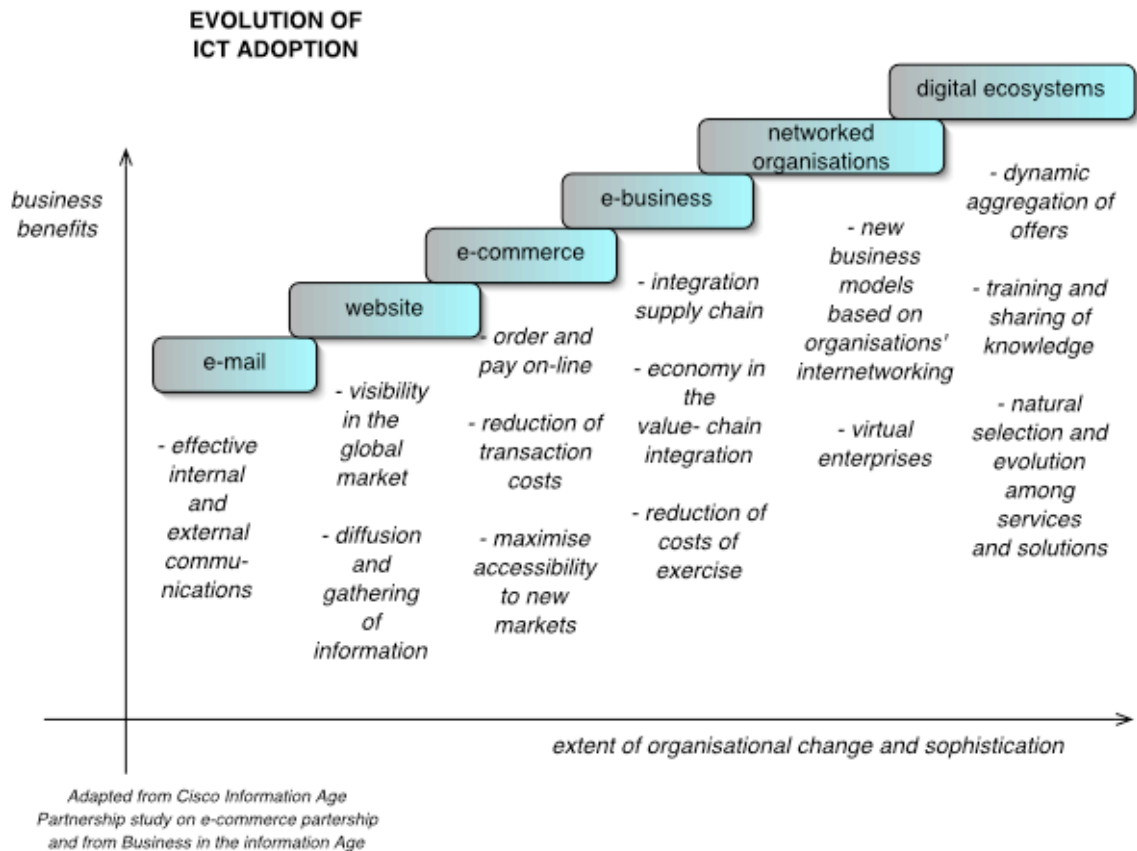
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[7] in 2000 34% of large enterprises compared to 10% of SMEs10 used e-business services (source Eurostat)

The initial adoption phases

The adoption of Internet-based technologies for e-business is a continuous process, with sequential steps of evolution. The steps could be classified in 6 phases: (1) e-mail, (2) web-presence, (3) e-commerce, (4) e-business, (5) networked organizations, (6) digital business ecosystems.

**EVOLUTION OF
ICT ADOPTION**

business benefits

e-mail
- effective internal and external commu-nications

website
- visibility in the global market
- diffusion and gathering of information

e-commerce
- order and pay on-line
- reduction of transaction costs
- maximise accessibility to new markets

e-business
- integration supply chain
- economy in the value- chain integration
- reduction of costs of exercise

networked organisations
- new business models based on organisations' internetworking
- virtual enterprises

digital ecosystems
- dynamic aggregation of offers
- training and sharing of knowledge
- natural selection and evolution among services and solutions

extent of organisational change and sophistication

Adapted from Cisco Information Age
Partnership study on e-commerce partership
and from Business in the information Age

In the early stages, Internet has been used as new instrument of commercial communications:

First phase: e-mail (early adopter started in 1986): The first adoption step was based on the usage of Internet for exchanging e-mails and messages. This adoption did not imply a cultural change.

Second phase: web-presence (from 1993) The second phase saw proliferation of an electronic presence, usually through a static Web site. Actually, those websites, "lost in cyberspace", were not visited by the target clients, and the unavoidable "dispersion" of those website led to a limited effectiveness in the cyberspace, partially solved by the establishment of vertical, thematic or regional e-marketplace portals and efficient search engines, On average, across European Union (EU), only 67% of SMEs10[8] have access to the Internet. In some Member States, this is even less than the Internet penetration rate among households. Of those that are connected, the majority uses the Internet only for information purposes. Only 44% of them have their own website, but the difference between large enterprises[9] and SMEs10 and between regions is relevant. Have their own website the 80% of large enterprises;

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[8] SMEs10 = enterprises with between 10 and 249 employees

[9] large enterprises are considered by Eurosta the enterprises with more than 249 employees

6% of Spanish SMEs10, 9% of Italian SMEs10, but 67% of Finnish and 65% of German SMEs10.[10]

E-commerce

Third phase: e-commerce (from 1996). When finally the technology allowed the use of the Internet to perform economical transitions on-line between enterprises and consumers (B2C) or among enterprises and suppliers, or internally inside the same enterprise (B2B) the e-commerce started, allowing to the enterprises purchases, sales, electronic auctions, e-payments. This stage brings closer interaction as customers and suppliers work together on-line and as vendors customize content for their users. Even in the most advanced Member States, only a minority of SMEs[11] uses the Internet for commercial transactions and can handle transactions electronically. Against the background of the explosive growth of e-business worldwide, especially in the US, these figures are alarming signs that European SMEs are not yet fully committed to the Internet. The OECD estimates that the value of Internet transactions doubles every 12-18 months. European SMEs therefore risk missing important economic opportunities.

E-business

Fourth phase: e-business (from 1999) Internet technology has gone far beyond a mere means of electronic transactions becoming a foundation for applications linked to the core business systems, modifying the internal working methods and processes and the internal culture and organisation.

The e-business technologies allow the enterprises to effectively directly connect with clients, suppliers, and business partners. The connection is recently made easier by the continuous emerge of new interoperability techniques and standards (like XML, ebXML). This business network modifies the internal working methods activating new models of information transfer and of cooperation. The recent increase of productivity due to the new technologies, initially has happened, in the organisations of North of America, with the extension of the usage of Internet from the simple commerce to all operation of their business, inventing new operative processes as well. There is the possibility of gains in productivity and increase of quality in all activities of business: from marketing to sales, from customer relationship to logistics and operation management, from education to training and knowledge management.

Examples of applications and infrastructures based on Internet includes: systems for e-commerce, e-procurement, Supply Chain Management, Customer Relationship Management, Enterprise Resource Planning, logistics, planning, knowledge management, business intelligence, e-training. Examples of innovative working processes are customer call centers, Intranets that link business partners, data warehouses that improve customer relationships.

 The e-business opportunities are mainly taken by large organizations, whilst the single small organization faces with well-known barriers: costs of the implementation, budget constrains, lack of technological awareness, lack of ICT skilled/enabled workforce, difficulties to determine costs and benefits, lack of knowledge of the e-business models, questions on reliability and security of technology.

Elements, like the employees resistance to the change, the non-support from the

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[10] 20.2.02 Eurostat Statistics in Focus newsletter ISSN 1561-4840 KS-NP-02-012-EN-N

[11] In 2001, 6% of EU enterprises used Internet for electronic delivery and 7% for e-payments; 18% of SMEs10 and 34% of large enterprises for e-ordering. Only 3% of EU enterprises used Internet for e-commerce for more than 2 years (20.2.02 Eurostat, ibidem)

management, the limits of bandwidth and Internet access are not considered an obstacle. The major obstacles could be overcome by having a software infrastructure with services at acceptable costs and adequate quality having the possibility to acquire the knowledge of business practices and to get the technological skills.

Networked organisations

The intensive exploitation of e-business systems gradually modifies how enterprises and markets are organized. Digital systems allow to more easily unbundling operations, retaining only those critical to market position. Transformations bring additional challenges involving organization, staff training, and includes outsourcing non-core operations, changes in processes and systems, and paying attention to legal and audit considerations. Organisations achieve tight integration with other organizations both within and outside their own industries. The new frontier is, then, combining organizational genetics with advanced IT solution in unique and inventive ways. Organizational genetic is an intangible asset that determines the basic character of a business; it influences the innovations to which people commit themselves. Little understood organizational genetics is of vast importance. The goal is to combine organizational genes in unique and inventive way, creating new organisms that (at least some of the time) will find ways to adapt to the new digital business environment. The game, then, to be played today is managing organizational genetics together with a new ecology of information technology.

Organisations build faster and more effective strategic partnerships and alliances, re-engineer and integrate their business processes, develop value added products and services, and share knowledge and experiences

When groups of organisations adopt networked methods of cooperative work, make associations for exploiting the market opportunities, combine their products and services, could jointly produce and offer new services and products. The boundaries among the organisations start to fade, forming networked organisation.

The Networked Organization is then a response to restructure and respond to the new digital market, where there has been a growing recognition of the need for new kinds of organizational structure. Networked Organization has been defined by Lipnack and Stamps[12] as one:

"where independent people and groups act as independent nodes, link across boundaries, to work together for a common purpose; it has multiple leaders, lots of voluntary links and interacting levels."

Other types of organization have been described, such as the lattice organization, the spider's web, the holonic enterprise and the virtual corporation. All describe new ways of organizing.

This process is advanced in the sectors of insurances, in the distribution, in the media and in telecom sectors.

Over time, this reorganisation will produce cross-industry supply chains that will come together to create networked organizations and markets. These new forms can best be described as dynamic customer-centered networks.

Towards digital business ecosystems

As consequence of this evolution, the dynamic networking of the organisations, drives to the dynamic cooperation of the players on the territory and the connection of the resources in a system, building a community that shares business, knowledge, and infrastructures. This will dramatically affect the ways enterprises are constructed and business is conducted in the future, and the actual slowly changing organisations will be

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12 Lipnack, JL, and Stamps, JS, *The Age of the Network*. New York: John Wiley & Sons (1994).

replaced by more, fluid, amorphous and, often, transitory structures based on alliances, partnerships and collaboration.

To support this scenario, which envisages the dynamic aggregation of services and organizations, is required a further stage in ICT technology adoption which exploits the dynamic interaction (with cooperation and competition) of several players in order to produce systemic results in terms of innovation and economic development.

The basic players to be considered are:
▶   research and education organisations, innovation centers;
▶   small and large enterprises with their associations;
▶   local government and public administration.

The adoption and development of scalable and adaptive technologies, allows new models of business based on the dynamic association of enterprises. The ecosystems are, in fact, characterised by intelligent software components and services, knowledge transfer, interactive training frameworks and integration of business processes and e-governance models.

The latter step in the adoption of Internet-based technologies for business, where the business services and the software components are supported by a pervasive software environment,which shows an evolutionary and self-organising behaviour, will be named *digital business ecosystems.*

sector-specific ecosystems Then *Sector-specific ecosystems* will pop up when a particular area of business starts to adopt the digital ecosystem and software components and services developed for that area of business will appear. These components are based on a set of specific requirements in sectorial, functional and local contexts in order to allow and facilitate the easy set-up of local business.

Instances of sector-specific ecosystems, implemented at local level are *local business digital ecosystems.* Digital business ecosystems also act as driver for small businesses and government re-organisation, in particular supporting the local governance of networked organizations and enforcing the cohesion of local communities.

They foster the local economic development processes creating nodes of innovation of local business digital ecosystems in various sectorial settings and facilitating their interactions with local government, research and innovation transfer.

small organisation The small organisations, facing difficulties to the migration to e-business, could take advantage of this evolution, but could afford this challenge only with a networked organization, cooperating and sharing information and instruments.

Thanks to the network organization and thanks to their flexibility SME could reach impressive results preserving their small dimension.

3. THE STRUCTURE OF THE BUSINESS DIGITAL ECOSYSTEMS

In this paper the ICT technology-based ecosystem will be denoted as "business digital ecosystem" to distinguish it from the "business ecosystems" used for socio-economic analysis.

In general terms both a local business environment and a digital business ecosystem could be described stressing the analogies with the natural ecosystems.

The business ecosystem metaphor

The use of the natural ecosystem as metaphor for the capitalist economy is used by several schools[13].

Already back in the '90,[14] Michael Rothschild observed:

"A capitalist economy can best be comprehended as a living ecosystem. Key phenomena are also central to business life. Information is the essence of both systems.
In the biologic environment, genetic information, recorded in the DNA molecule, is the basis of all life. In the economic environment, technological information, captured in books, blueprints, scientific journals, databases and the know-how of millions of individuals, is the ultimate source of all economic life." [15]

Organizations, like organisms, are built in complex hierarchies. One is made up of cells within tissues within organs, within organisms within populations, while the other is comprised of work teams inside departments inside divisions inside businesses inside industries."[16]

"The new paradigm requires thinking in terms of whole systems – that is, seeing your business as part of a wider ecosystem and environment. Our traditional notions of vertical and horizontal integration fail us in the new world of cooperating communities. In place of industry I suggest a more appropriate term: business ecosystem"[17].

The term circumscribes the microeconomics of intense coevolution coalescing around innovative ideas. Business ecosystems span a variety of industries. The companies within them coevolve capabilities around innovation and work cooperatively and competitively to support new products, satisfy customer needs and incorporate the next round of innovation. The dominant new ecosystems will likely consist of networks of

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[13] Some text of reference are:
Michael L. Rothschild, *Bionomics,* Henry Holt Publisher; ASIN: 0805019790; (1990)
Thomas Power, George Jerjian, *Ecosystem: Living the 12 Principles of Networked Business,* Financial Times Prentice Hall; ISBN: 0273656228; 1st edition (August 2001);
Don Tapscott, David Ticoll, Alex Lowy, *Digital Capital: Harnessing the Power of Business Webs,* Harvard Business School Press; ISBN: 1578511933; (May 2000)
James Moore, *Death of Competition: Leadership and Strategy in the Age of Business Ecosystems,* HarperBusiness; ISBN: 0887308503; Reprint edition (May 1997)

[14] Anna Pollock, Leon Benjamin, *Shifting Sands: The Tourism Ecosystem in Transformation,* DestiCorp Limited (April 2001)

[15] Michael L. Rothschild,, ibidem

[16] Michael L. Rothschild, ibidem

[17] James Moore, ibidem

organizations stretching across several different industries."[18]

These are defined by Moore as the primary elements of the ecosystem.

The business of organisations, *"which in turn comprises its own functional elements (marketing, sales, production) is equivalent to an organism. These organisms may coalesce, collaborate to create more complex structures. But a business ecosystem also includes the owners and other stakeholders of these primary species including government agencies, regulators, associations, standards bodies, and representatives of the host community. To one extent or another, an ecosystem also includes direct and indirect competitors that, as circumstances shift, may also be collaborators."[19]*

The digital business ecosystem metaphor

digital vs. natural ecosystems

The complex adaptive and self-organising digital business ecosystem, like the economic ecosystems, could be well described exploiting the parallelism with the natural ecosystem.

The digital business ecosystem, is a "digital environment" populated by "digital species" which could be software components, applications, services, knowledge, business models, training modules, contractual frameworks, laws, …

These "digital species", like the life species, interact, express an independent behaviour, end evolves – or becomes extinct – following laws of market selection. The less adapted species, i.e. services not interesting for the market are less and less used, becoming less and less present in the ecosystems, until they disappear. New more evolved innovative species (digital services, but also innovative business models, sectorial services.) continuously appear and decree the obsolescence of the other "digital species".

Gradually more complex species appears, often originated by the composition of simpler digital species (components, basic services). As the natural ecosystems, the digital species should have enough individuals to survive and the digital ecosystems should be populated by a sufficient number of species (a critical mass of species) for being appealing for the market and continue ad exist.

As in the world, there are several ecosystems, having some species in common, others are similar having followed a process of adaptation to local conditions, and others are endogenous.

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[18] James Moore, ibidem

[19] James Moore, ibidem

General Architecture

The digital business ecosystems are based on an evolutionary systemic process; they may be composed of three different layers:

▸   *The generic ecosystem infrastructure:* a common support environment and a <u>generic</u> basic infrastructure, which includes basic services components, generic integrated solutions and infrastructure components.

▸   *The sector-specific ecosystems:* services, solutions and components <u>specialized for a specific sector</u> (e.g. agro-food, tourism, manufacturing) <u>or transversal applications</u> (e.g. logistics) that use the services of the common support environment.

▸   *The instances of the sector-specific ecosystem* <u>applied to a specific node of innovation</u>, geographical area (or to a network of them), supporting, and being supported by a local community. These networked instances forms the network of ecosystems instrument for networking the European enterprises and organizations in a business excellence network

LAYERS OF A DIGITAL BUSINESS ECOSYSTEM
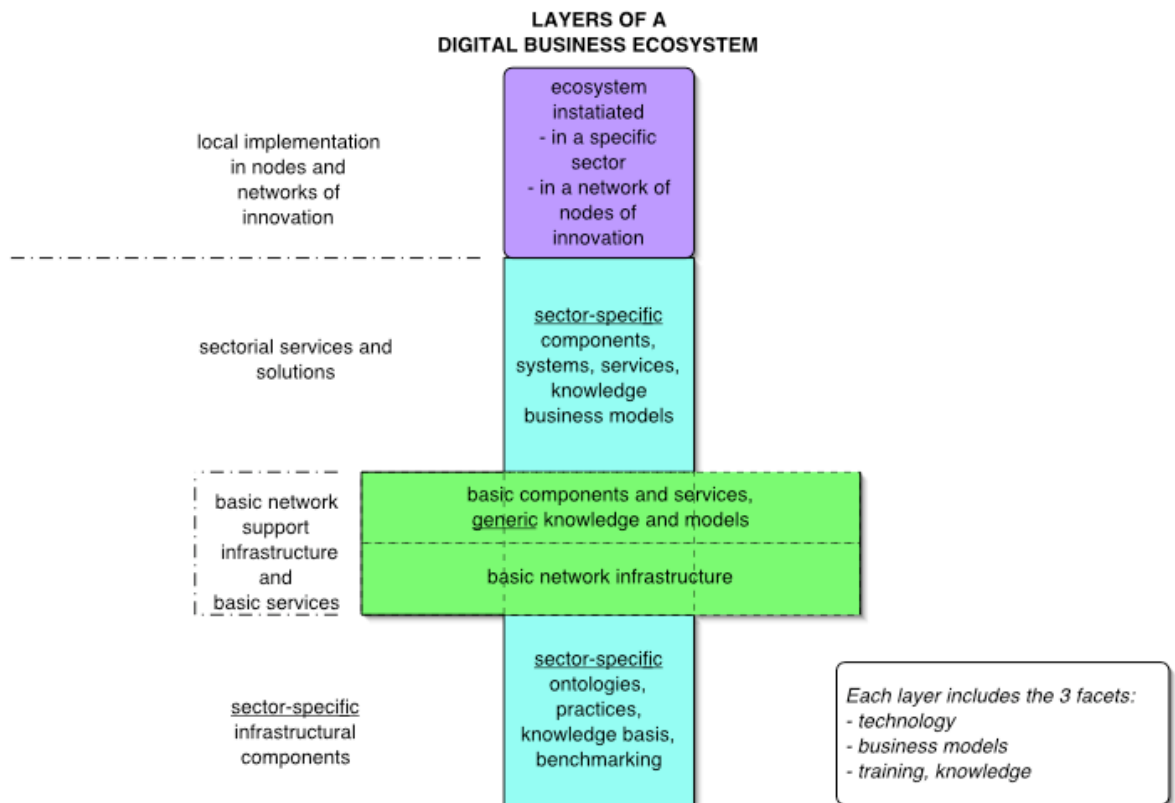
In the natural environment, the ecosystem needed for the proliferation of complex species (e.g. the lion) needs the presence of other species (e.g. the antelope) in ecological equilibrium. These species also need an infrastructure, which is composed again by other species (e.g. baobab, grass) and other components (e.g. water, salts). The distinction among basic species or infrastructure is arbitrary and what is considered a basic component belonging to infrastructure depends on point of view and ecosystem's evolution.

In the same way in a digital business ecosystem some services could be considered required component of basic infrastructure (e.g. micropayment system, credit-card payment system, fidelity card system) in others are included in the group sectorial or

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even in the local services.

The following table presents the parallelism among natural ecosystem, economic business ecosystem and digital business ecosystem, providing examples and showing the constitutive elements with examples.

Natural ecosystem	*Examples in natural ecosystem*	Economic Business ecosystem	Digital Business ecosystem	*Examples in digital business ecosystem*
Biological basis	*Cells amminoacids*	Laws, WTC regulations	Basic protocols, network infrastructure	*TCP/IP XML, ebXML*
organs			Software components, business models	*Open source models, operating systems*
Simple species	*Grass, worms, tiger*	Small organizations, universities, chambers of commerce	Basic e-services, Simple services	*Accounting sys, Payment sys, Groupware sys.*
Group of species in symbiosis	*Species in symbiosis: …*	Networked organizations, specific value chains	Aggregated services	*CRM, ERP, user profiling*
Local ecosystem/s	*Savanna, jungle / ecosystems of Amazonas*	Regional economy / multiregional economy	Local digital ecosystem / network of local digital ecosystems	*Digital environment + services for agrifood in 3 innovation nodes*
ecosystems	*Global natural environment*	Global world business	Network of digital ecosystems	*Network of local digital ecosystems for innovation*

The three facets

The community, in order to exploit the synergies of the systemic sharing of community resources should cooperate and share the following facets:

▶ <u>Services and technological solutions</u>, sharing vision, decisions and solutions that are able to share the infrastructure, together with the choices and the solutions, reaching the critical mass and the needed economies of scale;

▶ <u>The business</u>: aggregating the offer, but also other elements, like procurement, customer management;

▶ <u>The knowledge</u>: building a "virtual learning community" with training and competence center, a shared knowledge base, e-learning modules, benchmarking, etc…

The following picture illustrates the ecosystem, considering its layers (in horizontal in the picture) and its facets (vertically slicing all the layers). The vertical blocks represent the specialized ecosystems, which could be related to a specific sector (e.g. agrofood, tourism, manufacturing, etc.) or topic (e.g. logistics). Instances of the sector-specialized ecosystems (represented by the "vertical cards" in the picture), are implemented in the local areas where that business activity is performed offering

services, solution, knowledge, training, methods for the local organisations' business. All the ecosystems are interrelated and there is a continuous osmosis of "digital species" among them (exactly like in the natural ecosystems), forming a "European digital business environment". This continuous exchange contributes to the ecosystems' continuous evolution. A component developed for a sector, with the appropriate business agreement, could be used (eventually re-adapted) by a different sector.

The local ecosystems, which includes components and basic services, knowledge sharing facilities and as well as models for business process integration are the ITC instruments for building a networks of local communities evolving into a European network of small businesses and organizations.
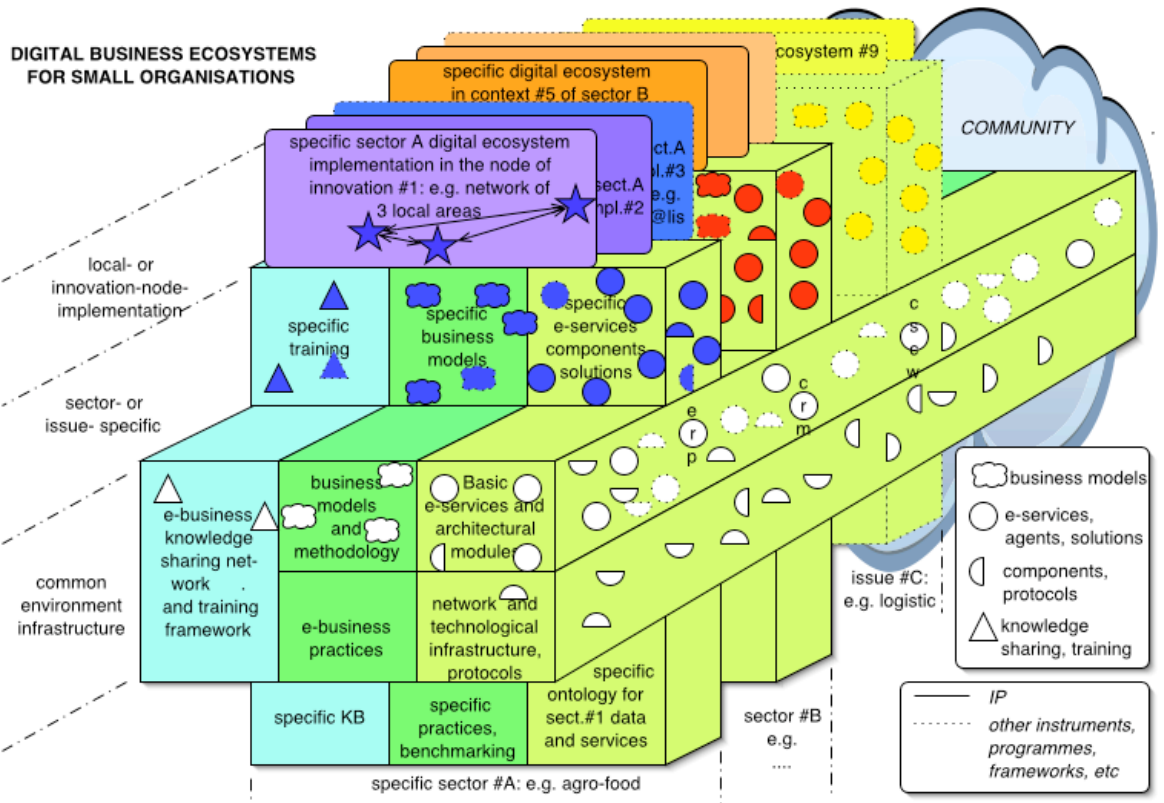
The common basic network infrastructure and the basic services

The generic technological infrastructure represents the basic dynamic building block for the development of the distributed network of local ecosystems and it is shared among all the ecosystems.

The distributed, open-source basic infrastructure is the common ecosystem environment and is composed by:

▸ the infrastructure: network architectural modules which include the services which implements the standard protocols and the services which allows the network communication, the interoperability and definition of common semantics, the dynamic webservices deployment, the seamless communication among the processes

▸ a set of basic e-services, which could be used as basic component for developing solutions for different business sectors.

The network infrastructure provides support in the definition and implementation of the protocols for the discovery, look-up and join mechanism. Spontaneous and dynamic detection and inclusion of the dynamically appearing and disappearing

services/components/solutions of the ecosystem is a key functionality provided by the infrastructure. An extraordinary level of distribution and sophistication is needed, in addition, the ontology mechanisms and distributed description services are considered as key components of the basic service network support infrastructure.

In addition to the basic services, a set of components and basic generic services not depending from a specific application sector could be provided by the basic infrastructure. They might include systems for electronic payment, for certification and trust, enterprise resource planning, customer relationship management, e-procurement.

The basic infrastructure supports all the three facets needed for building a community and the networking of the resources of the local nodes of innovation, i.e. addition to the technical infrastructure support, it provides the basic support for the other two facets of the ecosystem: the knowledge sharing aspect and the business models and practices. Therefore, it also includes instruments for knowledge sharing, for knowledge basis set-up, for community building, e-learning tools, support for e-learning and e-training (in technology and in e-business), methodologies and practices of networked business integration. All the modules, components, services and basic methodologies composing the infrastructure are implemented on a set of nodes of the ecosystem, distributed in the regions of Europe (the ones which have decided to implement the ecosystem). Not any node is critical, and the distributed, fault-tolerant architecture guarantees the dependability of the system/subsystems/services.

The sectorial services and solutions

Above the basic infrastructure layer there is the sector specific layer, i.e. the "digital species" tailored for specific sectors or transversal application.

Sector-specific ecosystems will pop up when a particular area of business starts to adopt the digital ecosystem and software components and services developed for that area of business appear. These components are based on a set of specific requirements in sectorial, functional and local contexts in order to allow and facilitate the easy set-up of local dynamic business.

Then the generic digital business ecosystem will start to differentiate into sector-specific ecosystems, which includes the basic infrastructure together with its "digital species" plus the sector-specific "digital species".

The sector-specific ecosystem includes:

sectorial components

- ▶ Generic software components and applications adapted for the specific sector (e.g. adaptation of customer relationship management systems, user profiling systems, …)
- ▶ New developed or imported sector-specific software components (e.g. reservation systems or yield management systems for tourism sector; cattle tracing system for agrofood, enterprise resource planning applied to specific sector)
- ▶ Specific ontologies which describe the semantics of data, services, processes for that business sector
- ▶ Sector-specific education and training modules
- ▶ Knowledge basis; business models; repository of practices, business solutions, regulations; newsletters
- ▶ …

The services, following the digital ecosystem philosophy are subject to selection and

evolution. Several versions of similar services coexist, with different level of functionality, licenses, and costs. They follow the same "natural selection" mechanism, they will continue to exist until will be a critical mass of active nodes implementing and supporting adequately such service.

It's worthwhile to note that the sector-specific ecosystem represents only a conceptual classification. Human or digital users accessing to the digital business ecosystem will see a global ecosystem environment, which includes all the generic and sector-specific components/services which they are authorized to "discover" based on needs and business agreements.

The specific implementations in the local nodes of innovation

When a set of organizations of a geographical area embrace the sector-specific ecosystems related to their local business activity, and when the ecosystem could deliver solutions related to that area, we have a local instance of the ecosystem and name it *local digital business ecosystem*.

The digital business ecosystems are implemented as clusters of digital sector-specific ecosystems. The technological infrastructure, the components, the services "lives" within a set of interconnected computer nodes based on the geographical areas which adopt the ecosystem concept. The "local implementations" does not necessarily refers to node of innovation located in a single specific region, but will be often represented by a network of nodes of innovation located in different European regions. The local development will be fostered by exploiting the integrated digital environment and by mobilising all local players including local authorities, innovation and research centres, universities, consumers and trade associations, NGOs.

It is crucial to achieve the local consensus and to build an active local community through the active involvement and mobilization of the three key actors operating on the territory:

 ▶ The research and innovation centers, the universities

 ▶ The entrepreneur community and small organizations through their representative organizations

 ▶ The local government and the public administration.

The local ecosystems, will gradually federate creating inter-regional cooperation by fostering nodes of innovation and integrating pan-European, national and local initiatives.

Increased use of ICT by national, regional and local governments is considered an instrument to activate a virtuous innovation circle[20]. National and regional policies for a more sophisticated and widespread use of e-based services for reducing enterprises administrative overheads in accomplishing their administrative duties would create an incentive for many enterprises to faster adoption of ICT.

It is crucial to activate also virtual communities, not based in specific region, but aggregated by topic of interest. The community made of the local players (or the network of local communities) together with the distributed virtual communities, contributes to develop strategies, technological solutions, digital services, business models. In this landscape of virtual distributed communities, the active participation of open source developer communities is a measure of the success of the initiative.

The local business digital ecosystems, supported by a strong and active communities could underpin local economic development and gain a competitive advantage. Pollock

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[20] Jeffrey Sachs**,** *The Global Innovation Divide,* Harvard University, Center for International Development, speech of 22 May 2002

and Benjamin[21] suggest that it *"would foster the development and use of standards that would enable a stable [digital] ecosystem to emerge. […] in this new, organic, fluid world, any provider, group of providers or any customer or third-party could become an e-mediary or synonymously a content and service aggregator. In a world of electronically available and purchasable services, virtually all barriers to becoming intermediaries disappear – a process of natural selection will take place around profit to companies and value to customers."*

4. MEASURES AND INSTRUMENTS FOR DIGITAL BUSINESS ECOSYSTEM IMPLEMENTATION

Objective

The long-term objective is to create an integrated, distributed pervasive network of local digital ecosystems for small business organisations and for local e-governance which cooperate exchanging dynamically resources, applications, services and knowledge. It will constitute a global digital ecosystems environment able to continuously evolve aimed at fostering local economic growth through networked nodes of innovation.

This objective could be achieved by developing an innovative evolving generic infrastructure for the creation of business-specific ecosystems as result of synergies between European research and national and local innovation activities, continuously transferring their results to local innovation activities.

This will contribute to the European Research Area also by mobilising pan-European, national and local research and innovation initiatives, and by allowing millions of European small organisation to innovate and to take the lead in the digital age. Results of the research aspects will constantly emerge over the time, continuously feeding the evolution of the ecosystems. Thus, the ecosystems will include an increasing critical mass of better-adapted components, which will be perceived as a unique pervasive and distributed European resource of innovative e-solutions supporting small organisations.

This approach implies a broad research challenge based on two interlaced research aspects:

▶   re-thinking the complex systems models: translating concepts, that have been developed for interpreting the social organizations and living organisms, into a set of appropriate concepts and operative models for the development of digital ecosystems; likely new concepts, models and paradigms will emerge,

▶   validation and refinements of these new ideas through their implementation: building a complex, pervasive, self-adaptive and evolutive system architecture, ensuring that all the enabling technologies and knowledge for the implementation of the ecosystems are in place

The dichotomy "theoretical approach versus applied projects" is inherent to this approach and a continuous effort should be devoted to reconcile the theoretical research with industrial and business realities.

To achieve these results, an interdisciplinary research team needs to work closely together, developing new concepts and views.

In the history of the science, two very large attempts to follow this kind of approach, produced an impressive economic impact and have originated new classes of concepts:

▶   Cybersyn project (1970-1973)[22]: it was a government-led project, with the objective to apply the principles of cybernetics for the democratic and effective

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[21] Anna Pollock, Leon Benjamin, ibidem
[22] Stafford Beer, Raoul Esperjo, et al, (a cura di F. De Cindio e G. De Michelis) ,*Il progetto Cybersyn : cibernetica per la democrazia,* Milano: Clup-Clued, 1980

management of the Chile's economy; the largest project ever launched on this subject ("*how should cybernetics be used in the exercise of national Government?[23]*"); it has originated the theory of autopoiesis[24] and the Viable System Model[25]

▸ Intelligent Manufacturing System programme[26]: it is a ten-year industry-led, international basic research programme (1991-2000); the largest programme ever launched on manufacturing, with the objective of establishing the next generation of manufacturing and processing technologies; it has originated the concept of Holonic Systems[27]

Measures against the major obstacles

A set of complementary measures together with the establishment of a network of local digital business ecosystems could help SMEs to become involved in the ecosystem.

These measures should include action against the ones defined as major obstacles for ITC adopton from SMEs. The major obstacles and the major corrective actions are:

Shortage of knowledge, skill, entrepreneurship

Actions: Creation of local "competence centers" on e-business and on the local sectors of activities (e.g. for improving quality)
building virtual learning communities
sharing e-learning and e-training modules
knowledge basis including models and e-business practice, benchmark
implementation of digital business ecosystems

Lack of technological solutions and of interoperability

Actions: use and promotion of standards
sharing common solutions
implementation of digital business ecosystems

Investment/Costs

Actions: software sharing, common development of open source software
open and distributed common infrastructure
use of digital business ecosystems

Complexity of regulations

Actions: knowledge base of norms and laws
alternative methods of conflict resolution
e-training and e-learning modules

Shortage of Capital

Actions: support for venture capital, investment forum

Stafford Beer, *Platform for Change,* , John Wiley & Sons Ltd, 1995

[23] Stafford Beer, *Fanfare for Effective Freedom, Cybernetic Praxis in Government,* The 3rd Richard Goodman Memorial Lecture, Delivered at Brighton Polytechnic, Brighton, On Wednesday 14th February 1973, on-line

[24] Humberto Maturana, Francisco J. Varela, *Autopoiesis and Cognition. The realization of living,* 1980, D.Reidel Publishing Company, Dordrecht, Holland

Terry Winograd and Fernando Flores, *Understanding Computer and Cognition, a new foundation for design*, 1986, Ablex Publishing Corporation, Norwood, NJ

[25] Edited by R. Esperjo and R. Harnden, *The Viable System Model: Interpretations and Applications of Stafford Beer's VSM*, 1989, John Wiley & Sons Ltd

[26] http://www.ims.org

[27] Mihaela Ulieru, Scott S. Walker, Robert W. Brennan,*The Holonic enterprise as a Collaborative Information Ecosystem,* on-line

5.   ECOSYSTEM DEVELOPING MODELS AND IMPLEMENTATION

The models of development, which maximize the opportunities of success and selfsutainability of the ecosystems, should be identified.

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

▶   for the common infrastructure: an open source model adopting multiple business models;
▶   for the "digital species" of specialised 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.

Basic principles for the infrastructure

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

▶   Equal opportunities of access to the infrastructure, affordability for small organisations
▶   Selfsustainability
▶   Independence from a specific provider, technology, license
▶   Critical mass of services and of users
▶   Maximising the number of "digital species" populating the ecosystem, maximizing their evolution

To ensure the open and equal access, and the largest adhesion to the ecosystem, it is indispensable that the protocols and the data format are open and not depending from a unique provider, to guarantee the independence from hardware and software platforms, the highest interoperability and the possibility to reuse the pre-existing information and services..

Open source basic infrastructure

To guarantee that the ecosystems attracts a critical mass of developers of services and therefore of users, is critical to guarantee evolution and continuity of services in time within an open infrastructure.

The basic infrastructure represents the "business tone" which 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 could be inspected. Indeed, the ecosystem's infrastructure must satisfy a series of requirements regarding the licensing model and code accessibility, without which cannot be given the users an adequate guarantee on critical aspects like trust, security, fair processing, integrity, confidentiality, and reliability / accessibility throughout time.

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 (which sometimes in condition of monopoly).

For these reason the ecosystem needs a basic infrastructure the development of which can be guaranteed due to the availability of the source code.

The components the basic infrastructure

The basic infrastructure of the common ecosystem environment is composed by the infrastructure network and by architectural modules, but also provides some basic e-services (e.g. electronic payment, interoperability modules, CSCW,), which could be used as component 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.

These e-services will evolve as all the "digital species" of the ecosystem.

Models for sector-specific ecosystems

The use of open source infrastructure, the convergence on open standard and open systems, the strong support for interoperability (if necessary through the creation of compatible free software); the mechanisms for semantic definition, ontology building and instruments for distributed look-up and discovery well supports the seamless integration of new components and services.

For the services and components, specific training and knowledge sharing modules, knowledge basis, business modules, is fundamental for the evolution and selfsustainability of the ecosystem.

The user (or other "digital species") could select the more adequate service or component (open source or proprietary), could substitute it as soon a more adequate one appears on the ecosystem, or adapt it to its needs.

The broad use and the diffusion of a network of local digital ecosystems: :
- ▸ provides the digital support for the economical development of small organisations
- ▸ 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: it will be the market to operate a selection provoking a continuous evolution.

National and local implementation

The regions where the small organisations will early reach the digital business ecosystem adoption stage the will gain an extraordinary competitive advantage, whilst in the others the two digital divides will increase: they will be further disadvantaged respect the large enterprises and compared to the other regions.

The objective of an early adoption could be reached only thanks to a clear action plans and coordinated strategies at European, national and local level.

The European Council held in Lisbon on 23/24 March 2000 recognised an urgent need for Europe to quickly exploit the new opportunities of the economy and in particular the Internet. To achieve this, the Heads of State and Government invited the Council and the Commission to draw up "*…a comprehensive eEurope Action Plan …. using an open method of co-ordination based on the benchmarking of national initiatives, combined with the Commission's recent eEurope initiative as well as its Communication* 'Strategies for jobs in the Information Society'[28]. For implementing the Lisbon strategy the European Commission has launched two action plans (eEurope 2002 and eEurope 2005), for "*promoting a favourable environment for the creation of new jobs, to boost productivity, to modernise public services, and to give everyone the opportunity to participate in the global information society. eEurope 2005 therefore aims to stimulate secure services, applications and content based on a widely available* […] *infrastructure*[29]. "*Where necessary and without distorting competition, public financing instruments will give increased priority to supporting the development of information infrastructure and projects, notably in the less-favoured regions."*[30].

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[28] Brussels, 13.3.2001 - COM(2001)136 final - Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions *helping SMEs to "go digital"*

[29] Brussels, 28.5.2002 COM(2002) 263 *eEurope 2005:* An information society for all: An Action Plan to be presented in view of the Sevilla European Council, 21/22 June 2002

[30] Brussels, 14.6.2000, *eEurope 2002:* An Information Society For All – An Action Plan prepared by the Council and the European Commission for the Feira European Council 19-20 June 2000

In order to support the evolution of use of ITC and enterpreneurship, 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 sectorial 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

In order to reach the goals defined by the Council of Lisbon, it's 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 from the consensus and the active participation of the local players:

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

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

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

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

▶ coverage of the territory
▶ number of applications and services present
▶ diffusion and availability of the infrastructure.

Stimulus for small and local ICT software and service providers

The ecosystems stimulates the innovation and the competition, providing to the small providers equal opportunities to offer their services and products, stimulating the local technological knowledge and development. A new component, although produced by a small producer in remote areas, is visible on the ecosystem and, thanks to the seamless interoperability, could replace a component in a solution. It allows a choice based on the technical merits of the component and not on the power in marketing and commercialization of the producer: the smallest software producer can compete on equal terms with the most powerful corporations.

Competitiveness and innovation is then increased, generating a supply of software with better conditions of usability, in a model of continuous improvement.

When the solutions are proprietary, the user stays "trapped" in the need to continue using products from the same supplier, or to make the huge effort to change to another environment. The risk to this dependence is one of the obstacles, which delays the small organizations in embracing ICT technologies, and could be partially removed by the diffusion of digital ecosystems.

The set-up of digital ecosystems, therefore offers the possibility to small local organizations operating in the ICT field to propose 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. Local policies of education and training could help to develop a local entrepreneurship, which could go beyond the technical support, localization and the development of small local solutions,

elements

Local communities

and could compete in a global market offering innovative components or services, or offering adaptation and integration of components. It could be followed any business and licensing model, which fits with the local developers' strategies. The possibility to develop software components and solutions creates more technically qualified employment and a framework of competence which stimulates the market, and increases the shared fund of knowledge, opening up alternatives to generate services of greater total value and a higher quality level, to the benefit of all involved: producers, service organizations, and consumers.

6.   FINANCIAL MEANS

Building a European network of digital ecosystems is an ambitious objective, which could be achieved only with a long-term vision and through an integrated approach able to exploit all available financial means and instruments and all the potential synergies.

A digital ecosystem implementation plan could be build upon existing Community programmes aimed at the research, at the regional innovation, at the specific needs of small organizations and local communities. These programmes include the DG Information Society's Information Society Technologies (IST) Specific Programme, DG Enterprise's Multi-Annual Programme (MAP), the innovative actions, and the Structural Funds.

The initial step could be the creation of a consensus among a community of players which refines and improves the concept and the vision, builds a large community, identifies the initial enabling technologies (subject to a continuous evolution), identifies the business sectors and geographical areas which will act as initial nodes of innovation and testbed.

The IST programme under the 6th Framework Programme could be taken in consideration for supporting part of the implementation of the concept through one or more of its instruments: Integrated Project (IP), network of Excellence (NoE), Traditional RTD projects, Support Measures. The IST programme could mainly cover the research and innovation elements. A flow of engineered results of research should constantly feed the digital ecosystem, which should evolve thanks to the continuous inclusion of the new components.

The research could be complemented by a set of implementation plans based on national and regional programmes and initiatives with similar aims (e.g. eEurope/GoDigital 2005). Implementation could be flexible and decentralised; pursuing common objectives and reflecting the need for closer co-operation among various support instruments. It would identify and exploit the existing support programmes and initiatives at national and European level, but also would define strategies in order to rapidly reach the financial self-sustainability of the network of ecosystems thanks to the value added that the ecosystem could provide.

Bruxelles, September 2002
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