

SOFTWARE 2.0: REBOOTING EUROPE'S SOFTWARE INDUSTRY

**REPORT OF AN INDUSTRY EXPERT GROUP
ON A EUROPEAN SOFTWARE STRATEGY**

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EXECUTIVE SUMMARY

Under an initiative of Commissioner Viviane Reding, the European Commission invited representatives of Europe's Software Industry to put forward concrete ideas for a European Software Strategy. This report represents the Industry's response to that call.

A group of leading industry experts – software vendors, SMEs, business associations and analysts – have collaborated in reviewing the status of the industry, identifying the main issues facing it, and formulating recommendations for addressing them. The issues are complex and go to the heart of competition for current players. While we have been unable to agree on all aspects, we have reached consensus on key areas. The result, we believe, presents a compelling vision for the European Software Industry.

Significance of Software

Software is everywhere today, yet its instrumental role in the modern digital economy is often overlooked. With market revenues of over €200 billion in Europe and growth rates of between 6% and 8%, software is the largest and the fastest-growing segment of the information and communication technologies (ICT) market. Furthermore, software is embedded within the majority of products we use today and a key enabler for innovation, growth, and employment in almost all sectors of the economy. Software has become the nerve centre of all modern societies.

Although there have been signs of consolidation over recent years, the industry remains highly fragmented. Despite excellent skills and research, European companies rarely become global leaders. Their small size makes it difficult for European software SMEs to grow fast enough in an increasingly globalised market; to operate internationally; or to create business relationships in other Member States. As a result Europe is punching below its weight in software.

At the same time, the software market worldwide is undergoing massive change. Customers' expectations of software are changing. A proliferation of software-based devices and infrastructures is emerging, creating new opportunities for software. Technological developments – such as service-oriented architectures (SOA) and software-as-a-service (SaaS) – are revolutionising the way software is produced, applied and consumed. And for the longer term, new concepts are emerging around the Future Internet where software will be an essential pillar.

As a result, **Europe still has all to play for in the software market.** The innovation necessary to create economic growth, drive societal change and address environmental challenges relies on ICT, at the heart of which is software. A new market paradigm is emerging – **Software 2.0** – where the competitive environment and market dynamics are totally different. The Software 2.0 paradigm challenges all current market players and offers huge opportunities for Europe's software industry. This is a new world, with new rules and Europe must compete. **Software should be a key part of an information society strategy for Europe post-i2010.**

The Software 2.0 World

In the Software 2.0 world, software will be developed, delivered and consumed in discrete chunks (known as *services*) designed to meet users' specific and highly personalised needs. Liberated from the PC and mainstream IT systems, software-based services will be accessible across a multitude of devices and appliances in a whole variety of settings. The Software 2.0 marketplace will comprise a rich blend of service offerings according to a spectrum of licensing terms and pricing models – some free, some subscription, some pay-per-use, some advertising-led. Furthermore, users will be a key part of the market ecosystem, acting both as consumers and co-producers.

The Future Internet and the Software 2.0 market paradigm are intimately bound together. Software will drive the next generation of the internet as it grows to occupy an ever-more central position in our society and economy.

We see three key challenges for Europe in seizing the opportunities presented by Software 2.0:

Challenge 1: Promoting Human Talent in Software

Firstly, we must **promote human talent** so as to nurture not just the best technical skills but also the creativity, innovation and entrepreneurship necessary to create and grow successful Software 2.0 businesses. Among actions in this area, we recommend:

- Creation of a European Software Expertise Network (ESEN) to improve skills capacities within the software industry.
- Maintain a careful multi-stakeholder balance in ICT training, driven by associative partnerships (industry, governments and third parties) alongside public support for industry-based ICT skills standards and certifications.
- Promote the creation of a European framework for the accreditation of ICT educational programmes at university level within the Bologna Process in association with industry.
- Strengthen the development of new 'University 2.0' models to adapt to the social computing phenomena and the networked information economy, and to establish ICT business-university associative partnerships.
- Incentivise access to university-level education through EU-funded scholarships
- Ensure 'access to access' throughout the entire 'Training-Employment Value Chain',
- Foster e-Inclusion, general e-skills and lifelong ICT learning among the labour force through multi-stakeholder partnerships

Challenge 2: Creating Innovative Capacity

Secondly, we must **build the innovative capacity** necessary for fast-paced software and service innovation – a key feature of Software 2.0 - to prosper and thrive. Our main recommendations here are:

- Launch a new programme, EUROSOF, to support innovation in software-based SMEs.
- Create a European Software Fund to invest in high-growth European software companies, using the existing instrument run by the European Investment Fund.
- Benchmark and promote national public-private funding schemes specific or adapted to the software sector, so as to boost public-private funding in strategic innovation.
- Encourage collaboration between OSS communities to overcome fragmentation and link them into global frameworks.

Challenge 3: Shaping the Future Internet

Thirdly, Europe's software industry must **embrace the Future Internet**, putting it at the heart of development and business strategies for Software 2.0 businesses. Our main recommendations here are:

- The Commission should ensure a consistent regulatory environment for the Future Internet across Europe.
- Support for international activities to develop an Internet control architecture that allows for a fair and equal experience for all users of the Future Internet.
- Further studies of the European opportunities and requirements on cloud services in the Future Internet infrastructure to identify any potential barriers.
- Commitment from stakeholders to reinforce the openness of the Future Internet. For vendors, this means ensuring the interoperability of software products based on open, non-proprietary standards. For public authorities it means reinforcing openness of the internet by funding and procuring open standards based products and solutions.

Rebooting Europe's Software Industry

We strongly believe that the sector should continue to be market-driven and that regulatory intervention should be kept to the minimum and limited to addressing market failures. Any policy measures should be neutral with respect to technology, vendor and the underlying software and business models. Given the dynamic development of new technologies and business models, policies that are designed to foster specific technologies or software and business models could hinder innovation and distort competition. Rather policy-makers should ensure a level-playing field and a favourable environment for all market players.

With determination and a common vision, we in Europe can seize the opportunities and establish top positions in the market for software and services that is now emerging. We must enable a European "web-services" based industry - a Software 2.0 - which will provide major new markets and new business models for software. **The time has come to reboot Europe's software industry.**

1 Introduction

Software is everywhere today. It is in the personal computers we use to write emails or make calculations; it is in the mobile phones we use to call friends and business partners; it is in the games consoles that our children play at home. Software is in the cars we drive, in the e-health applications used by our doctors, and in the sophisticated systems professionals use to track criminals, manage our transport networks, and keep the lights on. But because software is ubiquitous its significance to Europe is not always easy to identify or appreciate.

Yet the instrumental role of software in the digital economy should not be overlooked. With market revenues of over €200 billion in Europe and growth rates of between 6% and 8%, software is the largest and the fastest-growing segment of the information and communication technologies (ICT) market. Furthermore, software is embedded within the majority of products we use today and a key enabler for innovation, growth, and employment in almost all sectors of the economy. Software has become the nerve centre of all modern societies.

In her speech at the Truffle 100 event on 19 November 2007 Commissioner Viviane Reding both recognised the importance of the software industry and indicated her willingness to discuss how to leverage its contribution to the Lisbon strategy. The thrust of her analysis was that Europe is punching below its weight in software. Despite excellent skills and research, European companies rarely become global leaders. Europe is a major producer of in-house and embedded software but remains a large net importer of packaged software. Things are changing, however, with the shift towards new paradigms, such as Software as a Service (SaaS) and the Future Internet, where Europe could still take the lead. She invited the industry to come forward with concrete ideas to help put together a European Software Strategy to realise this potential.

This document summarises the European Software Industry's response to that call. It presents the collective views of leading industry experts – software vendors, SMEs, business associations and analysts - who have engaged in a process of open discussion and exchange. At the invitation of the European Commission¹, this group has collaborated in reviewing the status of the industry, identifying the main issues facing it and formulating recommendations for addressing them. The group as a whole met on two occasions during the period January – April 2009, while individuals also participated in a series of 'working groups' physically and online. Group members are listed in Annex 1.

Our main conclusion is that **Europe still has all to play for in the software market.** The innovation necessary to create economic growth, drive societal change and address environmental challenges relies on ICT, at the heart of which is software. The sector is undergoing massive change, with developments such as SaaS and Service-Oriented Architectures (SOA) revolutionising the way software is produced, applied and consumed. At the same time, new paradigms are emerging around the Future Internet where software will be an essential pillar. This is a new world, with new rules and Europe must compete. **Software should be a key part of an information society strategy for Europe post-i2010.**

¹ Specifically, these discussions have been led by DG Information Society & Media, Unit D.3 Software and Services Infrastructures and Architectures and have also involved other Commission services.

Why do we need a European Software Strategy?

Europe has made much progress in ICT over the last decade and software has benefited from this. In the internet and telecommunications fields, deregulation and vigorous policy-making have boosted the ICT sector, including software. The ICT Task Force was one of several initiatives taken under the European Union's industrial policy, which aims to help create a more favourable environment for business in the EU and was designed to complement the Commission's main ICT-related initiative, i2010. The European software industry participated in this effort².

The EU's most impressive effort in the field of software is the priority given to embedded software that has led to heavy investment in the industry-led ARTEMIS initiative³. However, this covers only a discrete – but very important – sub-sector of the software industry (see below).

Europe's packaged software sector also faces very specific challenges, such as a need for a rare mix of skills, atypical innovation and sales cycles, and software piracy. Meanwhile, it is clear that the future paradigms will be very different from the present, with profound impacts on all of Europe's software industry. This report highlights the issues and demonstrates why the EU's demand-side approach has to be complemented by a software-specific supply-side strategy.

Such a strategy could:

- Maximise the impact of software as an enabler of competitiveness in post-industrial society and economy;
- Try to redress the balance in import/export of software and related services;
- Mitigate Europe's dependence on non-European providers and technologies.

To date an absence of policy in this area has made it difficult for the Commission and policy-makers to act. Yet industry needs a clear policy framework within which to plan and operate. **We must find a way to reboot the European software industry.**

What is Software?

The creation of software encompasses many different activities which together form the software value chain. The main aspects include: architecture (consulting, analysis, concepts); developing code (i.e. programming); testing; implementation, marketing and distribution; maintenance (e.g. software update management); helpdesk and training & education.

The software sector actually comprises several different types of companies:

- **Independent Software Vendors** (ISVs, also referred to as "Packaged Software companies"): These are producers and vendors of commercially available "packaged software". They offer packaged software through sale, lease, or rental, or as a service. Revenue typically includes fees for initial and continued right-to-use software licenses.

² For ICT Task Force see: http://ec.europa.eu/enterprise/ict/policy/taskforce/reports/icttf_report.pdf

³ ARTEMIS is a Joint Technology Initiative launched by the EU to support research in embedded software systems and services. See <http://www.artemis-ju.eu/>

- **IT Services companies:** These are companies for whom a major part of their business consists in developing custom software applications that are turnkey solutions for a specific client. This is a very different business to packaged software, although many small companies in Europe sell both.
- **Embedded systems software:** Embedded software is computer software or firmware which plays an integral role in the electronics it is supplied with. It is written for machines that are not, first and foremost, computers. Manufacturers in a wide range of sectors include embedded software in their products. Key users include electronic components, mechatronics, consumer electronics, automobile, aerospace, defence, health, network & telecom equipment.

Embedded software is very different to packaged and custom software; specifically, it has no user interface with which to interact. Embedded software already accounts for a significant part of development and production costs in these industries and will drive all major product innovations in the years ahead. Today, European manufacturers have a strong position in the field of embedded systems and software and major European initiatives – such as ARTEMIS – have been launched to support these activities. For these reasons, embedded software should not be a focus of this report.

Our focus, therefore, is primarily on **packaged software and related services**, and the **role of software in the evolution of networks, especially the Future Internet**.

2 Software and Services in Europe: Sector Overview

2.1 The European Software Market

The European software industry is a significant contributor to the European economy and a key driver of innovation and change. Spending on software and related services is worth around €258 billion to the European economy, or around 2.6% of GDP⁴. The software industry creates tax revenues, is a major source of high-value jobs, and has downstream multiplier effects throughout the economy.

The observation that much of Europe's poor growth performance compared to the US is due to lack of investment in ICT has been widely made. In summary, ICT accounted for as much as 0.4 percentage points 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- 2002⁵. The European ICT R&D *expenditure* per inhabitant is only about one third of the amount spent by the US or Japan⁶. And the total and per capita ICT R&D *investments* are significantly larger in the US and in Japan than in Europe. Europe is unlikely to close this gap unless significant progress is made in areas such as skills, innovation and competition.

⁴ IDC Economic Impact Study 2007, "The Economic Impact of IT, Software, and the Microsoft Ecosystem on the Global Economy," October 2007. Sponsored by Microsoft [quoted by CompTIA]

⁵ "Reaping the benefits of ICT: Europe's productivity challenge", The Economist Intelligence Unit, 2004 [quoted by NESSI]

⁶ "Recherche et développement en sciences et technologies de l'information dans les grands pays industriels", Rapport CSTI, France, 2003, 2005 [quoted by NESSI]

It is not our purpose here to give a detailed statistical picture of the European software market. Such analyses are readily available elsewhere. A few selective figures serve to illustrate the position, however.

- **Software is a growing sector:** The software market is growing more rapidly than the ICT sector as a whole. According to one analyst [ref 4], between 2006 and 2011 in the EU software will grow at a compound rate of 6.9% per annum, versus 6.0% for the ICT sector overall. Growth is particularly strong in Central and Eastern Europe, which has some of the fastest ICT growth worldwide (CAGR of 20.5% between 2002 and 2006, and 14.1% predicted for 2006-2011).
- **Software creates value.** The annual revenue per employee in the software industry is over €100,000 per employee, which is among the highest rates in the whole economy⁷.
- **Software contributes to greater productivity:** Use of software is one of the key drivers of productivity growth in almost all European economic sectors. Packaged software and related integration and consulting activities are a key source for productivity improvements in service industries, such as retailing, transport and logistics, and professional services. Embedded software defines the attributes and functionalities of products and services in sectors such as automotive, aerospace, medical equipment, automation, telecoms, and consumer electronics.
- **Software is a major focus for research and innovation:** Total investment in software R&D from 2002 to 2015 for key sectors is forecast to grow by 128% to €133 billion, which would almost double the growth rate for these sectors' total R&D (74%). European packaged software companies in the Truffle 100 have a collective workforce of 175,000, of which 38,000 are employed in research and development.
- **Software is a source of high-value jobs:** The benefits of software are felt most dramatically in terms of employment. In 2007, the EU software industry employed 4.3 million people, 55% of all ICT jobs. Employment is forecast to grow at 5.0% per annum for the EU as a whole, and around 14% p.a. in Central and Eastern Europe.

While official statistics and market studies focus primarily on proprietary software (where data are easier to obtain), open source software (OSS)⁸ is now a key feature of the European software market and of increasing economic significance. One study on the economic impact of OSS, prepared in 2006, shows that European firms have invested an estimated €1.2 billion in developing OSS and these firms have a total of 565,000 employees and €263 billion in annual revenue (it is unclear if the firms produce only OSS or cover multiple platforms)⁹. The same study reports the 'notional value' of OSS investment in Europe at €22 billion.

⁷ "Finnish National Software Industry Survey 2008", <http://www.sbl.tkk.fi/oskari/> ; and "Etude économique sur le secteur des éditeurs de logiciels en France", OPIIEC, 2006. [quoted by NTAs]

⁸ Sometimes called free/libre/open source software or FLOSS. This is discussed further in Section 4.

⁹ "Study on the Economic Impact of Open Source Software on Innovation and the Competitiveness of the Information & Communications Technologies Sector of the EU." UNU-MERIT, the Netherlands, 2006. [quoted by CompTIA]

Europe represents around one third – 36% - of the global software market (Figure 1). However, Europe's overall trade position in software products is poor. Around two-thirds of the packaged software sold in Europe is produced elsewhere. Europe is therefore a net importer of packaged software, although there are differences between countries. Overall, reliable data is lacking.

...pie chart to be added based on EITO 2007 figures

According to OECD figures, in 2002 59% of the software produced in Europe was developed internally (by user organisations), 24% was spent on packaged software and 16% on outside subcontractors.¹⁰

2.2 The European Software Industry

Within packaged and custom software three major sub-segments can be identified:

- *System infrastructure software*: Proprietary as well as open operating system and system-level software used across all types of hardware from mainframe to PC.
- *Tools*: Collaboration and content tools; database engines; business intelligence infrastructure; development tools; and integration platforms.
- *Application software*: Office automation, business applications and other applications. Business applications are process-oriented applications such as financials, human resources management (HRM), customer relationship management (CRM), supply chain management (SCM), as well as industry-specific solutions such as billing (telecom, utilities), core banking systems, etc. Other application markets include graphical software, embedded systems, and other technical software.

Games and leisure software is an important category of software application but is generally excluded from industry definitions because these are seen as pure B2C products and artistic creations rather than as packaged software (which is mainly B2B).

Europe's software industry is fragmented and faces fierce competition

Out of the 100 largest software-companies worldwide most are US-based and have a global presence¹¹. Only eleven are headquartered in Europe¹². In 2007, only two out of the top 10 companies (see table) and five out of the top 25 obtained 100% of their revenues from software¹³. One is well known for its on-line sales and the other is a leading player in software games.

Rank	Software company	Software revenues (Million \$)	Total revenues (Million \$)	%
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¹⁰ Internal Reflection Group on Software Technologies, Embedded Systems and Distributed Systems, DG INFSO, 2002 [quoted by NTAs]

¹¹ The full list is available at: www.softwaretop100.org. The 100 largest software companies in Europe can be found in the Truffle 100 study available at: www.truffle100.com/europe/downloads/2007/Truffle100_2007.pdf

¹² These are: SAP (4), Dassault Systèmes (20), Sage (36), Misys (37), Business Objects (40), SoftwareAG (47), Philips (49), Cegedim Dendrite (57), Unit4Agresso (64), Exact (71) and Visma (79).

¹³ The companies are ranked according to US-dollar "software revenues". Revenues from support activities (also known as 'maintenance') and subscription are included but those from service activities, such as consultancy, installation, offshore and custom software development and system integration, are not.

1	Microsoft	37337	45494	82%
2	IBM	18204	91424	20%
3	Oracle	13099	16489	79%
4	SAP	8717	12408	70%
5	HP	4115	93103	4%
6	Symantec	3879	3879	100%
7	Computer Associates	3514	3887	90%
8	Electronic Arts	3216	3216	100%
9	Adobe	2484	2577	96%
10	Nintendo	2418	7253	33%

In 2005 there were an estimated 18,000 European packaged software companies¹⁴. Most of these had less than 15 employees and €1 million in revenues. Companies generally rely heavily on local (i.e. national/regional) markets. US companies are at an advantage here due to a large home market and common language.

Consolidation is moving up a gear, but the European industry is still highly fragmented. In Western Europe, the Top 10 players account for 46% of the software market¹⁵. The Top four, consisting of the four biggest global players, reach 37%. The share of the Top 10 has risen in recent years as consolidation has accelerated at the top of the market. Several top European software vendors have been acquired, mostly by US companies.

Finally, apart from industry-level aggregations, we note that the quality of statistical information on the European software market and sector is poor and needs to be improved.

3 The Competitive Environment

In this section we briefly review the workings of the European software market and the principal factors influencing competition. Fragmentation, competing software development and business models, and the influence of quasi-legal issues (standardisation, interoperability and IPR) are the main themes.

3.1 A Fragmented Market

The fragmentation in the industry, highlighted above, has a number of implications for how the European software industry operates.

- **Struggling to scale in a fast consolidating global market:** Software SMEs in Europe face a vicious circle when it comes to growth. To grow fast enough and face bigger competitors on their domestic market, and ultimately go global, they need better access to skills, to finance and to public procurement. But access to skills, finance and public procurement in Europe today is all the more difficult when you are small. Thus, many European software companies remain small and very often increase the share of services in their revenues to “survive”, which drives them apart from a pure

¹⁴ IDC figures [quoted by NTAs]

¹⁵ EITO figures [quoted by NTAs]

software vendor business and its potential economies of scale. This small size also hampers their pricing power on their domestic European market, where they more and more compete with global leaders. Within the current economic downturn, this vicious circle is all the more dangerous.

- **Inefficient and fragmented labour markets:** Despite recent improvements, the growth in demand for appropriately skilled labour continues to outstrip the growth in supply. Given the lack of suitable graduates and experienced personnel, many companies have to recruit staff from abroad. But while many SMEs could easily contribute to the EU economic growth by hiring more employees – including from other Member States - employing workers across borders has proven to be extremely difficult.
- **Barriers to doing business internationally:** Relatively few European ICT SMEs trade internationally. Recent studies show that a very limited share of European ICT SMEs sold products outside their national market. Finnish, German, Italian and Dutch firms are most likely to sell their products internationally. While not all firms will wish to sell their products abroad, there is clearly huge untapped potential for those that do.
- **Barriers to partnering with firms within the EU:** Similarly, SMEs often encounter difficulties creating partnerships with other companies based in another Member State. This is for a number of reasons, in particular:
 - difficulty to get access to information on potential SME partners in other countries;
 - a fragmented work permit system;
 - difficulties linked to the legal system of another country;
 - difficulties faced in litigation/arbitration cases, due to different national provisions and procedures.
- **Barriers to participation in European processes.** Processes on the European level, including standardisation, are too heavy and cumbersome for SMEs to participate effectively, and are especially unattractive for driving innovation. In SMEs, the main innovators come from a technical background and might also steer the business side; these persons usually have little time and interest for working on European networks and events.
- **A fragmented regulatory landscape:** Despite substantial efforts a Single Market is still far from a reality in Europe. The lack of harmonized rules in finance and financial infrastructures represent a barrier to cross-border cooperation of SMEs. Laws are very different across Europe and, as noted above, mobility of workers between Member States is hindered by lack of harmonized employment rules, social schemes and tax provisions.

Other issues arising from fragmentation, to which we turn in detail later, include difficulties in relation to public procurement, educational standards, and innovation.

3.2 Model Competition

The business environment in software is a complex interplay of three related and often overlapping models:

- 1) **The software model:** how the software's intellectual property is released or controlled. Proprietary software is a software model in which the software remains under control of the proprietor of the software, typically the developing party, and users obtain certain permissions on the software by accepting a licence. Typical conditions include time limitations for the licence, use for a certain purpose, on a certain computer, or by a certain person, as well as payment of royalties to the proprietor for obtaining the licence. Over recent years an alternate software model – Open Source Software (OSS) – has emerged, defined by a high level of user control over the software in combination with far-reaching freedoms to inspect the source code, and to study and innovate upon the software.
- 2) **The development model:** how the software is physically developed. Here there are various approaches, ranging from development by a single person or organisation using a limited cooperation model, through to open co-development. While some software models offer advantages for certain development models and are traditionally seen as aligned - e.g. OSS allowing for easy implementation of co-development issues across boundaries, including individuals and companies of varying sizes - the choices of software model and development model are largely orthogonal. It has become common practice to work with different combinations of software and development models.
- 3) **The business model:** how the software is marketed and sold. Business models are intimately connected to the issue of revenue generation and are largely orthogonal to the choice of both software model and development model, although both typically have some influence. Some sources of revenue are effectively unavailable for one software model or another. For example, the proprietary model provides direct licensing revenue from distribution or usage. This revenue is not available in the same way with the OSS software model, although very similar revenue streams can be implemented through contractual constructions, trademarks and/or certification.

Having shaken off its 'garage'/hobbyist origins, OSS is now a credible alternative to proprietary offerings and in some areas is the only alternative to dominant commercial products. A lack of 'market confidence' remains, however, due to concerns such as availability of support, skill levels, understanding of licence terms, and liability. OSS tends to push the integration function into the hands of users as opposed to vendors, as is the case for commercial products. Users are then exposed to issues, problems and extra support and integration costs which can be off-putting.

OSS is often quoted as a European success story; the facts do not entirely bear this out, however. While European experts and contributors are prominent and highly regarded in the OS community worldwide, many of the OS technologies developed in Europe are exploited by US companies. According to one estimate, 90% of the business derived from OSS is generated by non-European players.¹⁶ In addition, most

¹⁶ MS comment: NESSI figures, full reference needed. Is this consistent with CompTIA's claim: "an estimated €1.2 billion has been invested by European firms in open source software development" ??

OSS consortia – the non-profit organisations managing OSS development and marketing – are based in the United States and funded by US IT companies. Europe must address this imbalance. **We need to exploit OSS better and make sure the benefits stay in Europe, with European developers, users and entrepreneurs.**

The various business models that can be built on top of the proprietary or the OSS software models overlap to a large extent. Most business models can be built on either software model; custom development, COTS, service-based approaches, SAAS, appliances, advertising models can all be based on proprietary or OSS software models, or a combination of the two. However, the overlap is not total. Some business models are tied to one software model or the other and some business models depend on a mix of both models. Overall, the rising popularity of OSS has increased the ability for business model innovation and new models will emerge in the future (see further discussion in Section 4).

3.3 Standards, Interoperability and IPR

A constellation of issues around standardisation, interoperability and intellectual property rights (IPR) influences how the software industry operates and have been intensely discussed for several years. These are controversial areas with well established (one could even say entrenched) and divergent views within the industry. We have discussed these issues at length within the European Software Industry Panel and in particular the Working Groups and, on the whole, have been unable to shed any new light or make progress. Most issues are known and are already subject to fierce political (and in some cases legal) fights and lengthy reports.

There is not space here to elaborate the arguments of all the different camps; nor would it be productive to do so in the absence of relevant conclusions and policy recommendations. So, in these key areas **we have agreed to differ**, while recognising that all three issues are of fundamental importance to the prosperity and success of Europe's software industry. Aspects of the debate are referenced in the subsequent sections, where relevant. In particular, there are implications in relation to innovation and public procurement (to which we return in Section 6). We confine ourselves here to a brief exposition of the issues at a level and in terms to which we can all (nearly!) agree.

3.3.1 Standardisation in Software

Standardisation plays a crucial role in the development of the software industry, as it is a key element for innovation and interoperability. Standards can help to ensure that an ICT product or service is 'fit for purpose', and that competing products and services can communicate with one another and share information. As a result, standards can increase users' efficiency, reduce transaction and implementation costs, and promote competition. In new fields, such as the Future Internet, standards could be pivotal in giving Europe a better competitive edge.

Europe's approach to standardisation

Europe has a well organised standardisation landscape on the Basis of Directive 98/34/EC. It takes lessons from the past and gives European Standardisation a clear priority over national standardisation. With the European Telecommunications Standards Institute (ETSI), Europe has created a global player and home of the successful GSM standard. Consumer protection standards and New Approach are also seen to work well.

There is a well established cooperation between the European standardisation organisations (ESOs) by some common committees. Sometimes they have trouble agreeing, but this is inevitable. The cooperation between the ESOs and the Commission also works rather well and the mandate system allows the Commission to benefit from the ESO's insight.

The recent study by DG Enterprise [ref] showed that on the whole the European Standardisation System works pretty well for classic manufacturing industries, although there are some flaws with respect to information and communication technologies. But the shortcomings are just that – flaws. Nobody is calling for a radical overhaul; the changes required amount to an evolution not a revolution. **The European standardisation system needs improvements rather than a fundamental reform. Any additional measures in this area arising from the Europe Software Strategy should reinforce these efforts.** Nevertheless, there are opportunities for improvement in both the international and national systems.

All stakeholders emphasized that standardisation efforts should, under normal circumstances, be voluntary, market-led and industry-driven. The initiation and drafting of standards should be market-led, their acceptance and usage should be voluntary and flexible, and the development process should be open and transparent, allowing for implementation in a range of competitive products to ensure consumer choice. In addition, certain representatives drew attention to the World Trade Organisation (WTO) criteria about openness, accountability and due process. Standardisation also has some connotation to public interest, thus triggering some higher requirements.

These factors are especially important for SMEs, both as developers of technologies but also as users. Moreover, given the international character of the industry, it is important for Europe to focus its efforts on benefiting and influencing the development of international standards, rather than on promoting European standards once they have been adopted. This should also apply to the reference of standards in public procurement.

Recognition of fora and consortia

Due to the rapid evolution of the industry, many standardisation developments have been undertaken by industry consortia outside of the official standardisation bodies¹⁷. Formal standards processes tend to be too slow for a fast-paced market such as software. Industry-based consortia and other forums (also known as standards developing organisations, SDOs) are seen as being able to respond more quickly to market requirements and so have been much more widely used in developing software specifications. In some cases this has led to a dominant proprietary platform becoming the *de facto* standard.

While both 'formal' and 'informal' processes co-exist, this fragmentation has led to a need for an in-depth reflection on the coherence and efficiency of the entire standardisation landscape. Calls by customers for greater interoperability among software and other ICT products and services have also raised the question of whether standards could be better used in this sector.

¹⁷ The main European and international bodies in software are: the European Committee for Standardisation (CEN) and the International Standardisation Organisation (ISO). Examples of industry consortia and forums include the Motion Picture Experts' Group (MPEG), the Institute of Electrical and Electronic Engineers (IEEE), and the Worldwide Web Consortium (W3C).

One approach could be to reform the mandate system for standardisation, as recommended by the DG Enterprise study. The Commission has the possibility to issue mandates to the three ESOs to ask them for action. Actions can range from simple reports to a request for the elaboration of a standard. This is a useful tool for the Commission to influence and connect to the standards world, but the mandates sometimes surprise the community outside the EU standardisation system. This mandating system could be extended to allow for actions also by industry fora and consortia and the Commission could engage in a consultation before issuing a mandate.

In conclusion, it is clear that standards are essential in achieving interoperability which is vital for the success of the European software industry in world markets. On the other hand, standards on their own will not drive innovation and in our view are of secondary importance to issues such as entrepreneurial capacity, innovation and skills.

3.3.2 Interoperability in Software

Interoperability is one of those terms that is difficult to define and tends to mean different things to different people. One definition, drawn from IEEE [ref], is: *“Interoperability is the ability of an IT system to communicate and exchange information with other IT systems in a way that all IT systems can use that information”*.

Interoperability is an emerging principle of greater collaboration and interconnection between ICT systems at a time when the European economy and market need a dynamo of growth from within. Unleashing the power of truly open specification-based, interoperable ICT systems within the European Internal Market could revitalize economies, spreading efficiency and effectiveness in all vertical industries that have become IT intensive.

While the role of interoperability extends far beyond the reach of the software domain, its innovative capacity is not well known outside the ICT industry. There is great need to raise awareness about core interoperability principles such as open standards and specification and open architectures. There is also, potentially, a role Europe can play in framing the debate and implementation of interoperability across various industry domains.

In addition, our debate on this subject noted the following issues:

- **Interoperability is not the only goal of standards:** Standardisation is mostly associated with the goal of interoperability. But as noted in the DG Enterprise study, standardisation in Europe can have a variety of goals. The EU standardisation system is designed to also draw up standards for the New Approach legislation. The regulator sets a framework that is filled out and maintained by standardisation organizations.

Although standards can help facilitate interoperability¹⁸, they are no panacea. Standards change over time, as do the products in which they are

¹⁸ Interoperability has a number of dimensions here: it can be applied internally among the software-based systems within an organisation; between the systems of different organisations, such as within supply chains; and for interconnecting future systems with existing systems ('future-proofing').

used. The evolution cycles of the standard and the products that implement it are rarely in synch, leading to different generations of the standard being enacted, which brings its own interoperability challenges. These choices may have been made by engineers for the best of reasons – to improve the welfare of consumers. The aim should be to foster interoperability that is practical and meets market needs. We must guard against laws that define interoperability too strictly and so drive flexibility out of this constantly changing process.

- **Interoperability is being applied at ever higher levels:** Whereas once interoperability was applied at a purely technical level, such as communication between devices on a network, it is now being applied at ever higher levels. The web brought interoperability to the syntactical level – to data – while developments in areas such as eGovernment seek to apply it at the organisational level as well. Yet the higher we get in interoperability, the less there is room for competition. So SDOs have to be careful to leave room for competition. This sometimes leads to tensions as those not well positioned in the competition call for standardisation to overcome their weak market position.

3.3.3 Intellectual Property Protection

Strategic value of intellectual property

Intellectual property rights (IPR) are an essential feature of the software industry, enabling software vendors to invest in innovation and attract venture capital. Protection of IP encourages investment, offering the potential for a return on that investment. It also facilitates trading in innovations, so that innovations can be composed and can evolve further over time.

Over the last decade, the significance of IP has become even more apparent, as technological developments have made piracy and patent infringements easier. At the same time software-based systems have become a part of the critical infrastructure of companies, governmental institutions and society at large. In this new environment, companies need to be able to choose from a portfolio of IPR, to ensure their rights as creators are protected from illegal and illegitimate copying.

The most appropriate means of protection will vary depending on the type of software, the investment made in developing it, its usage and the software and business models adopted. The main options are:

- Patents: used to protect the technical solution implemented in the software program, if it is novel and inventive¹⁹.
- Copyright: covers the program as a form of expression²⁰.

¹⁹ In Europe, patents are not generally available for software (known in legal jargon as 'software as such'), but inventions with technical effect that are implemented by software (sometimes called 'computer-implemented inventions' or 'CIIs') are patentable in the same way as other inventions. National patent offices and the European Patent Office have granted patents on CIIIs since 1973. Computer-implemented inventions which *only* solve a business problem using a computer, rather than a technical problem, are considered unpatentable as lacking an inventive step, although they are allowed in the United States. Controversial proposals to widen CII provisions in Europe to include business methods were rejected by the European Parliament in 2006 [...check date??].

²⁰ Specifically, copyright protects against unauthorised copying of source code, object code (sometimes called 'machine' or 'compiled' code), the underlying design materials and other 'expression' of software.

- Trade secrets: used to protect the valuable and confidential information contained in a program.
- Trademarks: used to protect product and service brands.

Copyright and trade secrets have been the traditional forms of IP protection for software. Commercial software companies typically distribute their works in object code form, and rely on copyright to prevent unauthorised copying and distribution. Contrary to perceptions in some quarters, even open source developers rely on copyright to ensure that their innovations are freely distributed and not expropriated and made subject to more restrictive terms by their competitors.

Is software special?

[MS comment: this section is from the original report based on the first meeting and is not reflected in the WG reports, but is retained for the time being]

Is the software sector different to other technology industries in its IPR requirements? We believe it is, for a number of reasons:

- Firstly, the number of software patents has grown significantly over recent years, partly due to defensive strategies by some players. This has led to situations such as 'patent holes' or 'patent trolls' (where a patentee does not declare a patent until a technology is widespread) and 'patent thickets/fences' (unused patents being used to block innovation). Many of these patents are of questionable quality.
- Secondly, patenting has implications in terms of standards and interoperability. Patenting in some areas of the software market is particularly powerful, e.g. APIs²¹.
- Thirdly, unusually within the patenting field, software is an intangible. The end result is not hardware, or a device or a drug, but computer code. The sector's IP provisions will become increasingly important in future as the boundaries between hardware and software are blurred.

In software, companies need to share knowledge to innovate, leading to a high degree of collaboration and pooling of resources. Innovation is generally incremental, rather than through big breakthroughs, but involves rapid cycles. Patenting, on the other hand, is slow and the period of the grant is much longer than the period of exploitation. The current IPR system is out of tune with this fast-moving, collaborative, incremental innovation model.

A number of other factors influence the efficiency and effectiveness of IP protection for software. Litigation procedures for solving infringement must be fair (and be seen to be fair); enforcement of IPRs in overseas markets must be efficient and workable; and patent assessment and search procedures should be speeded up. Regarding the latter point, we note as a welcome development the use of open exchanges to share information between patent offices and interested communities²².

IPR and standards

²¹ Application programming interface – enabling interfaces that support the building of software applications.

²² *[reference or URL needed]*

The position regarding IPR in standards is particularly problematic. Our discussions identified a number of approaches:

- **Royalty-free approaches:** This camp opposes patents on CII in general and such patents in standards on FRAND terms especially. The community is broader than just Open Source but OSS has some specific arguments, the main one being that OSS projects cannot deal with patents in standards. To make OSS implementations of standards possible, standards should be unencumbered and bear no royalties.
- **FRAND:** This camp argues that the free, reasonable and non-discriminatory access (FRAND) provisions provide an incentive for rights owners to contribute their IP-based technology for use in standards by assuring that their innovations are protected and can be licensed on reasonable terms. Among other benefits, this assures a return on their investment in research and development. Proponents of FRAND do not exclude participation in royalty-free standardisation however, and in general the issue is more complicated than just 'FRAND vs Royalty-free'.
- **FRAND with ex ante:** A third camp argues against a "patent hold-up" problem that can occur because an implementer has a reduced bargaining position with the holder of essential patent claims vis-à-vis licensing terms once a standard is finalised. After reviewing the issue in some detail, a number of SDOs have decided to permit the voluntary disclosure of those licensing terms "ex ante". There have been additional proposals to the effect that SDOs should mandate the disclosure by the patent holder of the licensing terms for its essential claims before the standard is approved.
- **License of Right:** A License of Right (LoR) to use a patented invention guarantees that any interested party will have legitimate access to the patent to develop interoperable software without fear of patent holders trying to assert their exclusive patent rights to block the development of new products. As a result, the LoR ensures that patent protection will not be used strategically to prevent legitimate follow-on innovation in the software industry. LoR has been described as "benevolent FRAND" because there is a firm commitment to negotiate without the threat of injunctions. For the moment, voluntary LoR regimes exist in several Member States.

As noted previously, the issues are extremely complex and we do not attempt to dissect them further here.

Campaigning for software in existing forums

In conclusion, accessible, robust and effective IP protection remains essential to the software industry. **The software industry has specific requirements in relation to IPR and it is essential that any new horizontal measures cater for the industry's special situation.** The problems are real and urgent, and in particular it is necessary to reduce complexity of the system and improve its flexibility and responsiveness. While we have agreed to differ within our own deliberations, we look forward to meaningful and concrete progress on these issues within existing forums.

Software is the foundation of innovation and adding value in the 21st century; it cannot easily be accommodated within a system created for the industrial age. A paradigm shift is needed.

4 Business and Technology Trends

Globally, the software market is facing a period of unprecedented change. New technologies and business models with mass appeal are being introduced to the market almost on a daily basis. Software has reached a critical mass and has become ubiquitous in many aspects of 21st century life. As a result the driving force of consumer demand will continue to push this sector to reach new horizons for some time to come. New technologies also bring with them new ways of doing business which can occasionally make existing regulation or incentives obsolete.

The main trends we see affecting the software market are the following:

4.1 Shifts in Customer Demand

Within the business world, market demand is evolving in a variety of ways:

- **Globalisation:** Today, the world is flat – the trend towards globalisation has led economies to become increasingly interrelated. Companies operate in a similar manner throughout the world, and citizens seek to transcend nationality and location as the key determinants in their social and business transactions. In short, geographical and “national” barriers are reducing, changing the influence of a given individual, company or state and challenging the business models applied to industries and economies. Software vendors need to adapt their business models to meet the requirements of increasingly globalised customers.
- **Changing market expectations:** To address the need for flexibility and fiscal responsibility, companies of all sizes are looking at how they use and consume IT; in particular they are revisiting the traditional “buy” (Capex) vs. “rent” (Opex) tradeoff. Service-oriented models (vs. a software-oriented model) allow companies to scale when needed, putting less strain on the business by minimising capital expenditures and truly operationalising costs which can be charged to a specific cost centre. This shift has significant implications for the business models of traditional software companies. Shifting to or introducing a consumption-based software model will have a drastic impact on revenue recognition, sales compensation model, and go-to-market strategy.
- **Modular business structures:** Over the past decade, the quest for agility and innovation has led organisations to cut through the traditional silo/matrix structures to more cellular models, both internally and externally. This “componentisation” of the economic world, and subsequently of enterprises’ entire value chains, induces re-architecting of information systems in a much more modular way (known in software development as Service Oriented Architectures – see below). This impacts the software industry which will supply the “components” necessary to build these next generation information systems and address the transformation needs of the current business networks.

- **Consumerisation of IT:** The shift to Opex is helping to drive an evolution in the IT buying centre by empowering those outside of IT to make software buying decisions. IT purchasing is becoming less hierarchical, with purchasing decisions migrating from CIOs to Line of Business (LOB) leaders with specific goals. These LOB users are increasingly tech savvy and looking for business solutions that mirror their consumer experiences on sites like Google, eBay and Facebook. LOB executives are demanding solutions that offer accelerated innovation, rapid deployment, fast time-to-value and low risk, avoiding long purchasing and deployment cycles. Thus, end-users are now becoming empowered to make buying decisions and in turn are influencing CIOs. These requirements for new user experiences are making the software market more consumer oriented.
- **Generation shift - the Gen-Y influence:** Generation-Y – the generation of young people who have grown up with the internet – is now entering the work force. Gen-Y works and communicates differently to the retiring baby boomers and other generations that have gone before, and their expectations of work will be defined by their learning styles. The development of the Internet as a business medium and the corresponding usage by Gen-Y will have a significant impact on the IT market, especially for enterprise software.

In summary, business users expect more flexible and personalised IT environments and subscribed services in an “always connected” mode. Those tools, complementing their business transaction processing systems, will reinforce their ability to interact, collaborate, contribute, decide and adapt to their fast changing environment fusing their professional, social and private lives. User expectations for software will change based on experiences with websites and users will demand easy to consume, real-time information, where many legacy applications face challenges.

New consumers

In the consumer market, several specific trends can also be observed:

- **A proliferation of software-based devices and infrastructures:** The number and variety of computing, communication and purpose-built devices is growing and systems are becoming more complex. Thus, software in devices becomes more and more important. Users are looking for integrated solutions that include offline software, services, mobile devices or large servers, with emphasis on sharing and reuse. This creates opportunities to create new services that connect the various pieces of the ICT infrastructure, be it in a manufacturing process or consumer offering. Each combination creates unique offerings for the user.

This trend also creates increased demands on the network infrastructure – from local/home environments right through to the global level. These demands cover multiple angles – bandwidth requirements, latency expectations, number of devices connected, etc. Increased amount of endpoint-to-endpoint traffic (as opposed to hub-to-endpoint) leads to growing importance of peer-to-peer technologies (hence the need to differentiate at policy level legitimate vs illegal uses of P2P). Explosive growth of computing power available on the network (in form of large number of small devices) leads to interesting opportunities in system-level optimization with increase in efficiency, but also raises all sorts of questions about privacy, security, control of information, etc.

- **Ownership of customer relationships:** More sophisticated services and offerings to consumers, together with splintering audiences mean controlling the flow of information becomes all important. Whoever controls those flows will own the customer relationship and be able to charge a premium. Customers increasing expectations will inevitably lead to closer links between the media and ICT industries – and in some case conflicts.
- **User-generated content:** Consumers are increasingly able and willing to contribute to the creation of content. The need to share content coming from different sources requires increasing levels of interoperability and standards support, and pushes the limits of existing legal frameworks on privacy, information control, and data protection.
- **Free is the ideal price point:** 'Conditioned' by advertising-funded applications and services, consumers expect more and more offerings to be free or near free. The underlying trend is separation of user and payer, one example being ad-funded software services.

4.2 Evolution in Technology

We have identified four main technology drivers affecting the software industry: Service-Oriented Architecture (SOA); Cloud Computing; Enterprise 2.0; and Semantic Web, which are summarised below.

4.2.1 Service Oriented Architecture (SOA)

Service-Oriented Architecture (SOA) is a new paradigm in software development whereby a flexible, standardised architecture is used to allow a set of reusable applications to be combined into interoperable services. So a service-oriented architecture is simply a systematic approach to exposing as many systems as possible as to a collection of services that later can be combined or reused across a multitude of projects.

Service-oriented architectures are poised to transform business by enabling more flexible and agile IT infrastructures. Indeed, it is an essential tool for software vendors to address the complex needs of enterprises and business networks that have become volatile and moving targets in a globalised economy. **The key change agent in this transformation is middleware.** Leading companies are gaining operational efficiencies and business agility through adaptable, re-usable business processes and services built on portfolios of open, middleware products that transform their client/server infrastructures into services oriented setups.

Unlike client/server systems - characterized by tangled webs of tightly-coupled integrations that are expensive to maintain and update - SOA is based on loosely-coupled services whose interface exists independently of the implementation. Services can be built, used and reused based on changing business need, and easily integrated across heterogeneous platforms. Creating such reusable software building blocks - confusingly called services - that can combine with other services to form new business applications, yields cost savings since developers do not have to build applications from scratch.

The additional flexibility benefits both customers and vendors. In fact, the technology drivers of SOA-based software contributes towards re-outfitting legacy systems across Europe by building interoperability layers on top of them and/or replacing them with state-of-the-art, open standards based systems. Most applications (HR, CRM, financial management, supply chain) similarly rely on interoperability regardless of the industry they are destined to serve. Finally, all layers of technology need to be interoperable. While middleware and service layers are a current focus of standardisation, more needs to be done. Public funding of such activities could help towards the greater adoption of, and participation in standards activities by SMEs, and in the innovation within the European software market.

The SOA concept is widely understood among business and IT circles and almost everyone agrees with its benefits. However, the route to SOA is less clear. In fact, even though most corporations realise the benefits, SOA adoption has been sluggish at best. Why the disconnect? The reason is that changes of this magnitude require strategy, and many corporations understandably don't know where to start. As an example of what some vendors are doing, Oracle's Application Integration (AIA) project²³ gives programmers (and customers) a toolkit and a library that leads to manageable, adaptable and upgradeable SOA integration with less time, lower cost, and minimum risk.²⁴

4.2.2 Cloud Computing

"Cloud computing" has become the generic term for IT-related services that are used as flexible services. It serves as an umbrella term for the provision of a set of these services, such as storage, computing power, software development environments and application, combined with service delivery through the Internet to consumers and businesses.

Accordingly, cloud offerings today roughly fall into three categories, namely Hardware Clouds, Development Platforms, and Application Delivery Clouds, addressing the different target audiences of service providers, software developers and users. Alternate terms for the same respective offerings (and the ones which will be used here) are: **Infrastructure-as-a-Service (IaaS)**, **Platform-as-a-Service (PaaS)**, and **Software-as-a-Service (SaaS)**.

The main innovation in cloud computing is that the IT infrastructure no longer lies with the user, meaning that even inexperienced users can access these services. The key feature of all of these ICT service offerings is the breaking up of the previously monolithic ownership and administrative control of the assets at the various layers of the stack and distributing them across multiple separate entities. This has a number of advantages and benefits:

- *Operating efficiency*: Using clouds is more efficient and more flexible than maintaining internal IT departments, which may lead to a new wave of outsourcing. Moreover, resource sharing via clouds offers an overall optimizing energy usage.

²³ Oracle AIA, see <http://www.oracle.com/applications/oracle-application-integration-architecture.html>

²⁴ *IT as the Strategic Enterprise Business Partner: Building Manageable, Adaptable and Upgradeable SOA Integration with Less Time, Lower Cost, and Minimum Risk*, an Oracle White Paper, September 2008, available at: <http://www.oracle.com/applications/it-strategic-enterprise-business-partner-white-paper.pdf>

- *New business models:* Clouds provide major opportunities for new business models by restructuring the value chains in the ICT industry. The dynamics for new service offerings are changed dramatically by shifting from huge initial capital investments to pay-what-you-use business models.
- *Low barriers to entry:* The biggest advantage lies in a very low initial barrier to entry for all players and flexible consumption. This would benefit small businesses, in particular, wanting to launch innovative business ideas.

Effective usage of cloud computing could give companies a competitive edge. The uptake of cloud services by end-users has been fairly uniform across the globe. However, adoption by enterprises in Europe lags behind other regions. While a recent Gartner study showed plans for SaaS adoption in many enterprises, actual current usage in Europe somewhat lags behind the US by 62% versus 67%, and strongly trails the adoption of SaaS in Asia/Pacific at 89%.

Reservations about cloud computing derive from concerns about dependability, vulnerability, and lock-in to providers, as well as security-related issues, when there are no longer true internal systems. There is no uniform service level agreement (SLA), and the third-party cloud providers involved are dealing with sensitive data. Indeed, hardware breakdowns, loss of data, and a critical reduction in performance have occurred in relation to today's cloud computing offers. Therefore, many users are choosing to combine internal IT and cloud computing. In terms of data privacy and jurisdiction, national standards and regulations have resulted in few providers storing regional hardware and most choosing, instead, to use European and American infrastructures. In general, the question that arises is how national privacy and security standards can be ensured in a global cloud environment.

From a European perspective, two issues should be addressed:

- Firstly, cloud computing could potentially develop into an essential infrastructure of the information economy, as did roads and electric grids for the classic industrial society, thus creating a deep dependence on the reliability and availability of the supply and freedom of access, and the balance of power between providers and consumers. Since cloud computing, by its very nature, is global, there are no short-term concerns of any geographic region being at a disadvantage despite the current dominance of US providers. At least low-level interfaces for hardware clouds are reasonably standardised, and there is a healthy level of competition. Still, Europe should strive to also develop hardware cloud infrastructures since this will become a strategic asset in the digital economy. Moreover, Europe needs to be much more active in developing development and application clouds, regardless of underlying hardware infrastructures.
- Secondly, Europe should increase the use of cloud computing throughout the economy, in particular by SMEs. We recommend targeted action to foster education about the opportunities and pitfalls of cloud computing and to ensure a regulatory framework around clouds that ensures privacy, dependability, and a fair distribution of power between providers and users.

Finally, it should be stressed that openness, interoperability and collaboration should be the guiding principles for the development of cloud computing, as they have been for the Internet so far. Hence, global standardisation efforts should be a key priority.

4.2.3 Enterprise 2.0

Enterprise 2.0 is what happens when Web 2.0 gets down to business. Social networking tools applied in the firm are about to generate an Enterprise 2.0 based on collaboration tools which will significantly affect most IT applications across domains. But does Enterprise 2.0 simply mean using Web 2.0 technologies such as wikis, blogs, mash-ups, and gadgets within the organisation?

Dramatic changes are affecting traditional business models across most industries, making the case for a different approach. Competitive advantage today is achieved not through command, control, and operational excellence, but rather through collaboration, communication, and management excellence. Enterprise 2.0 facilitates this more open approach to management and leadership and is already making its way into business software, invigorating the feedback process around the tools themselves and the processes they govern.

Web 2.0 technologies will impact the way system services will be accessed and combined to create final applications. Combined with Semantic Web technologies (see below), they will drive the evolution of the web. The open and collaborative nature of Web 2.0 technologies will enable end-users to assemble, disassemble and reassemble applications. They will also enable them to share applications and knowledge with other users (employees) within the company. In the context of Enterprise 2.0, these newly-created applications also need to be secure.

The popularity of social networking web applications are indicative of a shift in the way people communicate with each other. These are becoming the preferred method of communication between not only friends and family, but also between businesses, customers, partners, and markets. In their work environment, digital native managers and professionals expect the same methods of communication. This is because social networking applications have, for the first time, technologically enabled conversational communication on a mass scale.

Organisations know that online communities formed around specific interests could help promote their products and services. However, the public web has few, and often no, rules of engagement or controls over what is said or how content is presented. This is where Enterprise 2.0 technology differentiates itself from Web 2.0 technology. Because it originates from within the business, users of Enterprise 2.0 technologies begin as known - rather than anonymous - entities with a specific identity or role. After all, they are employees of an organisation working toward a common goal: the success of the business.

Unlike a piecemeal deployment of distinct islands of information or capability, the Enterprise 2.0 platform allows services to be snapped in, turned on, and rolled out without long, expensive integration projects. Most importantly, the platform model means that employees are not required to constantly learn new software products and business processes in order to use the technology.

In summary, **Enterprise 2.0 is an integrative business strategy** that combines multiple disciplines, technologies, and experiences. It shows that the era of the pure "technology drivers", if it ever existed, is no longer the dominant force of contemporary computing.

4.2.4 The Semantic Web

The term 'Semantic Web' refers to a variety of developments and technologies aimed at making the web more user friendly by unlocking the knowledge embedded in multimedia content and real life objects.

Semantic technologies are a body of technologies relating to metadata formats, modern forms of artificial intelligence (AI) technology, and autonomic (self-learning) systems. These technologies are important to business because of their ability to create exponential value in reducing costs. Intelligent internet searches are probably the best example of Semantic Web technology in action. If the Semantic Web was here, a Google search for yacht racing would yield America's Cup results, even without using that search term.

Semantic interoperability is about drawing together data from different sources and relating data to real life objects. The Semantic Web puts HTML data into a machine-readable format, so that computers can aggregate it and understand these relationships²⁵. These standards and descriptors enable web developers to add layers of meaning to web documents, supplying a framework for defining how data is linked and how its intended relationships are expressed.

Metadata management is a key requirement for next-generation enterprise software and semantic technologies are key to metadata management. The adoption of semantic technologies can only happen while driving open standards and delivering a wide range of software products using those technologies. We believe that semantic technologies will see wide adoption in the next few years, but will require commitment from industry, understanding from end-users, and vision. While there are four typical ways a business could use Semantic Web technology: search, Web services, grid computing, and content management/compliance, many other areas will be ripe for it soon.

4.2.5 Future Networks

The work to migrate to a new internet protocol, i.e. the standard that enables the connection, communication, and data transfer between computing endpoints is essential. IPv6²⁶, a standard currently being developed by IETF, is an important part of the next generation of Internet technology. IPv6 fixes a number of problems in the current IPv4 protocol, such as the limited number of available IPv4 addresses. It is expected to gradually replace IPv4, with the two coexisting for a number of years during a transition period.

Overall, IPv6 will improve the performance of the Internet and will enable a wide range of devices and services to be integrated into our homes, businesses and while on the move. The introduction of IPv6, alongside unrestricted access to broadband, is of great importance. Together they will help to offer citizens wider access to an advanced Information Society. However, as Vint Cerf, sometimes called the Father of the Internet, has said: *"The value of IPv6 can be realised only if the deployment effort is broadly based on a global scale."* Currently, its penetration is still less than one

²⁵ For example, Extensible Markup Language (XML) and data-language standards such as Resource Description Framework (RDF) and Web Ontology Language (OWL), two World Wide Web Consortium (W3C) standards.

²⁶ See <http://www.ipv6.org/>

percent of Internet traffic in any country, so this is going to be a challenge for years to come.

4.3 New Business Models

4.3.1 Business models are converging

The competition between the proprietary and OSS software models has led to a heterogeneous ecosystem in which several trends can be observed.

Models are converging as companies become increasingly active outside of their traditional parameters. So-called 'commercial' software providers are developing and offering open source programs and components, while companies typically considered open source are offering commercial software for sale. Further, the two are actively working together to produce software. For example, Red Hat, the best-known open source producer also ships some commercial software products that run on top of its open source platform. IBM offers integrated open source and commercial solutions and even Microsoft, typically viewed as the archetypal commercial software vendor, actually produces products along a spectrum of software models.

Some change regarding the direction of software model choices can be observed. Many companies have tended towards OSS, in particular mixed model companies moving to a fully OSS software model to leverage the full benefits of the model for their strategic growth. Established large companies tend to use OSS components for diversification and to reduce cost in areas which do not determine the differentiator for their business model. For new market entrants the choice of software model is between proprietary, mixed, or fully OSS, a decision intertwined with considerations of development and business model requirements.

The competition between software models has generally led to more choice for the users and has impacted on the way in which the proprietary model is being applied. An example is the practice by some vendors to offer customers the full source code of a solution upon discontinuation of support for a particular software product. This seeks to emulate some of the advantages of OSS for customers of companies using the proprietary model, and while the effectiveness of this particular offer depends upon the particular terms, the example demonstrates the positive impact that software model competition can provide.

In summary, large enterprises seem to leverage the benefits of either software model for their individual business model and combine them quite freely with various development models. From their perspective, the future is mixed. Smaller enterprises tend to focus more on one software model or another, with some mixing applied for particular business model constellations. Overall, there is a wide variety of business models available, and the competition between software models is helping to drive innovation in business models.

4.3.2 Software becoming a service

Software-as-a-service (SaaS) is a delivery model where functionality is delivered over the network and users pay for what they 'consume' rather than per copy or by license. The end-user receives the benefits provided by the software without the need to install or operate it. The provider takes the responsibility for operating the

software on their own premises and the end-user simply utilises the software over the network.

The SaaS market is still embryonic: according to IDC, global SaaS spending in 2007 amounted to \$5.7m, of which the European market accounts for around 10%. But explosive growth is forecasted (over 50% per year) and it is expected to become mainstream within a few years.

Although generally associated with browser-based delivery, in fact SaaS is not tied to any particular product or technology. Nor is it tied with a particular business model. Certain business models (subscriptions, pay-as-you-go, usage-based billing) are easier to implement using an SaaS delivery model, but these models are not exclusive to SaaS.

For end-users SaaS provides both advantages and disadvantages. The advantages include better clarity of costs, absence or reduction of substantial up-front investment, increased efficiency due to economies of scale, faster development cycles and incremental delivery of new or improved functionality without extra costs. However, SaaS also has its drawbacks – less control (or even loss of control) over user data, limited opportunities for customisation, increased vendor lock-in and switching cost, increased complexity of integrating various SaaS applications, potential issues with regulatory compliance especially in the area of data protection, and need for producers to acquire operational skills in addition to development skills. SaaS is most suitable to standardised services which are (relatively) common across many companies and do not form a base for a company's competitive advantage and its differentiation vis-a-vis competition.

This is more than just an incremental development: SaaS represents a new paradigm for software provision. It offers the potential for users to be able to build and evolve their systems more flexibly and for new suppliers to readily join a pool of service suppliers and compete on an equal footing with installed suppliers.

Such a trend would require major change from European companies offering packaged software. Shifting to a pure SaaS business model implies a complete change to revenue recognition and a strong investment in new skills to move from a product-oriented to a service-oriented company. For instance, they would increasingly need to re-craft their sales proposition and retool their sales approaches to deal with the increasing number of technical queries.

4.3.3 Business model innovations

Two other innovative business models are also apparent:

- **Appliance, or embedded software & service:** Appliance, or embedded is another model of delivering the benefits of software to the end-user. Traditionally embedded software is associated with specific applications like industrial automation solutions, controllers, etc. However, recently an increasing number of companies have started to offer more 'traditional' software in the appliance form.

The essence of this delivery model is combining hardware, software, and more recently internet- or intranet-based services in a single easy-to-setup, easy-to-operate package. The appliance model shares some benefits with SaaS (ease of

implementation, ease of use, lower maintenance fees), however unlike SaaS the end-user retains full control over data in this case.

Data warehouse appliances and search appliances are the most visible examples of traditional, server software being delivered in the appliance form. Looking at the consumer space, the vast majority of today's consumer electronics devices have a very high software component, and an increasing number are including access to services as key features of the package. For example, all three of the latest-generation game consoles are actually a package of hardware, software (OS + other core components) and online services.

- **Advertising model:** Advertising is, unlike SaaS or appliance, a truly different business model in the software industry. A product or service is provided to the end-user free, with the software provider earning money from selling advertising services. Essentially the software provider sells advertisers access to its customer base. The revenue thus generated depends on size of the user base, ability to target ads to maximize relevancy to a particular target audience.

The advertising model allows companies to create and monetize products and services which are valuable to the end-user, but for which the user is not necessarily willing to pay – thus fostering innovation in new areas. Use of advertising in the software industry did not start with Google – for example, many developers of try-before-you-buy products include advertising in trial versions to complement direct sales revenue.

This model requires the provider to be able to collect, store and utilize a considerable amount of information about users of its software, raising potential regulatory concerns in the area of privacy, data protection, and cross-border transactions.

4.4 Software Shaping Society

In addition to technology and business trends, there are public policy initiatives that impact the software industry. Foremost are policies related to Green IT and IT security. Policies in relation to e-Health, e-Government and e-Inclusion could also be highlighted.

Green IT and Energy Efficiency

As computing becomes increasingly pervasive, the energy consumption attributable to computing is climbing, despite the clarion call to action to reduce consumption and reverse greenhouse effects. At the same time, the rising cost of energy is refocusing IT leaders on efficiency and total cost of ownership, particularly in the context of the worldwide financial crisis.

Energy is an increasingly scarce and expensive resource. This reality will continue to have a profound effect on how IT solutions are designed, deployed, and used, particularly at the data centre level. While virtualization and other power-saving technologies may go part of the way to solving the problem, virtualizing inherently inefficient applications has obvious limits.

Today's most utilized approaches — primarily focused on infrastructure optimization — may be too narrow to deal with the power challenges of tomorrow. Methods of optimizing infrastructure usage are required that run the entire ecosystem, spanning

the disciplines of application architecture and design, data centre management, and IT operations. There are multiple examples of applications in use today which are extremely inefficient. For instance, applications that run on multiprocessor computers but only effectively make use of a single processor; or servers that only run applications at certain times of the day.

Optimizing software for energy efficiency could lead to acceleration or slowdown of certain technology trends, increase demand for new skills, and potentially increase complexity and cost of software development process.

IT Security

Governments in several countries are developing policies that are designed to increase the security of public IT systems. However, in some cases there is at least a risk that these policies may be misused to unduly protect or foster the national IT industry.

China may serve as an actual example. On 27 August 2007, China filed 13 Technical Barriers to Trade notifications to the World Trade Organisation, covering a broad range of software and hardware product areas including secure routers, smartcards, chips, operating systems, data backup, and recovery or security audit products. The main concern here is forced intellectual property transfer, required encryption codes, and lacking compatibility between the CC and international standards (*ISO 15408-1:2005 and Common Criteria*²⁷). The crucial issue is that China defines “state/government applications” wider than the norm.

The regulation would create significant trade barriers to software vendors doing business in China. Some companies might even decide to pull out of China or drastically scale down their offerings. Following interventions by the EU, Japan and the US, China temporarily suspended the regulation. However, a final decision has yet to be taken.

We can expect these types of disputes to increase in future, as governments ramp up their critical infrastructure programmes.

4.5 Towards a New Market Structure

These market, technological and business trends effectively amount to a revolution for the European software industry. A wave of consolidation is sweeping the industry as companies seek to safeguard their position within a maturing market. New business models are emerging as companies try to gain competitive advantage and seek out new niches. And innovations such as virtualisation and software-oriented architectures (SOA) enable software to be increasingly sold as a service. As a result, over the next 5-10 years we will see a new market structure emerging, one which offers Europe immense opportunities.

²⁷ The Common Criteria for Information Technology Security Evaluation (abbreviated as Common Criteria or CC) is an international standard (ISO/IEC 15408) for computer security certification. The fact that CCRA is an open standard is crucial. It means there is a guarantee that all parties have access to the innovation going on. That way, there would not be the need for such a far reaching Chinese IT security legislation.

4.5.1 Consolidation creates new opportunities

As noted above, the European software industry is highly fragmented and relies heavily on local markets. While there has been some consolidation, it has been slower than in other sectors. The main driver here is the “speed to scale”. Acquiring another software producer can also be the best way for a company to expand beyond national borders, to enlarge its customer base and to implement diversification strategies.

The degree of consolidation depends very much on the maturity of a given market segment. Every year, new technologies and innovative software are produced by young companies that are quickly able to become leaders in these new markets. Once the market has developed consolidation takes hold and, very often, they are acquired by one of the top software vendors (usually from outside Europe). But in this fast evolving environment, the top players of today will not necessarily be the top players of tomorrow. **Europe, therefore, still has the opportunity to establish leading positions.**

The challenge, essentially, is how to improve interoperability for software users while guaranteeing a more open market for software suppliers. Business models, entrepreneurial capacity, innovation ecosystems, and access to finance are all important issues here and are addressed in detail in the following sections.

EU-level initiatives such as the European Research Area (ERA), the European Technology Platforms (ETPs) and the Joint Technology Initiatives (JTIs) are helping to integrate European efforts and reduce fragmentation, at least within the research domain. These could be a means to encourage SMEs to work with regional centres and networks. In addition, the transition to the Future Internet is an opportunity to reinforce a Europe-wide approach (see Section 7).

4.5.2 De-verticalisation offering new platforms for SMEs

The shift to SOA and related technologies will stimulate the industry to change in other ways beyond simple consolidation. A strong de-verticalisation is envisaged (i.e. the breaking down of vertical niches), leading to the emergence of a few leading ‘software systems manufacturers’ together with many ‘software component developers’. Moreover, the software system of a manufacturer will become a ‘platform’ for the component developers. Hence, in a few years from now, the software market may look very similar to the automotive industry.

One key impact of de-verticalisation will be small and medium-sized players will no longer be at a disadvantage. Many innovative companies will emerge, fostering creativity in the software world. Companies will thrive as Tier-1, Tier-2, Tier-3, etc. component developers, providing ‘spare parts’ to the integrator – the platform provider who will remain responsible for delivering an integrated package to the client. Among these spare parts, whether proprietary or Open Source, will be the regional/local adapters that will continue to be required for the foreseeable future, especially in Europe as national regulations will survive possibly for many years to come.

For the software systems manufacturers and platform providers, the competition will likely stay global. Leading American companies seem already well advanced in the platform competition: so, Europe must get its act together if it wants to play this game.

4.5.3 New innovation ecosystems

Shifts in demand and new technologies are creating new ecosystems for software development and use. In particular, there is a trend towards increased co-innovation where users and independent developers work closely with originators in developing effective solutions. Some of these characteristics initially emerged in the Open Source model, facilitated by the broad grants contained in its licenses. However, these trends have become a significant factor in the proprietary world as well.

Within the 'SAP eco-system', for instance, members of the SAP Enterprise Services Community (ESC) collaborate with SAP employees to define services and features for future releases of products, while more than 1.5 million members of the SAP Developer Network (SDN) share their experience with each other and developers working for SAP. Top contributors obtain 'SAP Mentor' status, gain direct exposure to top executives and have more influence on the SAP product strategy.

Co-innovation has a profound effect on the market, with increased user involvement in consultation, design, testing and improvement noticeable in every approach to software today. One result of this is to blur the distinction between what constitutes a user and what constitutes a provider. Indeed, the Open Source model notably empowers all users to become providers. While the proprietary paradigm does not encourage this level of user freedom, the relationship between providers and users has become less static than before. The trend towards co-innovation is also an important driver behind interoperability.

These new innovation ecosystems reflect an emerging trend of new business models that combine elements of both the traditional proprietary and open source software models. It is important that such trends, as with purely proprietary and purely Open Source models, are fairly facilitated by policy makers.

4.5.4 Software 2.0: The new market paradigm

After it has consolidated, de-verticalised and co-innovated, what will the future Software Industry look like? The answer, we believe, is totally different from how it looks today.

From these three factors a new landscape will emerge, one where the competitive environment and dynamics are totally different. This new market paradigm, which we call **Software 2.0**, challenges all current market players whichever 'camp' they are in – large and small, vendor and service provider, proprietary and open source. But it also, we believe, offers huge opportunities for Europe's software industry.

In the Software 2.0 world, software will be developed, delivered and consumed in discrete chunks designed to meet a users' specific and highly personalised needs (i.e. as *services*). Liberated from the PC and mainstream IT systems, software-based services will be accessible across a multitude of devices and appliances in a whole variety of settings. The Software 2.0 marketplace will comprise a rich blend of offerings according to a spectrum of licensing terms and pricing models – some free, some subscription, some pay-per-use, some advertising-led. Furthermore, users will be a key part of the market ecosystem, acting both as consumers and co-producers.

The Future Internet will feature large in this Software 2.0 world. Many sectors will be shaped by the Future Internet, as it weaves together a new seamless world of information, content, services and things. But the software sector will be affected

more than most. This is for two reasons. Firstly, software will provide the building blocks of the Future Internet, which in a componentised world will be delivered as services. Secondly, the software sector's own development models and business models are migrating to service-based approaches and will utilise the Future Internet infrastructure.

Thus, the Future Internet and the Software 2.0 market paradigm are intimately bound together. Software will drive the next generation of the internet as it grows to occupy an ever-more central position in our society and economy.

We see three key challenges for Europe in seizing the opportunities presented by Software 2.0:

- We must **promote human talent** so as to nurture not just the best technical skills but also the creativity, innovation and entrepreneurship necessary to create and grow successful Software 2.0 businesses.
- We must **build the innovative capacity** necessary for fast-paced software and service innovation – a key feature of Software 2.0 - to prosper and thrive.
- We must **embrace the Future Internet** itself, putting it at the heart of development and business strategies for Software 2.0 businesses.

While the remainder of our report concentrates on these three aspects, we note that the 'off-field' issues of standards, interoperability and IPR will also be important in the Software 2.0 context and may need to be revisited in that light.

5 Challenge 1: Promoting Human Talent in Software

5.1. Skills for the Knowledge Economy

For the European software industry to succeed in global markets it has to attract and retain the top talent – the best software programmers, managers and entrepreneurs. Yet, like other areas of the ICT industry, software is affected by a lack of experienced and well qualified people.

An IT skills shortage is now a serious and worsening problem throughout Europe and at all levels of IT use, from consumers and business users through to software engineers. The number of IT graduates has dropped considerably over recent years, especially in the software sector. In the UK, for example, the number of software engineering students has dropped by 60% in the past five years²⁸. Similar falls have been seen in other European countries.

The roots of this problem lie in a variety of factors - social, economic, cultural and structural. Poorly defined career paths in ICT; the unattractive – even 'nerdy' - image of software in the eyes of the public; the lack of interest shown by young people in science at school in all western countries – all of these contribute to the situation, which we can justifiably call a skills crisis, now unfolding.

²⁸ www.vnunet.com/vnunet/news/2159726/20bn-risk-uk-skills-shortage

This shortage is compromising Europe's growth in several ways. It prevents large sections of the population from participating in the e-economy; it makes the European workforce less attractive to companies seeking to base operations here; it provides an incentive to outsource software development to other regions; it inhibits the uptake of new technologies by European organisations; and it is threatening to put a brake on Europe's technological innovation and development.

We must do more to maintain and develop the European skill-base in software and its applications. The need is not just for IT specialists, but for software engineers skilled in applying software and services technology in all other application domains and industrial sectors. In such a fast-evolving sector, replenishing the knowledge of existing practitioners is also a key requirement. Moreover, a general public that is comfortable with IT, enthusiastic about using it at work and at home, and excited about its future prospects will offer an environment in which the youth will be drawn to it as a profession and so supply the future scientists and engineers.

There is also a strong business dimension here. As noted in Section 3, the key challenges for SMEs are human challenges. European software SMEs often have strong technical competences but need help in developing management capacity and business skills. Technical skills are generally well covered by training providers but areas such as marketing, finance, and entrepreneurship need to be improved. Again, the key difference in software is the fast-moving business environment.

5.2 Reshaping Professional Education and Lifelong Learning

The starting point to address this skills crisis should be the education system.

A rethink of educational structures is required

Given the pace of technological change, simple technical training is not sufficient to produce the fully-rounded employees needed by Europe's software industry. Further, educational styles which teach rote learning, rather than fostering creative dynamics in school, do not give new engineers the necessary freedom to think. In addition, the Eurostat data identified large ICT skills gaps between highly educated (only 11% with no basic computer skills) versus poorly educated (61% with no basic computer skills). With that variance in statistics and the stated European objectives of more aggressively bringing in under-represented groups, a series of scholarships for basic level maths and science education may be useful. Under-privileged or lower-income individuals could thus access better educational institutions.

Incentivise university level education in computer engineering

There are simply too few technical graduates graduating in IT-related fields. This means a dual effort to promote more interest among young people in these fields is critical, along with increasing immigration for highly skilled workers. As the World Economic Forum (WEF) has highlighted consistently, education is a critical ingredient of competitiveness. The quality of science and mathematics education, management training and specialised e-skills training for the workforce is vital to achieving the economic benefits of ICT use.

Foster access to lifelong learning

The need to constantly upgrade skills has been recognised by the Commission as critical to improving Europe's competitive capacity. Given the fundamental

importance of this recommendation, it bears further mention here. Companies find new graduates unable to fulfil essential technical roles. Indeed, as with doctors and lawyers, technical engineers must engage in lifelong learning programmes. European businesses recognise the challenge and are concerned. For instance, IDC found that *“75% of the respondents in a survey across 10 European countries believe that the level of ICT skills of their employees will influence the competitiveness of their organisations, its ability to innovate and its ability to grow.”*

The role of multi-stakeholder partnerships is essential

Part of the challenge with inadequate educational structures comes fundamentally to the speed with which technology changes. Human capacity must be fostered to drive change rather than hinder it. While some of this can happen through modifications to the educational system and increased capacity in maths and science, there is only so much a non-technology dedicated institution can do. Yet, dynamism and new approaches in skills training is essential. To supplement, there needs to be close co-operation between all stakeholders concerned. That may mean enhanced partnerships between university and private sector institutions as envisaged under the ‘Bologna Process’. It may mean more ICT-specific training centres. Or, it may mean investment by individual companies to promote the greater welfare of the industry by augmenting its technical capacity.

The Commission has clearly recognised the value of public-private or multi-stakeholder partnerships in developing e-Skills. Further, the Commission has thoroughly analyzed the situation with respect to public-private partnerships throughout Europe in the findings of *“Multi-stakeholder Partnerships for e-skills in Europe”*. We concur with Commission findings and encourage full implementation and ongoing research in this area to support the growth of multi-stakeholder partnerships for ICT education and training.

Actions

- **Promote the creation of a European framework for the accreditation of ICT educational programmes at university level within the Bologna Process in association with industry.** ERASMUS and other programmes, like the EUREC ‘Master Degree for Renewable Energy’ allow the creation, support and promotion of much needed European academic qualifications in the field of ICT. The European Commission should, as part of the “European Software Strategy”, strengthen similar academic skills initiatives in the ICT and software area. Accordingly, the European Union should also strive to ease, as much as possible, the access of non-EU students to these EU high-tech education programmes.
- **Strengthen the development of new ‘University 2.0’ models to adapt to the social computing phenomena and the networked information economy, and to establish ICT business-university associative partnerships.** The traditional European university concept is gradually evolving towards a “University 2.0” model which integrates ICT and software skills in all university activities. The virtual space of a University 2.0 emerges as the framework for universities to adapt to the social computing phenomena and the networked information economy. In this virtual space associative partnerships between the academic and business worlds will be established for the benefit of the European software interests.

- **To incentivise access to university-level education**, the EU should consider funding scholarships for underprivileged individuals and others to undertake software engineering and related degrees in cooperation between industry and universities.
- **Maintain a careful multi-stakeholder balance in ICT training, driven by associative partnerships (industry, governments and third parties) alongside public support for industry-based ICT skills standards and certifications.** ICT digital literacy, and professional training, e-skills credentials and industry-based certifications - whether proprietary or open source - are part of a much wider policy debate in Europe. As with the debate on technical standards, this discussion is being engulfed in the notion of mandatory formal 'European quality standardisation' by some policy initiatives. Specifically, there is a question of whether to rely on formal or informal training and certification systems, and whether best practices of tested informal delivery of global industry-based e-skills standards and certifications have to be aligned to European quality criteria. As with the issue of technical and software standards, the issue of e-skills standards is not an either-or question. It is not a choice simply of formal or informal standards and certification. ICT skills training, like ICT technology development, is dynamic and rapidly changing. Any work in this field requires close co-ordination among all relevant players. Government sponsored training on its own will naturally fail to respond to the rapidly changing market. Private certifications alone will not meet existing demand. In this environment, government should maintain a careful partnership with the business and training sectors and with independent organisations. Multi-stakeholder partnerships that drive credential value, communication and greater awareness are critical.
- In addition, authorities should **recognize ICT skills value credentials and support industry-based ICT skills certifications to keep European software industries competitive.**

5.3 Enhancing Skills Capacities within the Software Industry

Widening the skill base

These business, marketing, sales and project management skills are a key enabler for the health, growth and competitiveness of the software industry in Europe. A clear understanding and mastering of ICT as the backbone of business processes and as a catalyst for productivity and competitiveness is necessary throughout the whole business value-chain.

Furthermore, with the ever increasing use and reliance on digital technology across the economy and society as a whole, professional capacities in software development and engineering, as well as related management and marketing skills will be widely required in all areas of business and industry, especially the fast-growing service sectors.

Facilitating mobility

In software, as elsewhere, skilled workers are becoming increasingly mobile. Changes in the work model with an increasing number of dispersed offices and project engagements rather than long term employment, and the willingness of graduates to follow a career abroad have had a significant impact on employers. This trend has been reflected in off-shoring, both within the European Union and beyond. Currently, cumbersome work and residency permit requirements impede and sometimes even prevent software vendors from employing third country nationals on pan-European projects, resulting in lower levels of service to customers and lost opportunities for the providers. More must be done to improve the mobility of skilled workers at all levels – as students, researchers and employees - and in this respect we welcome the Commission's proposals for a 'Blue Card' scheme for highly qualified employment²⁹.

As a globalised sector, foreign competition is an established feature of the software market and one that has exercised both industry and policy-makers at length in recent years. Given the skills crisis, it may be necessary to rethink our perspective on this issue. Increasingly, foreign talent is an advantage to be leveraged by European companies, rather than a replacement for European talent. In this globally competitive environment, European industry has to compete for talent worldwide. Europe needs the best and brightest wherever they are.

Access to foreign engineering talent complements and strengthens existing European talent. Competition from emerging markets drives European producers to be more competitive and to link up strategically with complementary technology. Large established multinational players provide much-needed research budget, access to technology, and large economic impacts in the European ICT ecosystem. Because it is already strong, vibrant, and competitive, European industry has itself managed these challenges and turned them into very successful economic and innovative stimulants. Ownership, nationality, location - these terms are increasingly irrelevant in the technology sector.

Actions

- **Creation of a European Software Expertise Network (ESEN) to improve skills capacities within the software industry.** Europe needs more coordination in developing the skills of the existing workforce with regards to product software development as well as running and expanding a product software company. The ESEN would not be a new institution but an open network bringing together established centres and companies. It would be created by ICT-SME oriented associations, existing national ICT trade associations and existing software expertise centres. It would act as a hub for all existing players and facilitate co-operation between them.

ESEN will enable packaged software companies to share expertise and improve some of the most critical skills of the existing workforce in Europe: software engineering, go-to-market (notably cross-border) and management. It will contribute to further enhance the quality of made-in-Europe software, capitalising on European research and best practice in

²⁹ Council Directive on the Conditions of Entry and Residence of Third-country Nationals for the Purposes of Highly Qualified Employment. The Directive would introduce a Blue Card work permit system whereby, after an initial two year period, third country nationals would be allowed to work across the 27 Member States and not be restricted to work opportunities in the Member State that initially grants the work permit.

methods and tools relying heavily on process maturity and systematic reuse. In the long term, the activities of this network would lead to specialisation and to collaboration agreements between both the participants and their member companies.

5.4 Promoting a Digitally Literate Society

As noted above, the skills crisis is not confined to software but is symptomatic of issues facing the digital economy more generally.

Europe already has a mature policy agenda in the e-Skills area, backed up by strong analysis and recommendations. Specifically, this includes among others the efforts of bodies such as the European e-Skills Forum, the ICT Task Force Report, the European Commission's Communication on *"e-Skills for the 21st Century, Fostering Competitiveness, Growth and Jobs"* (September 2007) and the Competitiveness Council Conclusions on *"A Long-Term Strategy for e-Skills"* (November 2007). This latter Strategy, for instance, includes commitments on: motivating and empowering future generations with e-skills; promoting ICT practitioner education and training; boosting the employability of the workforce with ICT user skills; and providing foresight and support for future skills needed in the changing environment.

In short, there is strong consensus on e-skills development in Europe. We welcome and wholeheartedly support these efforts. What is required now is action. **Initiatives under the European Software Strategy should aim to extend and build on current action plans by focusing on professional software skills within the industry itself and in other domains and application sectors.**

We applaud the Commission for recognising the persistent problem of digital illiteracy in the Communication, and also through its monitoring and research. We agree that the ambitious goal of digital literacy will not be reached by itself. Europe needs a long term e-Inclusion strategy to avoid the risk of 30-40% of the European population being marginalised and the Communication represents an important step in this direction. In this respect we would especially like to single out the call to bring the industry-based and formal education closer together. If we want e-skills to be disseminated throughout the population, we need to pursue more flexible approaches to learning, bridging the different interests of industry, governments and of all stakeholders concerned in order to achieve this common goal.

We believe one of the most important concepts from these discussions is something summarised as 'access to access.' Throughout the entire 'training-employment value chain', from access to technology and physical infrastructure in schools, access to training and content, curricula and certifications, access to public funding, and finally access to labour placements, each is key[ref]. Each of these elements needs to work in tandem or the cycle simply does not work.

In 2008 The e-Skills Industry Leadership Board (ILB)³⁰, in conjunction with EU bodies and other institutional actors, developed a set of critical recommendations on the "access-to-access" concept. These called on policy-makers, European citizens and relevant stakeholders to build on tested best practices and to highlight the role of

³⁰ See: www.e-skills-ilb.org

multi-stakeholder partnerships to provide sustainable ICT training and industry-based qualification schemes, recognised credentials and certifications. [ref]

Finally, it is important to recognise that ICT-SMEs are everywhere and embedded in their communities, and hence can be a key enabler to transmit eSkills throughout the economy.

Actions

- **Foster e-Inclusion, general e-skills and lifelong ICT learning among the labour force** through multi-stakeholder partnerships with industry and other stakeholders concerned (as above).
- **Ensure 'access to access' throughout the entire 'Training-Employment Value Chain'**, including access to technology and physical infrastructure in schools, access to training and content, curricula and certifications, access to public funding, and finally access to labour placements. Government and industry efforts should support the ILB's existing work in this area.
- **Improve the image of the ICT and software industries, especially targeting the youth and women**, through a continuous European awareness campaign on high-tech basic ICT education capabilities and professional ICT careers opportunities in Europe.

6 Challenge 2: Creating Innovative Capacity

6.1 The Innovation Environment

A less innovation-driven environment in Europe, leading to a slower adoption of software

Studies show that enterprises, especially SMEs, in Europe are much slower to adopt ICT than their American competitors [refs]. One of the main reasons for this is that IT is much less frequently seen as a key differentiator to be more competitive. In the United States, companies will hesitate less to rethink and change their organisation if they see a competitive advantage through ICT. There is also more in-house software in Europe, and a lower degree of propensity to acquire packaged software offered by software vendors, especially from European vendors that are often seen as too small. Although there are important differences between countries, the general innovation ecosystem is weaker (less clustering between companies, research labs, venture capitalists and business angels, less massively funded universities, no strategic use of public procurement to boost innovative SMEs). Furthermore, small European software companies suffer from a widespread "risk averse" mentality (private and public customers, banks, etc.).

The European Commission has done a lot to stimulate demand and remove the barriers to enable the successful adoption of ICT. The EU's i2010 strategic framework, the Lead Market initiative and the launch of the Competitiveness and Innovation Programme are crucial steps in the right direction. But there is still a long way to go. This demand side approach must continue, including current standards policy orientations and increased visibility of the "Sectoral e-Business Watch". But it has to be complemented with a software-specific supply side approach.

Research and innovation are performing well under potential

Software is a major focus for research and innovation, and is recognised as being a source of systemic innovation in other sectors. However the innovation level at European scale is undermined by the current high fragmentation of the European ICT industry.

In this industry excellent R&D has often proved to be counterproductive if not combined with excellent development strategy, marketing and a channel policy. European software companies tend to have good R&D but have suffered from insufficient anticipation of go-to-market and industrialisation phases (product marketing, packaging, setting up a customer support service etc.). This is mainly due to a lack of marketing and managerial skills.

One approach is 'productisation', a standardisation of the firm's offering so that the cost and effort of selling and serving an additional customer decreases. Productisation results in making the product easier to market, sell and deploy. Studies in Finland have shown that companies that start to productize their offering usually go through a transformation process, from technology companies to product companies, and then to marketing companies. According to one respected Finnish entrepreneur this is still a disadvantage compared to US companies, which are marketing organisations from day one. Nevertheless, one of these Finnish studies [ref] demonstrated that innovations indeed have a statistically significant positive relationship with firm growth. However, this only occurs in cases where firms have made both technological and non-technological innovations.

Thus, Europe must encourage not only research but innovation. This will be especially important in the context of Software 2.0 where innovation will be even faster and much closer to the market. Good policy should target and encourage companies that invest in the complete innovation value chain: idea, concept, development (including translation and documentation), validation-pilot, and go-to-market (product marketing, business development). European R&D funding schemes could be used to target and stimulate this value chain approach, in particular helping them make the transition to Software 2.0 businesses.

Access to research funding

Software SMEs experience the same difficulties in accessing R&D funding schemes as SMEs in general. The barriers include: lack of information, too much red tape generated by calls, burdensome submission and negotiation processes, project management and reporting rules, etc.

Although improved since 2007, the existing European programmes are still too complex. Too often they are still only accessible to the "happy few" companies that have the information and the know-how to apply, or to big companies that can afford to employ specialised teams. We support the proposal for a two-step approach, as proposed in the 2008 Aho evaluation report [ref], allowing applicants to access initial seed funding to develop an idea.

Some difficulties are more specific to software companies. The innovation cycle in software is faster, with less massive R&D than in other high-tech sectors. It hardly matches the pace of traditional European R&D projects. Very often, software companies have already developed the technology and need to focus on pilots, demonstrators and go-to-market activities.

Furthermore, in the software industry most of the early investments (e.g. in people, algorithms and code) are not counted as “assets” in accountancy terms. Moreover experts and venture capitalists involved in the evaluation process often do not know the sector and are reluctant to fund companies with balance sheets that appear very weak.

IP issues are also particularly sensitive. When contemplating whether to enter into European projects, software SMEs do not see how they will receive a satisfying return, even in small and medium projects, as protective measures imply a full and complex process.

Finally, the top-down approach of the Strategic Research Agendas, which define top-level EU research priorities, is a hurdle for software SMEs that can not be well represented in such a process.

Fostering innovation eco-systems

The growing maturity of the IT ecosystem can be observed in the form of commoditisation of software and a growing relevance of interconnectivity as demonstrated by the discussions around interoperability and open standards. As observed in other industries (e.g. automotive), these trends will inevitably lead to an increased reuse and recombination factor, where only differentiating components are produced in-house while generic components are being reused or co-developed.

A well-developed OSS ecosystem is an ideal breeding ground for such an economy. The increasingly well-developed legal infrastructure around OSS, also thanks to initiatives such as the European Public License (EURL), provides a solid and reliable foundation for public and commercial activity, with clearly established ground rules that fall into no more than three basic categories.

While these trends and their impact seem largely inevitable, Europe is in the uniquely favourable position of already having a healthy OSS ecosystem in place that it can build upon.

Actions

- **Launch the EUROSOFTE programme supporting innovation in software-based SMEs.** This ambitious new programme would address the difficulties encountered by software SMEs in accessing public funding schemes for research, development and innovation. Modelled on the successful Eurostars Programme (which operates under Eureka rules), this would fund projects focussing on innovation rather than just R&D and would cover the whole innovation cycle, including validation-pilot, go-to-market both locally and beyond domestic borders within the EU. It would award a label to companies for meeting a series of criteria (such as usability of products in different European languages and cultures). Such a programme should be tested on a small scale before being rolled out Europe-wide.
- **Encouraging collaboration between OSS communities:** Europe has already done valuable work in OSS, and the specific research and development efforts of DG INFSO in the field of OSS have contributed in various ways to the growth of a healthy European IT ecosystem. This work should be built upon and intensified so as to spread the benefits from these projects both in form of available products and services, as well as increased reuse and

recombination factor. The Commission should try to get things more organised and shared by and between OSS actors and communities. Europe has several OSS consortiums, foundations and communities: these have many common needs and issues but suffer from “fragmentation”. They should be encouraged to operate in more global frameworks, maybe by joining their efforts, goals and roadmaps. They could be used as well as a vehicle to capitalise and build on top of open software resulting from European R&D projects.

- *...possibly add opportunities in the green IT agenda as a strategic innovation theme – promote the use of software in making IT greener and in sustainable development more generally.*

6.2 Public Procurement

Today it is widely acknowledged that ICT - and in particular modern software solutions - are essential to enhance the cost efficiency as well as the quality of public services. In turn, public sector investments in technology will reduce administrative burden for businesses and citizens and will significantly contribute to European growth and competitiveness. Public administrations in the EU have yet to fully exploit the potential of ICT, however. Member States' investment in eGovernment is not sufficient and cross-border public services are still the exception. Consequently, a truly internal market for eGovernment applications does not exist, despite various EU initiatives such as the i2010 eGovernment Action Plan, and Ministerial Declarations on eGovernment.

The public sector is by far the largest procurer of software and therefore public procurement policies can exert huge leverage in the European software market. The large majority of public procurement contracts of interest to software businesses fall under national procurement legislation. This has enormous macro-economic implications, and strongly impacts the ICT industry and wider business stakeholders. Public procurement presents particular barriers for SMEs, who are often not able to accommodate the high costs and slow processes involved in public tenders.

There is an increasing willingness in Europe to utilise procurement to promote particular business or standards development models. Most recently, EU initiatives - in particular the EIF - have sought to prefer products that follow certain implementations of open standards, implementations which some argue are too narrowly-defined. Individual Member States have followed the EU's lead, adopting formal policies in favour of one technology or software model over another. This may exclude many popular solutions based on widely-recognised open standards, in particular by excluding technologies implementing RAND-based standards. These decisions may impact the choices of other organisations that work with the government sector, inhibiting the ability of software companies to compete on a level playing field. In addition, it is important to recognise that EU policies influence public procurement around the world.

Others argue that the current position is stacked heavily in favour of incumbent large proprietary suppliers, with the result that lock-in has occurred to a significant extent precluding new suppliers or alternative models. According to one analysis, this affects up to 90% of public sector organisations in Europe [ref OFE]. A way around

this is for schemes which aim to identify and avoid lock-in in new procurements and developments. One such scheme, Certified Open®, is currently being reviewed and trialled in partnership with a European national government.

This is a controversial area for which we have been unable to agree detailed recommendations. We offer, instead, the following observations and suggestions:

1) Technology neutrality and consumer choice as the guiding principles of European public procurement in software.

Voluntary, industry-led standard setting is the most effective way to develop platform-neutral and market-based standards. When these standards are open and available to all through reasonable and non-discriminatory licensing they help developers to create products that can interoperate with each other. It is important that government policy recognizes that open standards - which are available to any software developers - are not synonymous with, and do not require, open source software either for their adoption or utility. Developers of commercial software that may not typically publish their source code often contribute technology and intellectual property needed to develop new standards.

Promoting competition, vendor choice and adaptability to evolution in technologies and user needs should be the guiding principles here. In general, the marketplace is the best way to ensure innovation in software development. Consumers should be allowed to select which model works best for them and public procurement policy should not discriminate in favour of or against one model over another.

2) Public procurement can be a vehicle for promoting innovative applications.

In today's market, innovation occurs not just in product development – whether in software or hardware - but also in areas such as integration and service delivery. This may be an aspect of SaaS or use of social networking in communication with citizens, etc. As key purchasers of software-based systems, public procurers can be prime movers in helping to bring innovative applications to market. Often such provider will be a small local SME integrator working in a tight niche market. The OSS business model may be particularly well tuned to such an approach, because of its focus on shared development.

'Lead markets', in which public agencies become early adopters of new technology, have been discussed for some years and could also be a means for promoting innovation through public procurement.

3) Results of public-funded research should be widely available.

For many years, governments have made important contributions to technology by funding basic software research. When public funds are used to support software research and development, the innovations that result from this work should be licensed in ways that take into account both the desirability of broadly sharing those advances, as well as the desirability of applying those advances to commercialised products. The dissemination of results broadly in this manner contributes to a sustainable cycle of innovation in which government funding for basic research advances the set of knowledge available to the public while helping spur advances in commercial products. These products in turn create the jobs, profits and tax revenue necessary to fund future rounds of public research.

4) Removing onerous contract conditions

Currently, the European software and services industry is heavily weighted in favour of small SME organisations, yet current government procurement practice is equally heavily weighted towards awarding contracts to large consortia and/or with heavy financial penalties. Such an approach, whilst understandable in the past, needs to be reviewed in the light of new business models, the move to software-as-a-service, and the impact it is having on European suppliers.

6.3 Financing Software Innovation

Few people perceive the software industry as capital intensive. Yet access to capital is one of the major critical success factors. When it comes to speed of delivery, factors such as packaging and go-to-market require much investment. Even if the early stage is the most critical, capital is even more needed during the development stage for international expansion and acquisitions.

The European industry faces a number of barriers here:

- Firstly, venture capital markets in Europe are less mature than in the US. Given that venture capital is needed to start businesses, the European software industry is held back by a lack of development finance *[MS comment: strong statement which needs to be backed up by data]*.
- Secondly, the software industry suffers from a lack of appreciation by investors of intangible assets and misperceptions due to its resemblance to value-add services industries.
- Thirdly, Europe's risk-averse environment is not conducive to serial entrepreneurs, in contrast to the dynamic investment environment of the United States.

These shortcomings could become even more challenging in the future, as businesses strive to embrace Software 2.0. While European software companies have traditionally been technology-centric solution providers, the global trend now is towards services. Many of them have already added the SaaS delivery model to their offering, but heavy investment will be required to compete with more business- and process-oriented global players as the market takes off. Against the background of the current 'credit crunch', these investment demands will not be easy to meet and could soon escalate into a crisis.

Actions

- **Encourage investment in innovative companies with special attention to high-growth companies** (the so-called "gazelles"). This will help accelerate the adoption of software-specific measures by Member States. This, in turn, raises the **need for a single definition of "innovative enterprise"** that would qualify for this sort of support. Such companies should be "innovation-centric" – as opposed to R&D centric under existing definitions - and should also include medium size enterprises.

- **Benchmark and promote national public-private funding schemes specific or adapted to the software sector, so as to boost public-private funding in strategic innovation.** Joint initiatives between government and private financial institutions appear to be the most efficient way to leverage public financing. Examples are found throughout the Member States, while at European level industry-led Joint Technology Initiatives (JTIs) pool public and private (at least 50%) investment in areas where existing funding mechanisms cannot deliver the scale and speed needed. Benchmarking of these initiatives (both within Europe and outside) can provide successful case studies and help to spread best practice.
- **Create a European Software Fund within the existing instrument run by the European Investment Fund.** The new High Growth and Innovative SMEs Facility (GIF), created within the Competitiveness and Innovation Framework Programme (CIP), funds venture funds that in turn invest in innovative SMEs. This is relatively new and little known at present, but critical mass will be important to attract investors and increase visibility of this instrument. Software suffers from a big venture capital shortage and, as a strategic sector for Europe, public policy should make a massive effort to correct the market failure. The European Software Fund should be set up as a separate facility within the GIF, with additional budget. It would focus on investments below €250k, implemented through venture funds investing in innovative SMEs. As well as introducing investors to entrepreneurs, the Fund should also help software companies to assess their needs and get 'investor ready'.

7 Challenge 3: Shaping the Future Internet

7.1 The Future Internet and the Software Industry

Over the last 30 years the internet has revolutionised our economy and society. From an obscure academic network in the early 1980s, the internet has grown into a truly worldwide open infrastructure for information, communication and commerce. The internet is now a central part of our lives in all sorts of ways, and in many activities is displacing traditional channels as people's first port of call. **It is the global network of the 21st century.**

We are now witnessing the emergence of the next generation of the internet, which will lead to a wealth of new services and will have an even greater impact on society and the economy than the internet today. In fact, the Future Internet will be the essential part of Europe's future ICT infrastructure, which will be instrumental to fostering the internal market as well as to achieving the goals of the Lisbon agenda and ensuring growth, productivity, and employment in Europe.

The future of the European software industry is intimately bound to the Future Internet in that the industry will be founded on Internet-based business models, as well as software being a fundamental enabler of the Future Internet. The Future Internet is a key feature of Software 2.0.

The web-based computing environment - "cloud computing" - opens a range of new opportunities for innovation, efficiencies and collaboration, provided that the challenges for openness and standardisation of this new, emerging Internet platform

are met. However, the scope of the Future Internet is far broader than software and impacts all aspects of the ICT market. Consequently our recommendations are concerned with the Future Internet rather than the software industry *per se*. More specifically, we are concerned with enabling a European “web-services” based industry which will provide new markets and new business models for the current software industry.

7.2 Overview of the Future Internet

The Future Internet will be enabled by software and will introduce dramatic changes in the economy over the next decade. And it will unquestionably define Europe's future competitiveness. The scope of the Future Internet can be characterised by the “Internet of Services”, the “Internet of Things”, and the network and data centre infrastructure services that underpin them.

The Internet of Services makes use of service-oriented architecture (SOA), a flexible, standardised architecture that allows various applications to be combined into interoperable services (see Annex 1). The Internet of Services also uses semantic technologies that understand the meaning of information and make content (video, audio, print) more accessible (including by machine). Thus, data from various sources and different formats can easily be combined and processed toward a wealth of innovative web-based services.

In parallel, ‘things’ are becoming smarter. The Internet of Things combines the power of ubiquitous networking connectivity with modern sensor technologies, such as radio frequency identification (RFID). It merges the digital world with the physical world in the sense that information concerning the identity, location, and condition of physical objects can be made available through the internet anytime and anywhere. Moreover, these objects possess the capability to communicate with each other and therefore can become active participants in global business processes.

The Internet of Services and the Internet of Things represent very broad trends that will impact the European software industry. More specifically, it represents a realisation of the technology trends described in Section 4 in areas such as: Software-as-a-Service (SaaS), Cloud Computing, Service-Oriented Architecture (SOA), and Platform as a Service (PaaS). De-verticalisation of the software industry will occur as a result of SOA and SaaS leading to the emergence of software systems assemblers and platform providers, and of software component providers.

Within the next decade people will use their computers completely differently to how they do today. Access to data, applications and content will be seamless and device agnostic. Internet-connected devices are moving towards software infrastructure (OS, middleware, application frameworks) that enable them to consume and provide web services and thus participate both in the “Internet of things” and “Internet of services”.

Core services components will be made available through service APIs and protocols to create a rich end-user experience mixing communication, web and local tools. These components could include real-time communications, multimedia conferencing, data sharing, identification and authentication, user and service profiles, information search, payment transactions, and maps.

7.3 Impact on the European Economy

The impact of this Future Internet on the European economy and society will be significant:

- **The Future Internet will invigorate innovation**, resulting in tremendous productivity gains. The benefits of these gains will be reflected most especially within the retail, manufacturing, logistics services, and energy sectors. According to industry experts, RFID technologies could lead to efficiency enhancements of 40% in the luxury goods industry or even 100% in the food sector. Indeed, rapid adoption of the Internet of Things and Services throughout the European economy could be instrumental in closing the productivity gap with the United States and secure European competitiveness in the years to come. Another area for productivity gains is the adoption of collaborative tools facilitated by Enterprise 2.0 and Cloud Computing approaches.
- **The Future Internet will shape the future of the services sector.** The Future Internet will undoubtedly become one of the major growth engines in all knowledge-based societies. It will be a business opportunity especially for start-ups and SMEs, and could lead to the creation of high-level jobs. As services comprise two-thirds of European GDP, it is clear that Europe can only sustain economic growth and prosperity by developing strong web-based services industries. Moreover, web-based services developed in Europe could easily be exported to global markets.
- **Future Internet will improve competitiveness.** Service-based approaches allow companies to cut costs and this will enable growth, in particular by small businesses. It used to be that every growing business would at some point have to make a big investment in computers and software for accounting systems, customer management systems, email servers, maybe even phone or video conferencing systems. Increasingly all of those services will be available via the network cloud, and users will only pay for the services they use. So small businesses can scale up without making huge capital investments³¹. By bringing sophisticated computer systems that were previously accessible only to larger players within the reach of small businesses, cloud computing levels the playing field. Given that small businesses generate most of the jobs in the economy, this is no small trend.
- **The Future Internet will bring disruptive technologies** that will create tremendous business opportunities for the ICT sector itself. The world market for technologies, products, and applications related to the Internet of Things alone is estimated at €7.76 billion by 2012, with average annual growth rates of almost 50%. As explained above, SaaS also presents a major growth market. Platform-as-a-Service could become a major enabler for innovation especially by smaller IT firms in Europe (see below).

³¹ For instance, the UK Broadband Stakeholders Group (BBSG) estimates the online model would save companies £350 a year per person in support costs. If 30% of SME staff made the switch to cloud computing, the savings across the UK would total £620m a year.

7.4 Challenges for Europe in the Future Internet

There are many technical, commercial and regulatory challenges in the development of the Future Internet, **not least of which is the development of a shared vision**. These are being discussed and addressed in many fora within Europe and internationally. Here we focus on those we believe are the most significant for Europe generally and the software industry in particular.

7.4.1 A European infrastructure for the Future Internet

The broad vision of the Future Internet is predicated on a number of developments in the evolution of the underlying infrastructure. Ubiquitous and pervasive connectivity, increasing the availability and predictability of high-bandwidth for all users, and the availability of on-demand “cloud” computing and storage resources.

Whilst positive progress is being made in all aspects, it is important to recognise that there are issues in each area that could impact the opportunities for growth in the European software industry. They include:

- **Openness is under threat:** As the web continues to increase in economic and social importance, so the incentives for some economic operators to deviate from the currently prevailing open and collaborative model are accentuated. For example, platforms based on closed and vendor-specific specifications that lock-in customers (thus denying them access to innovation from third parties, and constraining the available market for those third parties), or discrimination by internet service providers and network operators in favour of their own or affiliated applications and services over those offered by competitors. **A fair, non-discriminatory, transparent and competitive playing field that ensures consumer choice must be maintained** so that end-users can reach the Internet applications, content, and services they desire, without anti-competitive discrimination or restrictions. Only then can the Internet keep innovating and drive the economy, giving consumers and enterprises greater choice at an affordable cost, and delivering maximum benefit to the European and global economy.
- **Major investments in infrastructure required, driven by regulation:** The Internet is increasingly a critical component underpinning traditional industry value chains, as well as the basis for entirely new markets. In the Internet's open ecosystem, all parties depend on one another and the development of advanced Internet access offerings to consumers and businesses is essential for innovation by application and content providers. Moreover, the unprecedented wave of innovation in Internet applications and content is driving user demand for significantly increased bandwidth. Consequently, **significant investment is now required in the development of the Internet within Europe in both core and access networks**. Clear and consistent regulation will be essential to allow the necessary investment to be made on a sound commercial basis and preserve the natural cycle of innovation and investment in the Internet.
- **Accountability of resource use:** The TCP protocol includes mechanisms to manage and counter the effects of traffic congestion across the Internet. However there remain opportunities for individuals and application providers to exploit the architecture and provide themselves access to network capacity that

results in a degradation of the experience of others. These typically manifest themselves through inconsiderate use of P2P & UDP. Whilst individuals - citizens and businesses - should be free to use the Internet as they wish, they should not be able to do this at the expense of others, i.e. they should be accountable for their use of Internet resources. The IETF is studying and developing responses to these issues but solutions will require uptake across the industry.

- **Security of Future Internet infrastructure:** In addition to the connectivity afforded by the Internet, on-demand computing and storage resources – in the form of cloud services - are increasingly considered a critical part of the Future Internet infrastructure. The markets for these services have only just begun to emerge and there are significant opportunities for European companies to develop and capitalise on both in Europe and globally. However, whilst there is significant operational infrastructure within Europe, it is important for the Commission to consider that Europe is currently dependent on a relatively few US companies for commercial control of these critical services. Moreover there are significant financial and regulatory barriers for any European company wishing to develop competing services. For example, the varying planning regulations required to establish significant data centre sites.

Actions

- The Commission should support **a consistent regulatory environment across Europe** that allows for an adequate return on the investment required to develop the necessary network infrastructure, and that the return should reflect the risk premium.
- The Commission should support international activities to develop **an Internet control architecture that allows for a fair and equal experience for all users of the Future Internet** without discrimination, and should promote its adoption across Europe.
- The Commission should study further **the European opportunities and requirements on cloud services in the Future Internet infrastructure** to identify any potential barriers.

7.4.2 The Future Internet as an open platform for innovation

Open standards are the guarantors of today's internet. The internet is predominantly based on open standards for protocol and data formats, notably TCP, IP, HTTP, and XML/HTML. These standards give any and all users both internet access and the ability to create innovative content and offer innovative services on the internet. Moreover and crucially, the most important internet standards are not just open, they are also non-proprietary. Neither prior permission nor royalties are required to implement them. This means that all hardware, software and service vendors can freely create products which interoperate perfectly with others across the internet.

This ability of different software applications and services to access and exchange data via the internet, to read and write the same file formats and to use the same protocols and open standards is the vital condition for the continued development and dynamism of our increasingly networked world.

Moreover, with a significant cloud computing environment emerging, policy-makers should be vigilant of attempts to leverage closed standards built on proprietary technologies, protocols, formats and programming technologies, to the Internet. It is important that the Internet logic and software players' industry-wide demands for openness survive any potential pressure from players with other business models.

Furthermore, the Internet industry has developed a range of dynamic standards-setting processes, and it is important that:

- (1) these processes remain open and transparent; and
- (2) all players effectively implement web standards and do not “fork” agreed standards, for instance by adding proprietary extensions that create *de facto*, *closed* standards.

Actions

- Public authorities should seek to ensure a commitment from vendors to **the interoperability of software products based on open, non-proprietary standards** - the very foundation of the internet.
- Public authorities should ensure that public R&D funding and public procurement reinforce the openness of the internet by **funding and procuring open standards based products and solutions**.

7.4.3 Accountability in the provision of composed internet services

In the “Internet of Services”, a service accessed by an end-user (through a web interface or using a dedicated device) may rely on numerous internal services hosted by different parties. The responsibility for the quality of service, the security, the reliability of the composed service will thus be shared by these parties. The responsibility chain replicating the service invocation chain should be accessible to the end-user as well as some information of the different actors involved.

Actions

- The Commission should encourage the emergence of **a quality label and appropriate referencing of the elementary services** available in the “Internet of Services”. This should be based on functional and non-functional requirements (availability, guarantees of persistence of the service, legal information of the service provider, location of the data hosted by the service, conformance to privacy protection schemes) and may lead to the creation of repositories of critical services, hosted by third parties by delegation (similar to what is done today regarding domain names).
- Promote the emergence of **European trusted third parties to authenticate users and services providers** in the Future Internet and to enable access rights management on individual or composite services. This would be a key step in protecting service providers against fraud or illegitimate uses and users from undue access to their data.

8 Conclusions

8.1 Rebooting Europe's Software Industry

In concluding, firstly we wish to thank the Commission, and the Commissioner, for inviting an open debate on the future of Europe's software industry. Wide-ranging and probing analysis, within a field that up to now has lacked a clear policy framework, is long overdue.

The issues are complex and often the discussion has been highly charged. While we have been unable to agree in all areas, we are united in our desire to see the European software industry succeed. Although some of us would have wished to have gone further, the challenges we have identified are real and significant, and warrant serious attention from both the industry and from policy-makers.

Our investigation comes at a pivotal moment for the software industry worldwide. Traditional business models are breaking down; the sector itself is globalised; technology evolution is opening up many new possibilities; and customer demands for and expectations of software are changing fundamentally. Whichever camp people sit in, they will have to change.

What is required is a new spirit of innovation and entrepreneurship in software. We must nurture, attract and retain the top talent – the best programmers, managers, entrepreneurs – wherever it is to be found. We must build innovative capacity and create ecosystems best suited to the industry's particular innovation model. And we must drive a coherent European approach to the Future Internet, to which the future of the software industry is intimately bound.

With determination and a common vision, we in Europe can seize these opportunities and establish top positions in the market for software **and services** that is now emerging. We must enable a European "web-services" based industry – a Software 2.0 - which will provide major new markets and new business models for software. **The time has come to press the reset button and reboot Europe's software industry.**

8.2 The Role of Policy

First and foremost it will be the responsibility of the European software vendors to exploit this potential. Indeed, we strongly believe that the sector should continue to be market-driven and that regulatory intervention should be kept to the minimum and limited to addressing market failures.

However, EU policy-makers have a role to play to ensure a favourable environment for both the development of a strong European software industry and the adoption of software by enterprises, consumers and administrations in Europe.

Recommendations in relevant areas were presented above and are not repeated here. Rather we take the opportunity to set out some principles for action and to comment on other issues which seem relevant to us.

- **Policies must be model neutral:** We repeat again that any policy measures should be neutral with respect to technology, vendor and the underlying

software and business models. Given the dynamic development of new technologies and business models, policies that are designed to foster specific technologies or software and business models could hinder innovation and distort competition. Rather policy-makers should ensure a level-playing field and a favourable environment for all market players. In this respect, the European Commission should help to address the bottlenecks for the growth of the whole European software industry that were identified in the previous sections.

- **Toward a truly-functioning Internal Market:** Obviously, one of the major stumbling blocks for the development of a strong European software industry is the fragmented market structure in Europe. National markets differ significantly in terms of regulation, IPR, labour law, and so forth. We have not addressed these issues in detail. Against this background we would like to encourage the Commission to launch an empirical study to analyse the specific barriers for an internal market for software in the EU and propose policy measures to address them.
- **Lowering barriers to trade:** The EU in its trade policy should ensure fair access for European software vendors to third markets. This in particular holds true for IT security policies such as in China. In this respect, the Commission should deepen the engagement to break the existing market access barriers, share models of information assurance, and promote EU-third country collaborations.
- **Raising visibility of the European software industry:** While there is an increasing awareness among European policy makers about the growing importance of ICT for society and the economy, the role of software in this context is often overlooked. We therefore recommend that any European Software Strategy should strive to raise the visibility of the European software industry. Otherwise the impact of such a strategy, especially with respect to adoption of proposed measures in EU Member States, will be rather limited. We particularly propose to closely link the European Software Strategy with the EU Stimulus packages, the new Lisbon Strategy and the EU programmes related to energy efficiency.

ANNEX 1

...list of participants to be added