A NESSI Position Paper:

European Software Strategy

Foreword

Commissioner Viviane Reding rightly pointed out in her speech at the Truffle 100 meeting in November 2007: *"the ability to produce software is a strategic economic capability".*

NESSI wishes to contribute to this economic capability with its vision of a European Software Strategy. This paper was elaborated by the NESSI Steering Committee and approved by the NESSI Board.

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NESSI – the Networked European Software and Services Initiative – was launched as a European Technology Platform in September 2005. Coordinated by 22 partners, it unites a community of 300 organisations from industry and academia active in Information and Communication Technologies. It plans to deliver NEXOF, the NESSI Open Service Framework.

Executive Summary

Software is an essential part of an increasing number of products and solutions and is thus one of the main drivers of the European economy. However, Europe's position as a driver is not as strong as overall economic figures would suggest. The European economy is competing in a global market and a number of factors need to be addressed to improve its position.

Starting from Europe's strengths and weaknesses, opportunities and threats we analyze the future trends and the current picture of the emerging software and systems landscape. Within this landscape, the development of the future Internet and its networked and service oriented systems is one of the most important drivers. Sensors, embedded devices and embedded systems will all become easily accessible in the future Internet. This will enable enhanced applications in various fields such as industrial design and manufacturing, energy supply, retail, public sector. In this future, Open Source Software (OSS) and open standards will increasingly be the keys to global success.

In this context, NESSI wishes to give focussed input in support of the European Commission's efforts to reach the goals of the Lisbon Agenda and thus our analysis ends with a number of recommendations that are summarized below:

- ✓ **Increase the efficiency of the European Community's Research & Development by:**
  - endorsing competition between projects throughout the innovation process
  - including requirements from public procurement in publicly funded research projects
  - taking advantage of existing eco-systems and structures (Technology clusters, Open Source community, European Technology Platforms and other similar means).
- ✓ **Support SME growth by:**
  - leveraging potential contributions of large industrial players to their eco-systems
  - supporting collaborative R&D projects dedicated only to SMEs
  - favouring SME solutions in specific government markets.
- ✓ **Strengthen the exploitation of Open Source Software within Europe**
- ✓ **Reinforce the role of European industry in standardization for software**
- ✓ **Establish regional European excellence in the software industry by:**
  - joining the forces of European Technology Platforms, their stakeholders, industry, European Commission and Member States
  - linking regional competences across countries in Euro-Regions
  - linking European and regional technology roadmaps, development plans and pilots.
- ✓ **Strengthen education and academic excellence related to the development and engineering of software, services and applications**

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1 Why is Software so Important?

The critical importance of software for the operation, development and security of the economy at large was first described and demonstrated in the USA Presidential Information Technology Advisory Committee (PITAC) Report[1] issued in 1999. The vision presented in the PITAC report is summarized in the following statement:

«Software is the new physical infrastructure of the information age»

Since 1999, the role of software as the new physical infrastructure of the information society has increased dramatically and the vision of the PITAC report has been fully confirmed by the following elements.

From a societal point of view, software provides flexibility, intelligence and security to all complex systems and equipment that support and control the various key infrastructures of our societies: transportation, communication, energy, industry, business, government, healthcare, entertainment, etc.

From an economic point of view, software increases productivity and competitiveness in all business activities.

From a technology point of view, the traditional split into software and hardware and their respective businesses will disappear. Software will be increasingly delivered as a service, blurring the frontier between the computer, the network and the application.

In addition, software is no longer just an Information Technology (IT) issue. It is a key asset, opportunity and growth factor for all actors of the economy. In the same way as software is driving the rise of global production systems across many sectors, software itself is emerging as the first global production system.

Competition between economic and political regions of the world for a position in global software production is becoming a major factor of supra-national (e.g. European), national and regional policies.

In an analysis of global emerging IT hotspots by Wired magazine, the top ten locations include Helsinki (Finland), Cambridge (UK) and Sophia Antipolis (France) in the European research space. But this also means that 7 are outside of this area. The competition is global and areas such as Bangalore (India) and Singapore have, in recent years, achieved two-digit growth. Since transportation costs in software can be neglected, large parts of the

1 Presidential Information Technology Advisory Committee, Report to the President, USA, Feb. 1999

production system are rapidly spreading to new locations that offer either new capabilities or cheaper service production. In addition new forms of global collaboration are emerging – such as 24-hour "follow the sun" – that allow development collaboration between partners in different time zones. Here, new locations are putting forward their natural advantages, for example South Africa, being in the European time zone and having relatively cheap resources, has attracted many support call-centres.

One way to measure the share that a geographical region has in global software production is to look at the impact of ICT investments on the Gross Domestic Product (GDP). For example, the paper « Reaping the benefits of ICT: Europe's productivity challenge » [2] reports the following evidence:

- "In the US, software has attracted the largest share of ICT investment since the technology boom began in the early 1990s. By 2000, it accounted for about 14% of total non-residential capital investment in the US, and nearly 40% of overall ICT investment growth."
- "ICT investment in the EU as a whole has been more heavily weighted towards IT and communications infrastructure, where price declines have been steepest. Software nonetheless accounted for one-third or more of ICT investment in the UK, France and the Netherlands in 2000, and substantially more in the Nordic countries."

Regarding the impact of ICT on growth performance, it is now recognized that it accounts for much of Europe's lag behind the US in growth performance in recent years:

- "… analysis indicates that ICT accounted for as much as 0.4 percentage point of the 0.52-point difference between GDP per head growth rates in the US and the euro zone big three (Germany, France, Italy) in 1995-2002."
- "… forecasts also suggest that Europe is unlikely to close this gap unless significant progress is made in areas such as skills, innovation and competition."

[2] « Reaping the benefits of ICT: Europe's productivity challenge » The Economist Intelligence Unit, 2004

2 Europe's Competitive Position in the Global Software Industry

2.1 Successful Organisational Models

Europe needs to recognize the global character of the software industry and its production and how this affects competition. Three role models of organizations seem to be particularly successful in this environment – the first is the Globally Integrated Enterprise, the second is the specialized SME, the third is the Open Standards community. The three organizational forms are described below but should be seen as archetypal since many real-world organizations will possess the characteristics of combinations of these.

Globally Integrated Enterprises

Europe's drive to improve its competitive position in software can benefit from the evolution of multinational corporations to Globally Integrated Enterprises (GIEs)[3]. The emergence of the GIE is changing the competitive landscape of all industries and will have a profound impact on software. GIEs organise various elements of their business to be addressed wherever and by whomever each element is "best" performed. For example a Mexican retailing company may contract design services from a European provider, secure manufacturing in Asia, arrange for distribution through an Australian firm and have products serviced by local organizations in a dozen markets. Each of these providers is selected because it is "best" at doing that element of the business for which it is responsible.

Specialized Small and Medium Enterprises (SMEs)

The global nature of the software industry allows for interesting and highly profitable niches where small companies can emerge as successful actors. This can be linked to specific competences or specific technological assets and services. The example of the US shows that nurturing a large base of high-tech SMEs provides a fertile ground for the whole industry – of course with the potential for some of them to grow into GIEs. This demands ways to encourage venture capital investors to support the innovative start-ups which frequently define new software directions. Key to this process is the development of methods, tools and standards that define "best" for this industry. Leadership in these fields sets the stage for overall industry leadership. One dimension that has to be taken into account when addressing this category is that

[3] "The Globally Integrated Enterprise", Samuel J. Palmisano, FOREIGN AFFAIRS, Volume 85 No. 3, 2006

software SMEs should not be regarded as a homogeneous category defined by their size but need to be treated differently according to their strategic contribution.

Open Standards Communities

The software landscape is increasingly interconnected. In core areas of software and service interoperability, the openness of standards determines whether technology development can be locked-in by a single Intellectual Property holder, such as a vendor, or can be pursued openly. Therefore, policies to promote an innovative, healthy and competitive European software sector should place open standards at their core. Only open standards permit all potential vendors to enter a market, develop innovative competitive interoperable products and offer choice to consumers in Europe.

Open communities and alliances provide an innovative alternative to develop critical ICT standards. Europe and the European Commission should be proactive in promoting ICT policies that encourage and in some cases mandate the use of open standards and foster the establishment of open communities to develop and maintain them.

Following on from this analysis, the physical location of the providers of software design, development, testing and service is becoming increasingly unimportant. In addition, the evolution to Services Oriented Architectures (SOA) will make it easier for software development to be further decomposed, increasing the evolution towards a global distribution of work across different players and locations. This in turn will lead to faster development of new services.

In striving to make the European software industry more competitive and to achieve a higher market share it is important that Europe creates centres of software excellence. Europe has to attain the reputation level needed to propose specific centres of excellence in the global software industry. Consider the approach India has taken with IT services. India attracts foreign investment via outsourcing and in parallel nurtures extremely competitive IT services companies of its own.

The Helsinki area that was mentioned above as an IT hotspot is a European example of a centre of excellence. It bundles excellence in mobile communication (by being close to a GIE - NOKIA), is well connected to open source developments (e.g. Linux), contains a vibrant cluster of specific high tech SMEs and academic institutions such as the Helsinki Technical University. There are several other similar centres of excellence in Europe, such as the centre for enterprise computing nurtured by IBM and SAP in the German Baden-Württemberg region.

Europe thus has the necessary institutions and infrastructure to create further centres that provide their services to the global software industry. But it does

not exploit these rapidly enough to meet the global movement affecting the software industry today.

Europe should aim to become the "place to go" for many areas of software design, development, testing and service. It thus needs to focus its commercial enterprises, government entities and educational institutions on creating world-class centres of excellence for all aspects of the software value net.

2.2 Europe's ICT investment and Expenditure Gap

Recent studies[4] show that the ICT gap between Europe and the US has not decreased. On the contrary:

- The European ICT R&D *expenditure* per inhabitant is only about one third of the amount spent by the US or Japan.
- The total and per capita ICT R&D *investments* are significantly larger in US and in Japan than in Europe.

At the level of public funding, the analysis also shows a structural difference between European and the US. In Europe, civil budgets for public funding of are higher than in the US; in the US, public funding is very much driven by military budgets.

Open Source Software (OSS) is often regarded as an alternative way for the emergence of a strong software base in Europe. However, the situation of OSS in Europe is also unbalanced. Whereas more than 70% of the Open Source contributors are European citizens, 90% of the business derived from OSS is conducted by non-European OSS companies and most OSS consortia (i.e. not-for-profit organizations managing OSS development and marketing) are US based, funded by US IT companies and managed by US professionals.

Europe should aim at closing the investment and expenditure gap. In parallel, it should optimise the existing investments through effective coordination between regional, national and European policies.

[4] «Recherche et développement en sciences et technologies de l'information dans les grands pays industriels» Rapport CSTI, France, 2003, 2005

3 Strengths and Weaknesses of Europe's position

The 2007 Truffle 100[5] ranking of the top 100 European software vendors provides a good view of European software industry. It shows that Europe has still an unbalanced and fragile software industry base characterized by:

- Few large software vendors
- Myriad of small software vendors
- Continuous flow of significant acquisitions of European companies by US vendors

In this context, the following section analyses the strengths and weaknesses of the software industry in Europe.

3.1 Strengths

There are several strengths that provide the foundations to improve Europe's position in the Software domain:

- A good **educational** and **theoretical research** basis
- Strong **secondary IT and software industrial sectors**, e.g. mobile communications, automotive, defence, energy, aerospace and process industries. This is evidenced by the strong position of Europe in embedded software, complex engineering, systems design and integration and the strong capacities of these industries in the deployment of software intensive systems and products
- An important number of small **software vendors** with growth potential
- A well developed base of global software houses and service companies
- A large community of **open source software developers**
- Emerging **regional technology clusters** (Pôles de Compétivité in France, Kompetenznetzwerke in Germany, Poles of Innovative Technology in Netherlands) that establish strong concentrations of high-tech companies and research institutes.

[5] 2007 Palmares Truffle 100, Truffle Capital, November 2007

- Increasing and significant **public funding of information and communication technology research and development (ICT R&D)** via the European Commission as well as by Member States.

3.2 Weaknesses

On the other hand there are significant weaknesses that have to be addressed:

- Europe does not take **technology leadership** in the software, services and Internet area. In these industries often a "follower" attitude is predominant.
- Europe suffers from a lack of **large software players,** both as vendors and as structured OSS organisations.
- The large number of **small size SMEs** , while positive in terms of their existence, often compete on the same markets thereby creating a potential risk.
- European companies' involvement in industry fora on **software standards and interoperability issues** is insufficient. In almost all relevant global standardisation consortia Europe's influence and contribution is limited (e.g. W3C, OASIS, WS-I, OMG, OpenGroup, OpenSOA, IETF).
- Europe's **academic organisations and efforts are fragmented**; as a consequence, a limited number of European universities have the critical size to compete with top world universities. According to the 2007 Academic Ranking of World Universities[6], the Top 50 include 2 Asia Pacific universities, 9 European universities and 38 North and Latin American institutions. Academic excellence in Europe is therefore fragmented – although the European Institute of Technology and Innovation (EIT) aims to address this.
- **Governmental procurement** and EC R&D public funding policies are disconnected. Funded research will be more effective it there is a concrete drive, demand and implementation of results by governmental institutions.
- The current model of **EC funded collaborative R&D projects** has not significantly evolved since the first Framework Programmes in the late 1980s with the consequence of a diminishing efficiency.

[6] Academic Ranking of World Universities, 2007, Institute of Higher Education, Shanghai Jiao Tong University,

4 Opportunities and Threats for Europe

4.1 Opportunities

- The fast **growing markets for Internet and mobile services** call for Service Oriented Architectures (SOA) and stimulate innovative creation of seamless delivery of these services.
- New **low-cost PC-type products** are emerging with major opportunities for OSS initiatives (Operating System, office suites, etc.)
- Markets for **embedded software**, in particular in strong European industrial sectors (Aerospace, Automotive, Railways, Telecommunications, Health-Care …) are growing rapidly.
- **e-government and e-services applications** are being deployed at increasingly large scales.
- **Regional eco-systems and technology clusters**[7] emerge that will increase the productivity with which companies can compete.
- **Software standards** are no longer driven by public bodies but by industry consortia which provide opportunities for European companies to promote their technologies and turn them into standards.

4.2 Threats

- **Global players** dominate the market in operating systems, interoperability, development platforms and tools, as well as in related standardisation bodies; this can easily create dependency and "followers" behaviour.
- **New developing countries**, especially China and India, are emerging strongly in the area of software technologies.
- There is **a risk of missing the starting signal** for the new trends and developments and thus falling into the second tier for a long period or – even worse – being marginalized
- The **brain drain** could weaken Europe's position if the unbalanced situation of Europe in the software area is not corrected.

[7] "Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, and associated institutions in a particular field that are present in a nation or region. Clusters arise because they increase the productivity with which companies can compete." Michael E. Porter, Harvard Business School, Institute for Strategy and Competitiveness.

5 The New Software and Systems Landscape

5.1 Main Market Trends

With over a billion users world-wide, the current Internet is a great success in terms of connecting people and communities – a global integrated communications network and service platform underpinning the fabric of the European economy and European society in general. However, tomorrow's applications will attract more users to services needing greater mobility, higher speeds and enhanced interactivity. In parallel, the increasing interaction capabilities of electronic devices will enable new services within changing scenarios, adapted to different business needs and new situations thereby creating a totally new global system.

This new global system is not any longer purely computer-based and not any longer existing with the purpose of exchanging information; indeed in this system the ICT is there to dynamically and proactively serve in a natural, and "normal", way the everyday life of citizens and businesses of organisations. The main peculiarities of this system are: openness, scalability, dynamicity and pro-activeness, no central control and uncoordinated governance, and not fully predictable.

This analysis highlights the importance of the evolution towards a Future Internet that provides a safe and secure communication model, fostering trust and unleashing the full potential of the choices ahead. Without this evolution, future applications that would benefit Europe's economy and enhance the lives of its citizens and the competitivity of its industries will be limited by today's technology. Future Internet embodies the convergence between users, media, services, devices and networks.

- Future Internet: Network Oriented Systems

Infrastructure virtualization and "Cloud Computing" are the **main market trends** for future network oriented systems. Service oriented middleware and its interface to domain-specific applications will drive integration of industrial and public applications. Wireless sensor networks and peer-to-peer technologies will allow ad-hoc networking and pervasive computing in every part of daily life.

The **Key Research & Technologies challenges** for Network Centric Systems are resources management, security and dependability and performance. The increasing demand for "Green IT" will drive the development of low power communication and infrastructures. Network and service test beds will also allow the validation of systems with minimal impact on running environments.

- Future Internet: Service Oriented Systems

  The **main market trend** is that software will be increasingly offered as a service and this will create new business models. Horizontal and vertical integration of business and industrial applications (e.g. CRM, SCM, ERP, MES, PLM and Control systems) will be the drivers of the first stage. Then the integration across domain boundaries will bring in a new level of complexity which will have to be addressed – so-called Ultra Large Scale Systems. These will trigger the need for cross-domain integration and the development of systems of systems (e.g. for disaster management).

  The **Key Research & Technologies challenges** are service oriented architectures, interoperability and standards, service discovery, composition and service level agreements. Security, privacy and integrity also have to be ensured.

  Major players that are active in Europe in this area are engaged in the European Technology Platforms NESSI (with a focus on business, industrial and public services), NEM (with a focus on media services), eMobility (with a focus on mobile services) and ISI (with a focus on satellite based services). All four ETPs are currently pursuing collaboration around the Future Internet. In addition the European Commission has launched an initiative on the Future Internet that brings together these platforms and EC funded research projects.

- Future Internet: Internet of Things

  The Internet of Things combines the powerful notions of universal networking connectivity with embedded systems, sensors, markers and actuators in the physical world i.e. it makes ICT pervasive in the real world. Sensors and embedded systems acquire and include information about objects of the real world and their respective surroundings. When combined with ubiquitous wireless communication infrastructures, devices mounted in different environments, embedded in systems, worn by users or even swallowed or injected under the skin, can provide this information to all kinds of applications local, remote or distributed. The Internet of Things adds an enormous range of novel industrial opportunities to the ICT market and offers new foundations for strategic alliances between the ICT and non-ICT industry in Europe.

  The **Key Research & Technologies challenges** are edge technologies, individual identification and tagging through technologies such as RFID, cross-layer integration from applications to devices, scalability, security, reliability and integration with the Internet of Services.

- Future Internet: Internet of Services

  The Internet of Services introduces a consistently service oriented paradigm to service and application creation and delivery. All objects in the

Future Internet will actively be advertising their services using open and standardized interfaces and semantic service descriptions. Combination and orchestration of these services allow for the establishment of more advanced services which themselves can be the basis for applications. In this respect, each and every service can be considered as a marketable product which can be used to build new products. The Future Internet is the prerequisite to make services as tradable as products and the Internet will be the worldwide market place for services.

The **Key Research & Technologies challenges** are service engineering, legal aspects of services including eContracting and ePolicies, service consumption including end-user experience. Other issues to be addressed include end-user programming, business webs, security topics (trust, reputation, and identity management).

- Future Internet: New Industrial Services

The Future Internet in general and the Internet of Services and Things in particular are creating new business and technological trends. In the coming years, these will in turn lead to drastic transformations of many industry sectors.

eEnergy

Due to the tendency towards a much more decentralized energy production, the energy distribution will change from hierarchical to a meshed and interrelated approach with a much higher number of active participants. Using enabling ICT technologies, new forms for more intelligently managing energy production, distribution and consumption end-to-end can be established. The Internet of Services enables the emergence of different business models that can be easily tested. In parallel, such an environment enables fast reactions to changing supply and demand side eco-systems, incorporating a wide spectrum of market and / or regulatory options.

Retail

The retail sector will continue to drive efficiencies and be the major source of goods movement and consumption world-wide. Intelligently managing the entire retail chain can help address both the valid concerns of consumers regarding transparency, health and safety of the entire chain as well as the environmental impact, cutting unnecessary production or waste and loss during distribution. Issues such as brand and fraud protection, continued and secure identification of goods through RFID will play an increasing role for producers and consumers as well as for the competitiveness of Europe.

eHealth

Assisted living, patient monitoring and medical asset tracking scenarios are built around Internet of Things technology enabling the management of thousands of sensors and RFIDs combined with the Internet of Services. They build on an appropriately scalable, reliable, and safe communication infrastructures with full mobility support, embedded localization capabilities and a service paradigm allowing for dynamic service auto-configuration and orchestration.

Manufacturing

Manufacturing and assembly will be further automated and robots will continue to dominate industrial plants. Along with their rising intelligence, robots emerge as autonomous entities and ICT is becoming central to them. Digitally supported interaction is required not only to operate and control robots by a human supervisor but also in order to communicate between the robots themselves. Hence, predominantly machine-to-machine communications have to be supported.

Moreover, in order to withstand competitive pressure in a globalized market manufacturers need to adapt quickly to changes in their environment and to reduce the time lapse from innovation to product. While ICT is often perceived as a tool for cost reduction, the key role of ICT is as a source of competitive advantage. ICT in manufacturing has the potential to provide the right means for better traceability and real-time decision making. It can also improve collaboration throughout the manufacturing process, leading to new opportunities for flexible business processes and faster introduction of disruptive business models and products.

- Embedded Systems

Embedded systems underpin the competitiveness of important industry sectors: from aerospace and automotive to consumer electronics, manufacturing, energy management and telecommunications. In terms of **main market trends,** the share of the value of embedded electronics components in the value of the final product is expected to reach significant percentages. In the automotive sector for instance the value of the electronics embedded in each car is expected to increase to an average of 35-40% by 2015. Multi-functional devices will be more and more often part of daily life and business.

The **Key Research & Technologies challenges** for embedded systems are the extreme complexity of new systems, the strong safety requirements in several industrial sectors (aeronautics, automotive railways, healthcare ...) and their seamless connectivity. Cost and productivity will be drivers for success. Hardware and software upgradability has to be ensured and the necessary methods and tools have to be provided.

Major players active in Europe in this field are represented in the ARTEMIS Joint Technology Initiative. A large number of SMEs acting as suppliers for automotive, military, and capital goods industry form the backbone of Europe's industry.

- Industrial Design & Engineering Systems

The **main market trend** is the dramatically important role of software tools in the design, development and production of innovative products: from new molecules for the pharmaceutical industry to new composite materials for the aircraft industry. Domain-specific evolutions will be the drivers for industry automation and total integration (e.g. vertical, horizontal, and lifecycle integration). The evolution towards new human-centric embedded and pervasive applications e.g. for medical solutions, automotive systems etc is a major driver for innovation. This innovation requires a strong level of cross discipline integration of complementary domains ranging from mechanical, electrical and civil engineering to software and hardware design, as well as the elaboration of virtual working environments which support both simulation and optimization.

Key Research & Technologies challenges are software and service engineering and processes, the integration methodologies and technologies. New engineering methodologies will be required to ensure

- Software and service development / simulation / deployment / runtime / evolution
- Product lifecycle / production lifecycle / service lifecycle support
- Business process modelling and execution.

These trends affect major industries such as aeronautics, automotive or healthcare which constitute European strengths. Even though these companies are not necessarily recognized as software companies there is a rising interlink also between these companies and the "pure" software and ICT companies.

5.2 New Eco-systems for Software

A major change in the software landscape is the emergence of new eco-system models for software. These eco-systems increase the productivity and as such constitute important enablers and drivers for the strengthening of Europe's position in software in the global market.

The main types of eco-systems are:

Software as a service Model (SAAS)

- Delivery of functionality over the network and payment per use as opposed to by copy or license

Supply Chain integration model

- Collaborative platforms for members of the supply chain of an industry sector
- Members: OEM, Tier 1 … Tier n

Cluster model

- Technology Clusters or « Pôles de Compétitivité »
- Members: large companies, high-tech SMEs, Laboratories

Open Source Software (OSS) model

- Non-for-profit organisation (OSS Consortium) developing (or managing the development of) OSS and marketing and distributing the resulting technologies.
- Members: founding companies, partners, OSS developers
- OSS communities as new eco-systems for software development, dissemination and exploitation.

6 Recommendations

Following the analysis of the European position, the future trends and the SWOT analysis NESSI has come to a number of recommendations that are organized along six directions: R&D Efficiency, SMEs, Open Source Software, Open Standards, Centres of Excellence and Education.

The recommendations address EC policy as well as the different organisations from industry and academia.

6.1 Increase the Efficiency of EC R&D

- *Recommendation: introduce a new model for EC collaborative R&D projects.*
  This new model should include:
  - ✓ Allowing R&D projects to become specific to the stages in which a technology is maturing - in other words, finding a new balance between calls for innovative prototype solutions (in later stages, maturing areas) and calls for research ideas (in early stages, emerging areas)
  - ✓ Maintaining competition during the project phase by selecting several (2 or 3) competing proposals
  - ✓ Assessment (against success measurements) of competing projects and selection of the best approach for follow-on in the next stage
  - ✓ Supporting experiments at all the different stages of a project life cycle (i.e. development, test and utilisation phases.). Experiments between different R&D teams should also be encouraged and supported.
  - ✓ Fostering open standards development out of collaborative R&D projects and providing public means of IP protection for these outcomes
  - ✓ Creating a multi disciplinary network that pushes a new business culture, works proactively in terms of investments, provides fiscal assistance and supports long term initiatives
- *Recommendation: organize the dialogue* with all international stakeholders in the areas of the new service eco-system and of the Future Internet and cooperate with world-wide Future Internet research activities.
- *Recommendation: include future requirements from public procurement* (EC and Member States) in the work programme definition process and to involve organizations in charge of public procurement in the research project selection and review process.

- *Recommendation*: take advantage of and *reinforce existing and structured eco-systems* (technology clusters, Open Source consortium, Supply Chain organisations) by:
  - ✓ Recognizing such clusters by an EC label
  - ✓ Involving them in the work programme definition process
  - ✓ Recognising validation from such clusters positively in the project proposal evaluation process
  - ✓ Organizing the collaboration of regional technology clusters by ICT research projects
- *Recommendation*: exploit and *enhance the capabilities* of European Technology Platforms (ETPs) by:
  - ✓ Supporting the establishment of strategic programmes that go beyond strategic agendas to develop real open frameworks and establish new open standards in the ETP work areas
  - ✓ Supporting the creation of Federating Projects run by ETPs (with associated rules and funding) with the objectives of coordinating conventional EC collaborative R&D projects (FET, STREPS, IP) to support the creation of open frameworks and a better transfer from research into innovative prototypes and applications. These Federating Projects need to go beyond coordinating actions.
  - ✓ Setting up specific actions and support in order to develop the "Umbrella Vision" of the ETPs Strategic Research Agendas (SRA) at national, transnational and European levels.

6.2 Support SME Growth

- *Recommendation*: *increase the contribution of policy and big industry players* to the growth of high-tech SMEs by a better harmonization and coordination of their SME partnership policies[8]:
  - ✓ From an R&D viewpoint and from a purchasing / acquisition viewpoint,
  - ✓ From an R&D viewpoint and from a business point of view, especially in terms of international development and access to local customers,
  - ✓ SME policies of big industry players should be documented in projects proposed for public funding and form part of the evaluation criteria.
- *Recommendation*: develop and support *aggregation of SMEs* (through interoperable technologies and products, cross-distribution channels, joint

[8] Similar actions have been successfully implemented by the French Pacte PME (SME Pact) as reported in the Rapport 2007 du Pacte PME (see www.smepact.eu)

ventures, etc.) by dedicated EC funding for full SME only collaborative R&D projects.

- *Recommendation*: create a "Small Business Act" favouring SME solutions in some government markets.
- *Recommendation:* create a network that pushes investors and SMEs to build new multi disciplinary initiatives, that works proactively in terms of investments and provides financial help.

6.3 Strengthen Exploitation of Open Source Software

- *Recommendation:* ETPs and their stakeholders (industry, academia, EC and Member States) should work together towards the establishment of Open Source Software consortia (as not-for-profit organizations) by:
  - ✓ Identifying market opportunities where there is a demand from industry and an active European community of OSS developers
  - ✓ Proposing technology roadmaps and development plans.
  - ✓ Pushing further usage of OSS to establish open standards especially in education and for SMEs
  - ✓ Further supporting the build-up of competence centres
  - ✓ Creating and supporting OSS networks for SMEs

6.4 Reinforce Industry's Role in Software Standardization

- *Recommendation*: industry should *increase its participation to standardization initiatives*. This role could be supported by a policy initiated by the European Commission. Active participation by the industry could be achieved by
  - ✓ Supporting the establishment of open alliances and communities to develop and maintain standards
  - ✓ Mandating the use of open standards in public and private procurement as well as through IT governance rules
  - ✓ Participating and taking board level positions in industry consortia such as W3C, OMG, WS-I, etc.
  - ✓ Promoting within these industry consortia the results of EC funded R&D projects

6.5 Establish Regional Excellence in the Software Industry

- *Recommendation*: ETPs and their stakeholders (industry, academia, EC and Member States) should support the *emergence of regional European excellence in the software industry* by:
  - ✓ Linking regional software competences across countries in Euro-Regions
  - ✓ Linking technology roadmaps and development plans on European level – e.g. ETP roadmaps – to regional development and pilots
  - ✓ Providing Europe with interlinked regional test-beds for new software infrastructures and ICT networks.
  - ✓ Creating European centres of software excellence.

6.6 Strengthen Education and Academic Excellence related to Software, Services and Applications

- *Recommendation*: support education and academic excellence that relate to key academic areas of software development, services and application
- *Recommendation*: support new integrated academic areas – such as a new "Science of Services" - that link computer science with business, social, economic and legal sciences – in order to promote an in depth-understanding of software and its interaction with society
- *Recommendation*: use the European Institute of Technology and Innovation as a driver for European academic excellence in software
- *Recommendation*: In order to promote global quality within the European universities and thus support software excellence, set up policies to encourage;
  - ✓ Access by citizens of Member States to all European universities as full time undergraduate and postgraduate students
  - ✓ Access by citizens of all Member States seeking mid-life educational opportunities
  - ✓ Continued support of student mobility throughout Europe
  - ✓ Global collaboration with leading institutions outside Europe
- In order to prepare citizens for use of the Future Internet, including acting as software creators and users, it is recommended that policies be adopted to encourage;
  - ✓ Greater use of OSS software
  - ✓ An ICT education orientated towards the Internet, distributed computing and the needs of tomorrow

7 Acronyms

CRM	Customer Relationship Management
EC	European Commission
ERP	Enterprise Resource Planning
ETP	European Technology Platform
GDP	Gross Domestic Product
GIE	Globally Integrated Enterprise
ICT	Information & Communication Technologies
IETF	Internet Engineering Task Force
IP	Intellectual Property
IPR	Intellectual Property Rights
ISI	Integral Satcom Initiative (ETP)
IT	Information Technology
MES	Manufacturing Execution Systems
NEM	Networked and Electronic Media (ETP)
NESSI	Networked European Software and Services Initiative (ETP)
OASIS	Organization for the Advancement of Structured Information Standards
OMG	Object Management Group
OSS	Open Source Software
PITAC	Presidential Information Technology Advisory Committee (USA)
PLM	Product Lifecycle Management
RFID	Radio Frequency Identification
SaaS	Software as a Service
SCM	Supply Chain Management
SME	Small and Medium Enterprise
SOA	Service-Oriented Architecture
SRA	Strategic Research Agenda
W3C	World-Wide Web Consortium
WS-I	Web Services Interoperability Organization

8 Contributors

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