Digital Ecosystems supporting growth and SMEs

How ICT could support business and SMEs, preserving local development and values?
Which research?
Which synergies with other actions?

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Head of Sector “Technologies for Digital Ecosystems”
Structure of the presentation

- Local and global challenges: networking for s&e development.
- Lisbon Strategy: Role of ICT and knowledge
- Regional Clusters:
  - from Industrial Districts to Business Ecosystems
- Digital Ecosystem concept
- How to implement?
  - IST-FP: building a Digital Ecosystem infrastructure
  - FPCI,...: A network of local Digital Ecosystems

Better perspectives for EU local economy and SMEs?
SMEs: Advantages

- highly focused: niche products - specialized services
- flexibility; no large bureaucracies to overcome
- can play a role as innovator

SMEs: Disadvantages

- SMEs could be strong through synergies, but depends from value chain players (often large enterprises): find the right partners, learn how to network and cooperate
- limited specialised resources (knowl, legal, markt)
  no R&D dept., no legal dept, limited marketing
- difficult to cope with complexity and globalisation
  access to global value chain, access to knowledge
Globalization => decline of European SMEs?

- From a limited environment to a global competition, + interrelations
- From a well-defined business relationships to dynamic fuzzy relationships
  - un-known partner => quickly changing business relationships

SMEs software users (i.e. non-IT product/service providers): limited usage if ICT
  - affordable applications not available for SMEs
  - taylored applications fitting with local conditions not available
  - limited adoption of IT => minor increase of productivity

SMEs sw providers:
  - Rapid evolution of standards
  - Sw is part of an environment, interoperability, sw more and more complex
  - Difficult to compete with large global corporations with dominant positions

SMEs new difficulties: increased complexity and role of knowledge

A) more R&D, innovation needed
B) the value is extracted by immaterial (it’s now an asset)

  Creation, distribution, use, exchange of knowledge for purpose of value creation
  Attempt to limit diffusion of information
  => drm, patents, copyrights, secrecy clauses

----- > risk of foreigner oligopoly of immaterial means of production
The Lisbon Perspective

Lisbon Objective

"EU: Largest knowledge-based economy by 2010"

ERA: European Research Area
FP6, Eureka, COST, national RTD programmes

... towards a 'single market for research & innovation'

Enlargement
Candidate countries were full partners in FP5

Other policies
Single market, single currency, security of Europeans, sustainable development, ...

e-europe
Broadband access, e-business, e-government, security, skills, e-health, ...

European Commission - Directorate-General Information Society
F Nachira  Unit D5 : ICT for Business - Sector "Technologies for Digital Ecosystems"  October 2004
Role of ITC

The adoption and use of ITC is one of the major factor of productivity gain

- Internet creates new opportunity of business (services, content …)

... but his usage allows:

- to increase the productivity
- in all sectors
- in all kind of business
- the access to the global market
- the access and sharing of knowledge and skills
- the development of networked organisations

Half of productivity gain in US during last 5 years depends on ICT adoption
Models of Clusters (1)

Industrial District

Growth Node

Business Ecosystem

*Source: G-Nike 2002
“networks of production of strongly interdependent firms (including specialised suppliers) knowledge producing agents (universities, research institutes, engineering companies), institutions (brokers, consultants), linked to each other in a value-adding production chain”.

an evolution of the cluster concept that emphasizes the external networking dimension, the knowledge transfer, social learning through high-performing geo-clusters of organisations and institutions networked to other clusters and potentially supported by ICTs.

A virtual cluster (also defined as “e-business communities”) is an inter-organisational system in which each enterprise adds one or more distinct aspects of product/service value to the value of the network, by exchanging digital knowledge with other members through internetworking technologies.

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.

To develop 10 … 100 … 1000 Digital Business Ecosystems
Models of Clusters (1)

**Industrial district [Alfred Marshall 1922]:**
- Business structure dominated by small, locally owned firms
- Scale economies relatively low
- Substantial intra-district trade among buyers and suppliers
- Key investment decisions made locally
- Long-term contracts and commitments between local buyers and suppliers
- Low degrees of co-operation or linkage with firms external to the district
- Labour market internal to the district, highly flexible
- Workers committed to district, rather than to firms
- High rates of labour in-migration, lower levels of out-migration
- Evolution of unique local cultural identity, bonds
- Specialised sources of finance, tech.expertise, biz.services avail.in district (outsourc.)
  - geographical proximity, innovation and competition, entrepreneurship, social capital,
  - specialised workforce, tacit knowledge, ...

**Industrial district, Italian Variant [Markusen, Alberti 1996]:**
- Hi-degree of cooperation among competitor firms:
  to share risk, stabilise market, share innovation
- Strong trade associations / regional agencies which provide:
  shared infrastructure, mangmt training, marketing, tech./financ.help
- Strong local government role:
  in regulating and promoting core industries
Models of Clusters (2)

Growth Node [O’Callagan 2000]:
an evolution of the cluster concept
- emphasises the external networking dimension, knowledge transfer, social learning
- hi performing geo-cluster of organisations and institutions
- networked to other clusters
- potentially supported by ICT

Business Ecosystem [2002]:
“an economic community supported by a foundation of
interacting organisations and individuals”
“distinct identity + adaptation to environment”
- with dynamic relations
- depends on global networking

sw+hw ICT infrastructure is an essential element
which includes: services, knowledge, business
Evolution in ICT-adoption: Increased complexity in business networking

- Europe is used to cope with complexity and diversity.

SMEs are dynamic and flexible.
Lagging behind in ICT adoption
The vicious circle to be broken:

weak network infrastructure
unavailability of on-line services

Two parallel actions which reinforce each other developing a virtuous circle

1. group services, applications and digital content
   - has the goal to develop modern on-line services (of e-government, e-learning, e-health)
   - and of services for favouring a dynamic e-business environment

2. group is composed of catalysts aiming at creating:
   - affordable broadband
   - infrastructure for information security
Which ICT technology?

- "...the actual slowly changing network of organizations will be replaced by more fluid, amorphous and often transitory structures based in alliances, partnership and collaborations".

- "...building a community that share business, knowledge and infrastructure"

- "To support this scenario, which envisages the aggregation of services and organizations, is required a further stage in ITC technology adoptions 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."

From "Towards a Network of digital business ecosystems fostering the local development" (EC, Discussion paper, 2002)
Business Ecosystems
the local conditions shaping the economy

- Technical Infrastructure
- Governance & Industrial Policy
- Human Capital, Knowledge & Practices
- Business & Financial Conditions
Digital Ecosystems
the technical infrastructure supporting the Business Ecosystems

- Computing & Telecom. Infrastructure
- Community
- Science & Computing
- Business & Organisational Models
Digital Ecosystems: enabling environment for regional innovation and growth

European SME are loosing competitiveness with a serious impact on economic growth

- Small and Medium Enterprises have difficulties to cope with a complex dynamic global environment and to access to the resources needed in situation of rapid technological and organisational innovation. Their capability to quickly adapt to changes would not enough.

- The large enterprise has the critical mass and the specialised resources for coping with such increased complexity. The divide among Small and Medium Enterprise and the Big Company is becoming wider.

- The loss of competitiveness of the SMEs damages the areas whose economy is mainly based on the SMEs. The industrial districts should reach a further stage in networking SMEs making available common resources and services which isolated SMEs can't produce.

SME-based BUSINESS ECOSYSTEMS AT RISK OF DECLINE

- Only a change of paradigms fostering dynamic cooperation and resource sharing, co-evolution among organization and technology will overcome the problem of SMEs critical mass.

  - Mechanicistic way of organizing business based on static view of the market: *i.e. implement a predefined plan*

  - Top down approach to technology development unrelated to inter-organizational issues and local identities and needs

  - New complex evolutionary approaches based on models from mathematics, physics and biological science: *creating the condition for a spontaneous co-evolution*

  - New paradigms in which technology and organization are related variables enabling innovative way of collaborating and competing, self-adapting to local identity, needs and cultures

BUILDING DIGITAL ECOSYSTEMS
How to deal with the complexity?

No easy answer, no short-term solution
long-term process, but intermediate results

Paradigm shift:
- machine model => living organism model
- building a machine => nurturing players and conditions

Cooperative effort:
- among local actors (gov, biz, uni-res)
- among EU regions

Local actors:
- R.O.
- P.A.
- Univ.
- Gov.

Small organisations
Advantages of new paradigms

- How turn weakness in advantages
- Abandoning un-necessary constrains; discovering new opportunities

• Examples of this approach
  - Intelligent Manufacturing System programme
    (establish. Next generation manufact. Sys)
    91-00 => holonic systems concept
  - Cybesyn project
    (apply principles of cybernetics for effective democracy)
    S.Beer Chile 70-73 => autopoietic systems

• Visionary approach
  + intermediate tangible results
Lessons from the living world

- Is built on composition and complex hierarchies
- No central control, no plans defined in advance
- Fault tolerant:
  - No central point of failure, just viability concept
- Diversity and autonomy (recursive)
- Just adaptation to the local conditions
- Selection and evolution
- **But** you need an infrastructure supporting the life (composed of living organisms too - rec. concept), and a critical mass of individuals and biodiversity (bootstrap problem)
Dynamic composability for evolution

- A digital component is made by components which:
  - are distributed
  - should change for allowing evolution
  - all elements could switch and change (sw, modality of usage, protocols)
  - Reusability of existing initiatives (web services, GRID services, semantic web) protocols
  - \( \Rightarrow \) adaptation to local conditions
What is a Digital Ecosystem?

THE DIGITAL ECOSYSTEM

- is a pervasive “digital environment”
- which supports the business ecosystems
- which is populated by “digital components”
- which evolves and adapts to local conditions with the evolution of the components

THE SOFT SUPPORT INFRASTRUCTURE, WHICH OFFERS AND TRANSPORTS SERVICES & INFORMATION (knowledge) EMPOWERING THE NETWORKING
What is a Digital Component?

**DIGITAL COMPONENT**

- could be: software components, applications, services, knowledge, business processes and models, training modules, contractual frameworks, law ...

- .... and hopefully a mixture of that

**AN USEFUL IDEA, EXPRESSED BY THE LANGUAGE (formal or natural), LAUNCHED ON THE NET, WHICH CAN BE PROCESSED (by computers and/or humans)**
Advantages for SMEs of the digital ecosystem paradigm

- SMEs (dynamic, adaptable, flexible, rooted at local level)
- Advantages of approach
  - Reducing threshold for market entrance
  - Reducing the relevance of the marketing
  - Possibility to provide only a component
  - Provision of ethnocentric solutions
  - Afford together the complexity (1 component)
DBE Overall Goal

to provide an open-source distributed environment which
- supports the spontaneous evolution, adaptation and composition of services and software components
- also embeds business rules,

allows SMEs that are solution and e-business service providers to cooperate in the production of components and applications adapted to local business needs.

This will allow small software providers in Europe to leverage new distribution channels providing niche services in local ecosystems and extending their market reach through the DE framework.

=> local ICT services => ICT adoptions => local growth
Goals

The Objective of the Digital Ecosystem Approach is to foster local economic growth through new forms of dynamic business interactions and global co-operation among organisations and business communities enabled by digital ecosystem technologies.

It aims at addressing two strategic issues in parallel:

1) Empower the EU competitiveness in software ICT service industry in Europe

- Proposing a new paradigm of software production through new forms of cooperation, developing reusable components Europe-wide, accessing multi-revenue-models;
- Fostering public-private cooperation among national and international research communities with a specific regard to SMEs software producer involvement;
- Supporting the bottom-up decentralised definition of a framework, based on open standards, in order to sustain sw developers in creating and deploying ethnocentric e-business applications.

2) Sustain the SMEs in ICT adoption to increase their productivity

- Supporting the growth of new multidisciplinary profiles at European level, capable to integrate business, organisational, regulatory and technological competencies;
- Proposing a technological infrastructure, which enables the evolution of the concept of business-ecosystems;
- Supporting the creation of regional economic business ecosystems enabling SMEs access to global market, through software and networking services.
A representation of the digital ecosystem
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A representation of the digital ecosystem
Network of local “knowledge areas”
FPCI (innov. centers, ...)

IST FP6/7, ERA, (DBE, ...)

Bootstrap of the the digital ecosystems
Network of local "knowledge areas" (innov. centers)

DBE
A systemic approach to enterprises global collaboration

open-source, public, distributed pervasive environment
- spontaneous evolution, adaptation and composition of services, digital content and SW components
- embedding business rules, revenue models, ontology...
Example of use of Digital Ecosystem
Tourism Sector

Digital Business Ecosystem
Open-source infrastructure

Dynamic digital Services
(multiple revenue models)
Strategic goals of Digital ecosystems

The Digital Ecosystem policy has two main goals:

1 - To facilitate ICT adoption on the part of European SMEs

2 - To support European SME software producers

- Cultural, social & economic problem

Digital divides
(N/S; am.regions; LE/SMEs; ...)

- SW that adapts to SMEs rather than SMEs that adapt to SW

Markets, business networks, supply chains,
automatic service composition, ...
Innovation targets

1 – ICT adoption for SME users. If successful, the DBE will increase the efficiency of business transactions and processes:

DE as digital infrastructure that mediates a market

2 – SME SW Producers. If successful, the DBE will increase the market for software services and applications:

DE as digital infrastructure that mediates a “meta-market”
Crucial condition for economic growth is a broad deployment and use of ICT by enterprises and public institutions...

Shift eBiz & eGov policy
- from connectivity
- to taking up complex ICT applications

The Digital Ecosystem integrated approach

RESEARCH INNOVATION DEPLOYMENT

Growth

Competitiveness, market & internal efficiency

improve

lead to

improve

catalyse

“Digital Ecosystem Infrastructure”

Policy

Open Source Evolutionary infrastructure

encourage

New organizational & business models

support

improve

shape & foster

supports

Biology

en enhances

supports

Open Source Evolutionary infrastructure

make viable

Encourages

New organizational & business models

supports

Policy

Shift eBiz & eGov policy
- from connectivity
- to taking up complex ICT applications

The Lisbon objective for the Information Society cannot be reached through research alone. R&D will be useless if other complementary policy instruments are not developed and used effectively. [5yA]
To develop theory and representation that allow to explore and model the coevolution processes between technology, organization and business.

**FUNDAMENTAL SCIENCE**

Mathematics, Physics, Biological Science

To develop theory and representation that allow to explore and model the coevolution processes between technology, organization and business.

**COMPUTING**

Technological platform, languages and methodologies for software development

To develop a technological platform that enable evolution and composition of distributed service, and to define framework, mainly based on open standard, to sustain software developer in creating and deploying new services.

**BUSINESS**

Organisational theory, business models, policy and growth models

To identify new inter and intra organizational models, to study new business model, new policy and new growth and development mechanisms enabled by internetworked technologies.

Enable ICT adoption for SME users.

Improve SME SW producers capability.

DBE TP will increase the efficiency of business transactions and processes for SME, facilitating their ICT adoption.

DBE TP will increase the market for and the availability of software services and applications supporting SME software producers.
Research Aspects

Transposition of behaviours and architectures from natural to digital and to economic systems
Development of basic theories and technologies needed for structuring and the spontaneous deployment and evolution of digital ecosystems

Some non-exhaustive examples are:

In fundamental science
- Models and Complex system theory, how to transpose from living organisms mechanisms like adaptation, selection, evolution, autonomy, viability; how to develop concepts & operational models for self-organisations of digital components.
- Formal languages and models: how to express the genetic structure of the digital components; how to include environmental influence; how to make semi-formal knowledge computable, such as revenue or business model languages, business needs, contracts and legal constraints.

In network architectures
- P2P technologies enabling spontaneous evolution of a non-centric, fault-tolerant, secure and self-healing pervasive architecture; Interoperability and system orchestration
- Knowledge sharing and management: how to implement knowledge sharing sharing with introspection capabilities; distributed semantics.

In socio-economic and organisational models
- Business model and license interoperability: compose components with different license/revenue models.
- Management of dynamic Value plain
- Industrial Policy and growth models; Promotion of self-organising cross-cultural dynamic communities;
## History of digital ecosystem concept

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tr>
<td>End 2002</td>
<td>Large interest from Scientific Community</td>
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<tr>
<td>October 2002</td>
<td>Brainstorming on “Digital business ecosystems” concept</td>
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<tr>
<td>April 2003</td>
<td>Three independent FP6 IP proposals submitted</td>
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<td>November 2003</td>
<td>Start of selected proposal: DBE</td>
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<tr>
<td>June 2004</td>
<td>Two regions joined to the initiative on their own (in addition of initial 3)</td>
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Stakeholders: Who takes advantage from a Digital Ecosystem?

Players in the Business Ecosystem economy empowered by the Digital Ecosystems

<table>
<thead>
<tr>
<th>Stakeholder Category</th>
<th>Description</th>
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</table>
| SME : ICT-based services and software providers | can play a role in a global production value chain,  
can produce a component of a complex product/service  
get the instruments / infrastructure / knowledge / culture for cooperating  
provide equal opportunities of access to the global market |
| SME : IT users                               | DE ETP provides the missing IT-based affordable solutions tailored on local SMEs needs and competence, today crucial for accessing to global market and allowing business networking, the solutions - made by SME for SMEs - will continuously evolve |
| Universities / Research Organisations       | due to the need of continuous research and evolutionary innovation related to local socio-economic environment: multidisciplinary research is fostered; it avoids brain drainage; allows local human capital development; the evolutionary paradigm allows the short-term exploitation of results and the creation of local spin-off |
| Innovation Centers                          | ETP is the framework for structuring and making their intervention effective;  
the tangible short-term exploitable results provide private-public funding |
| Local / National Government                 | the DE ETP is an instrument for structuring the R&D and innovation intervention for growth -> governance + policy; it allows to fire and common actions in cooperation with other local/national governments; the provision of an ETP build consensus from all local actors |
| Operators of the networked knowledge-based economy | Telecom Operators (the massive IT usage increase the usage and need of communication infrastructure)  
Content producers (more content is needed)  
Hardware, software, appliance producers (more need of devices, computers, switchers, chips…) |
| Local and Global Communities                | the ecosystem structure allows communities to contribute in building and shaping the digital ecosystem at local or global level (e.g. Open source community, Trade associations and Workers representatives, …) |
How could Digital Ecosystem initiative grow?
Which instruments? Which Synergies?

**Means of intervention**

| Regional and National networks and Initiatives |
| Research Community; Open Source Communities |
| Open Source community |
| Pilot Projects |
| EU initiatives, ETP, Industry Lead Initiatives, FP(IC), Policy Actions, … |

**ACTIVE PILOT LOCAL ECOSYSTEMS**

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<tr>
<th>AREA</th>
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<td>Tampere</td>
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<td>West Midlands</td>
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<tr>
<td>Aragon</td>
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<tr>
<td>Piedmont</td>
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<tr>
<td>Extremadura</td>
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</tbody>
</table>

**ACTIVE INITIATIVES**

| EC-funded Integrated Project (DBE) |
| Research Sector in the EC (Technologies for digital ecosystems) |
| Nat’l initiatives |
DBE project: Digital Business Ecosystem

FP6 Integrated Project 507953
20 partners from 9 EU countries
Total initial EU funding 10.5 M€
Duration 3 years, started: 1 Nov. 2003

A digital ecosystem infrastructure adopting mechanisms from biological theories of self-organisation and evolution addressing networked software solutions & business models

Paradigms and open-source component-based infrastructure enabling the creation of networked local digital ecosystems for SMEs competitiveness and local development

http://www.digital-ecosystem.org

- Project Manager: Andrea Nicolai – T6 - a.nicolai@t-6.it
- Project Coordinator: Jonathan Sage – IBM - jonathan.sage@be.ibm.com
- Scientific Coordinator: Paolo Dini – LSE - P.Dini@lse.ac.uk
- Technical Coordinator: Miguel Vidal – Sun - miguel.vidal@sun.com
**Project timescale**

- **DBE 1st release**
- **DBE Sw available**
- **DBE operational**

**Phase 1 (1-18 Months):**
- Stakeholders & SME Briefing
- SME Recruitment for Research
- Tendering & Selection Process
- Training and Adoption support
- DBE Growth

- 15-30 SMEs
- 100-150 SMEs

**Nov 2003**

**Nov 2006**
Estimated Timeline for DBE Components

Nov 03
- KB
- Servent
- Demo DBE Services
- Accounting
- DBE Desktop
- DSS
- FADA

BML Editor
SDL Editor
Service Manifest
Portal
Authoring Tool
Recommender
Wizard
Manual Composer
Automatic Composer
TWFM
Intelligent System
Billing
Contracts
Certification Authority
Habitat
Population
Fitness Function
Testing Harness

Nov 04
Apr 05
Nov 05

DBE will populated by service coming from SME that will grow continuously from mid 2005
From Research to Exploitation => DBE Innovation

Open Source model
- Reduced barrier to entry and easy adoption
- Customizability (local languages, customs, laws, ...).
- Development of local software industry
- Technological and provider independence

5 Regions involved in the project
- Tampere, Aragon, Midlands (funded)
- Piemonte, Extremadura
- 10 % of the project budget is reserved to directly fund and support adoption and deployment in industry by SME in the regions.
- Local nodes will be established to support DBE operation for local providers
- More than 10% of the budget dedicated to local training initiatives
- 200 SME connected before the end of the project

Support and stimulation of Local government policies addressing ICT adoption and DE model support
DBE pilot regions (September 2004)

- Local Ecosystem co-funded by the project
- Local Ecosystem associated to the project
- Potential future take-up local ecosystems
Facets of DBE Project

Socio-economic context
- Regional policies
- Socio-economic dynamics
- Value systems
- Organisational forms
- Open Source/Open Standards

Business
- Business modelling
- Requirements gathering, User profiling
- Regional Catalysts
- Training & adoption
- Regulatory framework

Computing
- Knowledge base, Recommender
- BML, SDL, Fitness Landscape
- Dynamic service composition
- DBE UML profile
- P2P networks, Architecture
- Test automation, Accounting

Science
- Evolution
- Self-organisation
- Optimisation & Networks
- Complex systems dynamics
- Language & DNA

Because we are always looking for alternatives to the status quo
Because we truly want to achieve ICT adoption by SMEs
Because we want to deliver technology that works
Because we want to abstract a quantitative model of sustainability from Nature, the ultimate sustainable system
DE Internal and External Issues

- **Business Networks**
  - Dynamics of Software
  - Recommender algorithm

- **Intelligent Service Composition**
  - Memory Gene Learning
  - DNA model for software

- **Evolution**
  - Contract & Agreement
  - Regulatory Framework
  - Service Manifest meta-model
  - Automated Testing
  - Knowledge Base, TWFM

- **Technical and Financial Viability**
  - Technical and Financial Viability
  - SME Providers and Requirements

- **Integration, Implementation and Population**
  - Composer Recommender
  - Composer Recommender
  - Multiple scales & Critical phenomena Dynamics of SME networks

- **Training and Regional Catalysts**
  - Critical Mass

- **Economic Sustainability and Policy Impact**
  - Regional Policies for Europe-wide DBE Adoption

- **Legal**
  - Contract & Agreement
  - Regulatory Framework

- **Language**
  - BML Editor
  - Position paper on Open Source
Goal: build the digital ecosystem infrastructure supporting the transition from industrial district to business ecosystem

SMEs software users (non-IT product and service providers):

- to have available ethnocentric tailored software + knowledge infrastructure which make them more competitive
- to develop networked business among Europe which preserves local identity and culture
- to support sustainable local growth

Sw providers:
- to rebuild a competence in building software (based on SMEs and independent producers)
- to foster research and to rebuild scientific and technological leadership
- to develop new paradigms for producing software and sharing knowledge
- to develop new cooperative business models

- to build and provide software and solutions that evolve and exploit / foster all local assets of European regions