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Towards a competitive European Internet industry

A socio-economic analysis of
the European Internet industry
and the Future Internet
Public-Private Partnership

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Prepared for European Commission, Information Society and Media
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Preface

What will the future Internet bring us? This is a question that keeps many policymakers, researchers and industry players busy. Not only because the Internet has transformed our daily lives over the past decade, it has also revolutionised the way we do business. While there remain challenges, in the coming decade the Internet promises to fuel economies and improve well-being. However, Europe has been slower than the US, Korea or Japan to capture the full benefits of the Internet economy.

The European Commission has recognised these challenges and opportunities in its Digital Agenda for Europe and aims to stimulate Europe's competitiveness in Future Internet technologies by investing in a Future Internet Public Private Partnership.

This document presents the Final Report of the study in support of this Future Internet Public-Private Partnership (SMART 2009/0044). The study, labelled FI3P, is commissioned by European Commission DG Information Society and jointly conducted by RAND Europe, IDC, WIK-Consult, IC Focus and Istituto Superiore Mario Boella (ISMB). The study is set up to estimate the potential economic and societal contributions of the European Internet industry as well as the impacts of EU support for a Future Internet Public Private Partnership (FI PPP).

Through objective analysis and research, combining a range of different methodologies, the FI3P study supports the European Commission in its deployment of the Digital Agenda, and the Future Internet PPP in particular. In doing so, the study aimed to:

- Identify the key drivers and opportunities for the development of the European Internet industry, its growth and competitiveness;
- Estimate the potential future economic contributions of the European Internet industry;
- Estimate the economic impacts of the Future Internet PPP and its potential successor; and
- Identify, assess and address the future barriers to competitiveness of the European Internet industry.

The study finds that the Future Internet has considerable economic potential for the EU Internet industry and Europe has the opportunity to reap these benefits. But only if some tough choices are made and a number of barriers to its international competitiveness can be overcome.

This document should be relevant to European policymakers with an interest in enhancing the competitiveness of Europe's Internet industry and to anyone with an interest in Internet economics. For more information about the FI3P study or this document, please contact Stijn Hoorens (hoorens@rand.org), Jonathan Cave (cave@rand.org) or visit the FI3P website (<http://www.fi3p.eu>).

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List of abbreviations

3DTV	Three-dimensional television
AFIS	Automated Fingerprint Identification Systems
B2B (or BtoB)	Business-to-Business
B2C (or BtoC)	Business- to-Consumer
BEREC	Body of European Regulators for Electronic Communications
BRIC	The group of countries constituted by Brazil, Russia, India and China
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CEF	Connecting Europe Facility
CDN	Content Delivery Networks
CRM	Customer Relationship Management
DDoS	Distributed Denial of Service
DAE	Digital Agenda for Europe
DE-CIX	German Internet Exchange
DVR	Digital Video Recorder/Digital Video Recording
EIB	European Investment Bank
EUII	European Union Internet Industry
FI	Future Internet
FI PPP	Future Internet Public Private Partnership
FRAND	Fair, Reasonable and Non-Discriminatory
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GINFORS	Global INterindustry FORecasting System
GPS	Global Positioning System

HDTV	High Definition Television
ICT	Information and Communication Technology
IDS	Intrusion Detection System
IMS	IP Multimedia Subsystem
IoS	Internet of Services
IoT	The Internet of Things
IP	Internet Protocol
IPO	Initial Public Offer
IPR	Intellectual Property Rights
IPTV	Internet Protocol Television
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISPs	Internet service providers
IT	Information Technology
ITPS	Institute for Prospective Technological Studies (European Commission, JRC)
ITU	International Telecommunication Union
JRC	Joint Research Center (European Commission)
M&As	Mergers and Acquisitions
M2M (or MtoM)	Machine to Machine connectivity
Mbps	Megabytes per second
MNOs	Mobile Network Operators
NetCo	Network Company
NFC	Near Field Communications
NGA	Next Generation Access
NGN	Next Generation Networks
NRA	National Regulatory Authorities
OLAP	On-line Analytical Processing
OpCo	Operating Company
OPEX	Operational Expenditure
OECD	Organisation for Economic Co-operation and Development
PAN	Personal Area Network
PC	Personal Computer

PFI	Private Financing Initiative
PPP	Public Private Partnership, in this context: the currently deployed Future Internet PPP
PPP+	Potential successor to the current Future Internet PPP
QoS	Quality of Service
R&D	Research and Development
RDBMS	Relational Database Management System
RDI	Retail Demand Intelligence
SaaS	Software as a Service
SME	Small and Medium-sized Enterprises
SOA	Software Oriented Architectures
TCP	Transmission Control Protocol
VAT	Value Added Tax
VoIP	Voice-Over Internet Protocol
WORM	Write Once Read Many

Executive summary

The Internet has become a fundamental enabler of economic development and growth, but Europe lags behind other countries in capturing its benefits.

The Internet has fundamentally changed the way we stay in touch with friends and relatives, search for and purchase products and services, entertain ourselves and participate in society. It has also transformed the way we do business.

However, Europe has been slower than the US, Korea or Japan to develop and capture the full benefits of Internet-based innovation. This makes it a follower, rather than a leader in the global Internet industry. As a result, the European Commission determined that the Future Internet and innovation are crucial components of the EU 2020 growth strategy and its flagship initiatives, the Digital Agenda for Europe and the Innovation Union.

A Future Internet Public-Private Partnership (FI PPP) initiative was officially launched on 3rd May 2011, in which the European Commission and the European Internet industry sought to join forces to lay the foundations for the Future Internet in Europe. The FI PPP seeks to advance Europe's competitiveness through the development and deployment of advanced "Future Internet" technologies, systems and services and thereby to support the creation and uptake of enhanced applications of social and economic relevance.

This report examines the potential impacts of the technologies, services and applications being developed by the FI PPP.

This report is the final phase of a study (FI3P) designed to analyse the challenges facing the European Internet Industry and the mechanisms by which the FI PPP is addressing them. An earlier report (Cattaneo *et al.* 2011) characterised the key segments and the main players of the European Internet industry. This report builds on that analysis to explore the current and future role of the European Internet industry in, and for, the European economy.

This report explores the role of the **EU Internet industry** in, and for, the European economy of the Future

We approach this exploration from various perspectives in order to examine how the European Internet industry may grow and develop in the near future. We explore how the economy may develop in

various scenarios and how those developments are likely to be affected by the success or failure of the core platform and use cases being developed by the FI PPP. This report addresses the following issues:

- the determinants of growth and competitiveness of the European Internet industry;
- the potential future contributions of the European Internet industry to Europe's economy and society;
- the economic impacts of the technologies, services and applications pursued by the current FI PPP and its potential successor; and
- other barriers that may affect the uptake of these Future Internet elements and the competitiveness of the European Internet industry.

European firms dominate the more mature, slower-growing segments of the Internet industry, while higher growth segments remain relatively untapped.

The European Internet industry (EUII) can be divided into three components: 1) a “core” providing Internet IT and network products and services; 2) a linking component providing Internet telecom services; and 3) a fast-emerging “web ecosystem” whose actors

60% of the revenues in the EU internet industry come from telecom services

provide web-based applications, services and content in close and innovative relationships with users and traditional players.

The core Internet industry tends to be dominated by global IT players based in the US, while Internet telecom services are led by the predominantly European telecom suppliers, who gain the lion's share

of the EUII's revenues (58% in 2012). This is a natural consequence of the geographic localisation of telecom networks and their historical origins as national and natural monopolies. Our estimates of EUII's revenues include only sales of Internet-related technologies and services and exclude general purpose IT, such as PCs. Web ecosystem revenues do not depend on technologies, but on other services, such as e-commerce, advertising, or subscriptions, which were not included in the EUII's revenues.

In the globalised Internet industry, Europe is also relatively strong in network equipment and smart handheld devices, but faces tough competition from its Asian counterparts.

Europe has only limited presence in the new and rapidly-growing areas of software and IT-services and the web ecosystem, at home or abroad. In particular, business models based on advertising or data mining —characteristic of many successful players in the web ecosystem— are only sparsely represented among the European players in the European Internet industry.

Revenue growth is projected to vary widely across different parts of the Internet industry.

Looking ahead to 2015, software and IT services are expected to be the most dynamic components of the EUII, driven by the diffusion of cloud computing, mobile apps and innovative applications such as big data analytics, at rates of 12-13% annually. The telecom services and network equipment and operations businesses are projected to grow at a modest 5%.

Significantly, even growth in the network aspects has held up during the current recession; thus the Internet Industry can be expected to lead the recovery of the ICT market from the economic crisis. It is not evident that the rest of the economy will follow, or that these growth rates can be sustained if growth does not spread beyond the Internet industry.

Demand for Internet-related technologies and services is estimated to grow rapidly in all business and consumer segments, but particularly in those sectors where European suppliers are currently lagging behind in the intensity of IT usage. This includes: utilities (12.7%), healthcare and education (9.7%), business services (8.4%) and distribution (8.2%). As a result, on current trends Europe's dependence on foreign IT suppliers at home will grow and her share of lucrative global technology markets will shrink.

The next decade will be crucial for the European Internet industry.

Sustaining competitiveness and innovation will require different strategies for the EUIT's players who face an increasingly convergent market from very different starting points. European IT players—in majority small and close to local markets—will have to become bolder, find new financial and human resources to invest in innovation, look for new clients and possibly test their mettle beyond the EU borders. Or else, they might be wiped away by emerging players stealing their market. One example: Amazon's revenues from its cloud-based services are expected to reach US\$1 bn in 2012, in direct competition with the IT industry.

But perhaps the greatest challenge lies with Europe's leading players (from the likes of Nokia and SAP to the former telecom monopolies) who must adapt or renew their business models and need unprecedented levels of investment, even at a time of austerity.

Europe's leading players
must adapt or renew their
business models

The strategic assets that once sustained a relatively small number of dominant market players, particularly in the telecom sector—for example fixed line subscriptions—are becoming less important due to different and sometimes disruptive technological and market trends.

These challenges can be met in different ways.

One is for incumbents to gain a new lease of life by vertical integration and diversification into the IT and service layers ('facilities-based competition'). Another is a layered competition structure. At the base of this structure, both communications and network services are provided as utilities, sustaining a common platform on which the web ecosystem can thrive. In any case, the industry will have to find ways to support the continued development and deployment of (open) network infrastructures without restricting the flow of rapidly evolving Internet-based applications and services generating value for end-users. Each path has its own requirements: openness requires interoperability and standardisation to allow a competitive web ecosystem to flourish. Moreover, innovation is slower and offers more general benefits in communications and IT services. It is faster and easier in the applications and user services domain, but benefits are more localised to the innovators themselves and their customers.

In order to sustain useful networks, innovative applications and services and adaptive business model and markets innovation, unprecedented and risky investments are required. The risks range from technological R&D risk, infrastructure deployment risk and/or market risk facing new services or products. The public nature of the benefits and the unwillingness of (esp. European) capital markets to take long-term, systemic and novel risks might be seen to justify large-scale public funding. However, at the moment governments are more committed to austerity than to growth, while businesses are flush

with capital but lack attractive investment opportunities. Neither traditional industrial policy consultation nor efficient capital markets seem able to clarify and appropriately allocate these risks or fund necessary investment.

Clearly, Europe's Internet Industry needs access to suitable financing, mechanisms to clarify and reallocate risk and efforts to stimulate entrepreneurial activity, including support for start-ups.

In the process, governments will have to move from picking winners to sustaining competition. Large and small businesses alike must open their innovation, production, delivery and value chains to suppliers and users on much more equal terms. Agile and small-scale enterprises and user-led innovation are especially important to the Internet industry. Therefore, industry should embrace flexible business arrangements and lower adoption costs in order to encourage end users to exploit the potential of new Internet-based services and applications.

The future economic contributions of the EUII depend critically on the evolution of the global technological, economic and societal context.

The potential contributions of the Internet industry were assessed in three different scenarios for the period 2015-2020, based on plausible assumptions about the future magnitude and trends of key variables summarised in Box A.

Box A. Three scenarios for the future EU Internet industry				
Recovery begins at home, but SMEs still struggle.	Dynamic recovery is led by agile, self-organising networks of small firms.	Prolonged economic malaise prompts myopia and retrenchment.		
The Realistic scenario represents intermediate economic prospects, a modest pace of innovation and a homogeneous pattern of Future Internet deployment and exploitation. This situation leads to continuing volatility and a weak position for small firms and potential innovators. European firms are more competitive within the EU Single Market than at a global level.	The Tipping Point scenario provides the scope for realising the potential benefits of the Future Internet. Economic growth is demand-led with rapid and balanced recovery from the financial crisis. It is characterised by a good mix of pre-competitive and intra-European co-operation and coordination, with service competition on open platforms and in world markets.	The Slow Motion scenario is dominated by faltering economic recovery, which strikes first at consumers and the home sector. Adoption of Internet-based innovation is slow, top-down and limited across all sectors. The EU Internet industry fails to keep pace with technological developments and invest in foreign markets and gradually loses competitiveness abroad.		

We estimated the economic contributions of the Internet industry (which we call the Internet economy) as the aggregation of BtoC e-Commerce, that is consumption over the Internet, plus private and public investments in Internet technologies and services (the Internet market). Between 2015 and 2020, the Internet economy is projected to grow, depending on the scenarios, between 7% annually in the Slow Motion scenario and 15% annually in the Tipping Point scenario. In the Realistic scenario, which falls between these two, the EU Internet economy should reach € 1,474 bn by 2020. In the best scenario, the size of the European Internet economy would grow from €884 bn in 2015 to €1,877 bn in 2020. These economic contributions are higher than in the Realistic scenario, due to positive feedback between innovation and growth and the greater scope for exploiting and extending Future Internet services provided by a strong economic recovery. Note that

recent macroeconomic developments seem closer to the Slow Motion scenario; however, the continuing volatility and domestic competitiveness of European firms and the modest pace of innovation are consistent with a slightly slower version of the Realistic scenario.

Our projections for the European Internet market suggest that the balance of economic activity will gradually shift to the end of the value chain: away from telecommunications towards Internet services, applications and end-user sectors. In the Tipping Point scenario,

Between 2018 and 2022 changes associated with the Future Internet PPP are predicted to **reduce employment**

this shift happens faster than in the other two scenarios, due to an accelerated diffusion of advanced services into previously immature Internet-using sectors. This downward shift is also caused by a rapid diffusion of cloud computing, which is expected to enable business actors to implement more easily Internet-based new services, particularly SMEs. Faster adoption of innovation by SMEs is indeed one of the distinguishing features of the

Tipping Point scenario, which assumes overcoming legal, cultural and economic barriers which slow down SMEs in the other scenarios.

SMEs fall behind in the Slow Motion scenario. They struggle for access to the Future Internet innovations and many of the sectors in which they are most active are slow to reap the benefits as well.

The growth of the Internet industry generally leads to an increase in employment in the Internet industry itself. However, the fast pace of innovation and the increasing demand for a new range of e-skills applied to business sectors is likely to lead to a mismatch of demand-supply across Europe, with scarcity of skilled personnel in many countries and regions, particularly affecting innovative SMEs, accompanied by unemployment of personnel with obsolete skills. Research suggests there is a risk that by 2015 the European ICT industry will not be able to fill between 86,000 and 384,000 jobs, depending on the pace of growth of the economy. Many of the new jobs created come at the cost of job losses elsewhere. In the rich ecosystem of highly dynamic and networked SMEs under the Tipping Point scenario, the Internet industry is more likely to produce high-quality employment than in the other two scenarios.

Successful, widespread and generative adoption across a broad range of sectors of the core platform and generic enablers sought by the current FI PPP can have substantial impacts across the scenarios.

The effect on GDP is potentially positive, significant and driven by productivity improvements. Full deployment, uptake and exploitation of the outputs of the current FI PPP is expected to increase investment, private household purchases of goods and services and labour productivity. Productivity enhancements appear to have a particularly significant impact on EU GDP growth. Under ideal conditions, the spillover effects across the economy unleashed by the FI PPP could raise annual European real GDP by €28 bn (0.24%) in 2020.

However, the distribution of these positive impacts varies among Member States. Overall, the proportionate effect tends to be higher in new Member States, possibly as a result of

the rapid pace of modernisation since these countries joined the Union in 2004 and existing pools of skilled and underemployed labour. In gross terms, however, the impacts projected for 2020 are largest in the largest economies, being €8 bn in Germany, €5 bn in the UK €4 bn in France.

While the changes potentially associated with the FI PPP are projected to increase employment in the European Internet industry, many of those jobs are displaced. The positive employment effect associated with success of the current FI PPP initially peaks at 42,000 jobs in the year 2016. Its eventual positive impacts are even greater, but only after a transitional period of increased unemployment from 2018 to 2022 as real wages catch up with the initial boost to productivity.

A successful potential follow-on PPP could contribute between **€37 and €58 bn** to EU-27 GDP in 2025.

A successful follow-on Future Internet PPP could have even greater positive GDP impacts.

The analysis recognises that the full uptake and exploitation of the core platform, the spread of generic enablers and associated advanced services throughout the economy as a whole and sustained stimulus to innovation and investment are likely – particularly in the face of a delayed or weak European recovery, to require a potential follow-on initiative (FI PPP+). Note, however, that the associated changes might be produced by other means (e.g. private sector initiative) if the pump is sufficiently primed by a successful FI PPP.

A successful FI PPP+ is therefore expected to produce longer and stronger stimuli to investment behaviour, private household purchases and (labour) productivity. Although they vary considerably per scenario, our estimates show an annual increase in European real GDP peaking at €48 bn (0.4%) in 2025 under the most favourable conditions. This would increase the importance of the European Internet economy, raising its direct GDP contribution by a further 10%.

The rate of recovery from the economic crisis is an important factor in real GDP growth. In the Tipping Point scenario, changes associated with FI PPP+ account for €58 bn of the projected €460 bn rise in European real annual GDP by 2025. At the other end of the scale, real annual GDP is forecast to fall by €570 bn by 2025 in the Slow Motion scenario, although changes associated with FI PPP+ make this €37 bn higher than it would otherwise have been.

The employment effects of a successful FI PPP+ are also potentially larger. Employment in the Realistic scenario is expected to grow until 2017, fall as real wages rise, and gradually recover, reaching a maximum after 2025.

Europe has many reasons to seek rapid economic recovery, but fewer hopeful avenues for achieving it. The role of the Future Internet in this recovery is potentially in both respects. The Internet industry is one of the few buoyant sectors in the current situation, and may thus lead the recovery. Conversely, economic recovery could enable the development of a web ecosystem that can enrich the lives of Europeans in non-financial ways. For instance, by lowering the cost and increasing the effectiveness of counter-cyclical employment, health, educational and industrial policies, a successful European Future Internet platform could make Europe more resilient to future macroeconomic shocks. It appears that

European policy can improve the positive impacts of changes associated with a successful FI PPP+ program if it improves investor expectations and willingness to invest and reduces cost pressures on Member States. Conversely, should it fail to do so, the expected benefits might disappear, or even reverse.

But equivalent stimuli in the US or Japan would have larger effects on their GDP.

Whatever Europe does regarding the Future Internet will not occur in a global vacuum. Other advanced economies are undertaking their own FI initiatives.

High-growth BRIC economies have yet to reap the full potential of the Internet, but are their export-led growth and rapid Internet development put them in a very strong position. While the Internet's main contribution to developed economies' GDP comes from private consumption, foreign trade accounts for the majority of the Internet's contribution to GDP in India and China. Hence stimulus programmes in these countries may operate through foreign trade, especially if their exports recover more rapidly than domestic production in the developed economies.

Even other developed countries may be better positioned to benefit from comparable initiatives. Compared to Europe, studies suggest that US investments in ICT generally produce higher direct returns. Our projections suggest that the GDP multiplier effects of US or Japanese stimuli equivalent to those of a successful FI PPP are also larger. This probably reflects Europe's relatively more fragmented and rigid markets, as well as barriers to innovation and to the adoption and diffusion of Internet innovations, both of which have been long-standing European concerns.

The European single market still faces barriers to competitiveness.

The success of the EU 2020 growth strategy and in particular, the EC's Digital Agenda, will depend on the extent to which the European Internet industry is able to compete internationally. While a number of EU countries are world leaders in Internet contribution to GDP, the EU as a whole lags its international counterparts in the US and Japan and has few global players as measured by market capitalisation.

The Future Internet PPP is one initiative to encourage firms to invest in Internet-related R&D. However, despite the introduction of the European Single Market, the potential contributions of the European Internet industry to economic progress and prosperity still face serious competitiveness barriers.

These can be broadly divided among: access to inputs; obstacles to innovation; effectiveness of market competition and cooperation.

The most important barriers identified by our analysis are lack of access to skilled and flexible human and financial capital; insufficient or poorly-formed R&D investment; inadequate market access for innovative business and service models; weak coordination between the Internet industry and other sectors; and economic, cultural and legal barriers that weaken both competitive incentives and the prospects for cooperation. The Future Internet PPP can address many of these, but not in isolation.

The effects on GDP of an FI PPP equivalent in the US would be **twice as large** as in the EU

Making effective use of Europe's labour resources is more important than meeting today's skill needs.

Actions are needed to generate and nurture useful and relevant skills to balance general ICT and Internet-related skills that citizens increasingly acquire through life experience and to exploit the capacity of ICTs to improve labour mobility.

Much of Europe's human and social capital goes unused or underused through barriers to participation based on training, gender, age, location and disability. This is a paradoxical failure of coordination. Businesses struggle to find the skills they are accustomed to needing, while workers struggle to find fulfilling employment for skills they already possess, which erode through lack of use.

Migration within and across Europe's borders is important; the (bi-directional) brain drain could be transformed into "brain circulation" as part of efforts to improve the mobility and flexibility of labour and the alignment of skills to jobs.

Engaging Europe's youngest and oldest citizens in Future Internet-based industries can transform a drain on public and private finance into a unique competitive strength.

Many European populations are ageing, though some (United Kingdom, for example) are rapidly becoming younger. At the same time, citizens at both ends of the working age distribution are underemployed, especially in the current economic climate. Suitable measures are needed to facilitate the employment of both groups, and to stimulate the emergence of new businesses that can uniquely benefit from the combination of skills, experience and ambitions they offer.

Present measures aim at increasing the employment of young people (mostly in existing jobs) and in increasing e-participation among the elderly. National and EU policymakers can act together with existing employers to join up these measures, and national governments could take steps to facilitate the emergence of new forms of employment by using a portion of the resources devoted to economic recovery to support start-ups on an initially non-commercial and 'enterprise 2.0' basis.

This will be no more expensive than current employment policies, but potentially more productive in the medium term and an indirect stimulus to other start-ups, and to the acquisition of e-life skills among those approaching traditional retirement age.

Europe does not lack money so much as access to suitably-structured finance.

Capturing the fruits of the Future Internet requires expansion and risk-taking by SMEs and start-ups at one end of the value chain and providers of high-speed infrastructures at the other. Both struggle for venture capital and lag in nurturing organisational capital, despite the general surplus of liquidity in many quarters.

Access to capital is particularly important for the generic enablers and service infrastructures of the Future Internet PPP, which are needed to strengthen an application-led and dynamic web ecosystem. Ecosystems by their nature are robust-yet-fragile; business failure is as important as success to overall competitiveness, but the costs of failure in Europe are higher than the costs of trying.

One problem is the general perception that investment into highly innovative products and services is *inherently* very risky. Mechanisms that facilitate investment into a balanced

portfolio of risky and less-risky investments through public risk capital participation and/or targeted regulatory relief, could promote greater investment in innovation.

Public financial support may be needed to drive the universal roll-out of high and ultra-high broadband coverage without destroying openness and affordability. This can draw on methods developed for other networks, such as telephony or electricity.

New assets and financial partnership models are needed to support the transformation of Europe to a leading competitive player in the emerging, Internet- and service-based global economy.

Europe's financial sector is currently failing to finance start-ups and innovative business models and services adequately. Prevalent current financing vehicles contain structural incentives that inhibit collaboration, long-run success and "sharing."

Regulatory clarity is needed from the EU and Member States to reduce 'policy risk'. Entrepreneurship and innovation can also be enhanced by risk capital participation by public bodies and the financial sector earmarked specifically for Future Internet enterprises. This might involve new financial assets offered by private sector financial institutions to public as well as private investors and adapted to the needs of companies whose success metrics may derive from market share, third-party monetisation of value creation or licensing/reuse of intellectual property, and who may have to move rapidly in order to realise and sustain these advantages.

Europe's global rivals in the Internet economy are finding tax incentives a useful way to encourage R&D and other firms of innovation.

Europe's international competitiveness relies on a vigorous, diverse and resilient domestic economic environment. Fiscal innovation incentives are necessary to compensate for restricted access to capital, especially for new firms, services and business models. Such measures are currently being pursued by Europe's main global rivals; the initiative, once lost, cannot easily be regained during the next phase of the global business cycle. Member State governments should implement favourable tax treatment for R&D, for new forms of partnership and for revenues to early-stage offerings (for example via deferrals). This can provide far more cost-effective medium-term stimuli than untargeted austerity or subsidy measures. To prevent costly and destabilising tax competition, such measures must be harmonised or at least balanced at European level.

The barriers to innovation and competitiveness are not only financial.

Many initiatives have sought to make Europe friendlier to innovation. In the Future Internet context, it is particularly important to give stakeholders throughout the value network the space and resources needed to explore possible innovations in tolerant platforms for innovation and collaborative working where inspiration and initiative are not foreclosed. Actions to provide such an environment include: common access to high-performance ICT and other resources; tax policies to promote investment, recruitment and collaboration; regulations that facilitate mergers and acquisitions; a suitable legal status for SMEs on their own and self-organised into agile (and temporary) networks; public procurement aimed at innovative solutions and small suppliers; and incentives to foster the growth of technology clusters.

Small firms, start-ups and enterprises in remote regions often lack access to increasingly-necessary computing (storage, processing) and service (e.g. identity, security, privacy, data curating) resources. As the Future Internet economy develops, this will become increasingly important: European competitiveness depends on near-universal access to such resources. Cloud computing provides one way to level the playing field. Member States and established users of such services should use targeted procurement and other measures to stimulate cloud development, while Member States should consider requiring such sources of strong scale economies to be made available to all economic stakeholders on a fair, reasonable and non-discriminatory (FRAND) basis under commercially viable terms and conditions.

National and European infrastructure initiatives must be “joined up” to encourage pro-innovation and pro-competition investment and growth by all sizes of firm and all sectors of the European Internet economy.

Europe's communications (and computing) infrastructures are growing, but gaps in coverage and inequalities in speed, quality of service and affordability are restricting access and producing uneven growth across sectors, regions and business sizes. Because the growth 'hot spots' include the most keenly contested areas of the global economy, this concentration threatens to undermine competitiveness.

A high-quality, affordable and 'dense' infrastructure would be a trans-European public good. The European Commission's Connecting Europe Facility (CEF) should be actively used to “join up” existing regional, national and European infrastructure measures and to ensure—through funding conditionality and regulatory changes at Member State level where necessary—that the resulting networks remain open, affordable and of uniformly high capability, security, etc. This is particularly timely because such measures may be threatened by public austerity programmes, at least in some counties.

The CEF creates opportunities at European level that can reinforce such initiatives and ensure their balanced progress. Various new models are available, especially when orientated to how the infrastructures are used (for example private, enterprise, community clouds; use of shared data centres to justify fibre investment, etc.).

The Digital Single Market continues to provide a unifying vision, but is in need of defragmentation.

The Internet economy is characterised by fault lines, for example technology (ICT versus user/service sectors), size (big versus small), localisation (localised versus agile or globalised firms), language, etc. Such divisions are not wholly counterproductive; they provide protective environments in which innovation and prosperity can flourish, and incentives to escape from market niches can be profoundly productive. But they can also inhibit development and growth, especially if the divisions become too wide or permanent.

A range of economic, cultural and legal measures are needed to narrow the gap. These include making markets more accessible to newcomers, establishing a consistent, Europe-wide understanding of net neutrality, and promoting customer mobility so that they can access more advanced services easily.

Defragmenting the market will necessitate a common framework and harmonised rules, monitoring and enforcement in such areas as data protection, service delivery, warranties, quality of service contracts, dispute resolution, data location and information recovery. On

the business side, in addition to those factors listed for consumers above, cross border retail, VAT, recycling rules and special measures such as copyright levies for blank media will also need to be harmonised. Especially important is uniform treatment of on-line and off-line commerce.

Addressing these considerations through a certification approach has benefits and drawbacks. While certification can provide a high level of trust, it also requires a high degree of monitoring and transparency to protect against corruption, and possibly cross-border co-regulation regarding e.g. data ownership and privacy.

FI PPP use case projects in food and agriculture, environment, energy, public safety, transport and logistics can shed further light on sector-specific obstacles to innovation

While the relative immaturity of many potential applications does not permit a thorough life-cycle analysis of competitiveness or market barriers, the relatively low uptake of advanced Internet services in these sectors does highlight the importance of innovation barriers at this stage. Initiatives to push efficiency and drive change in sectors such as food and agriculture, energy and transport should involve large numbers of SMEs. They will be the most innovative application and service adopters, in many parts of the value chain and regions. Useful innovation may arise at any point. The key challenge is the aptitude, readiness and ability of these diverse SMEs to invest in innovative solutions. Resistance to change is also evident from established players. This inertia is reinforced by current practices, business models and contractual forms. It inhibits large-scale adoption of promising solutions. Moreover, these entrenched attitudes are not well-suited to the dynamic and open culture of the Future Internet.

These barriers will not be removed by a unified Grand Strategy, but by self-organised co-ordination among many independent actors.

It is both unrealistic and inappropriate to attempt a grand synthesis of all actions, stakeholders and objectives. The Future Internet is sufficiently complex, and the critical uncertainties sufficiently important, that this may be ineffective or even counterproductive. To make progress, a looser form of coordination might be preferred.

This should be based on open collection and exchange of information, flexible governance arrangements and clear principles. European institutions have a particular role to oversee important elements of common structure binding the Digital Single Market that underpin European regional competitiveness. But they should also provide leadership by opening up new areas of separate—or even coordinated—activity where progress is retarded by coordination problems.

It seems appropriate to build on the Europe 2020 initiative to create the basis for a partnership that will subsume the current PPP within a wider and looser framework. It should offer constant engagement, the possibility for effective action and a reliable basis in the form of a clear set of principles and institutional frameworks, to allow participants to undertake individually risky medium to long term initiatives that interact to reduce future risks.

Value-creating Future Internet innovation is likely to move closer to user applications.

Europe has traditionally struggled to convert its scientific excellence into successful market products. It lags its global rivals in business model and service innovation. These factors will become more important as the global economy recovers.

Europe's scientific strength is matched by diversity and inventiveness near the user application end of the value chain; its small enterprises and its population.

Many of the actions suggested here will make it easier for European Internet users to refine, tweak and build upon the technologies, enablers and services directly or indirectly encouraged or enabled by the outputs of the FI PPP. They will encourage the development and employment of Europe's human capital, entrepreneurial energy and inventive spirit. They should also stimulate development in use case sectors whose potential benefits from Internet services remain largely unrealised, reduce formal barriers that have marginalised small start-ups and limited consumer sovereignty, and open up closed models of technology and service provision to wider modification and customisation. This will involve enabling service providers to fit their offers to user needs (user-driven or user-centric innovation). It will also increasingly encourage current trends towards user-created innovation: app development; construction of community- or sector- specific "smart infrastructures" using generic FI technologies; customising a common platform such as FI-WARE for specific uses; and users themselves implementing generic services. Taken together, this will enable Europe as a whole to produce globally competitive offers, especially as quality, utility, trust and engagement become increasingly necessary for market growth and consumer loyalty.

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1.1 **Background and context: the Commission's commitment to a Future Internet PPP**

While various dates have been offered for the “birth” of the Internet, 1982 stands out as the year that the concept of a worldwide network of fully interconnected TCP/IP networks called the Internet was introduced (Handley, 2006). But it would be at least another decade before the invention of packet switching and the standardisation of Internet Protocol led to the introduction of the World Wide Web and allowed the Internet to start transforming economies and societies.

Today, the Internet has fundamentally changed the way we stay in touch with our friends and relatives, purchase products and services, and entertain ourselves. It has also transformed the way we do business. There are more than 2 billion Internet users,¹ and Internet communication is no longer limited to human end users—M2M mobile connections, for example in healthcare and fleet management, are expanding rapidly, with a 40-fold increase in traffic expected between 2010 and 2015 (Cisco, 2011).

The European Union is leading the world in terms of Internet diffusion. It has the world's largest business-to-consumer (B2C) eCommerce market. However, the EU is not a leader in the global Internet economy. Europe has been slower than the US or Japan to exploit the potential of Internet-based innovation, and the recent economic crisis has exposed structural weaknesses in Europe's economy, particularly in its ability to invest in and deploy innovation.

The European Commission and the European industry have joined forces to lay the foundations for the Future Internet in Europe. The Future Internet Public-Private Partnership (FI PPP), officially launched on 3rd May 2011, is an initiative framed under the Digital Agenda for Europe (DAE) (European Commission, 2010c). It aims to advance Europe's competitiveness in Future Internet technologies and systems and to support the emergence of Future Internet-enhanced applications of public and social relevance (European Commission, 2010e).

The FI PPP addresses the need to make public service infrastructures and business processes significantly smarter (i.e. more intelligent, more efficient, more sustainable) through tighter integration with Internet networking and computing capabilities. The

¹ Based on International Telecommunication Union's (2010) global estimate of 30.1 Internet users per 100 capita and a global population of 6.85 bn in 2010 (US Census Bureau, 2011).

initiative builds upon existing EU-funded research and works with partners at national and regional level to develop new technologies, services and business models for the Internet of the future.

The Commission has made €300 million of FI PPP funding available over five years, with Europe's research organisations, public sector and industry committing an equal amount². Projects already launched under the first phase involve 158 partner organisations and companies, and 18 academic institutions, from 23 different countries. They will receive (and collectively match) €90 million in EU funding.

The characteristics of the individual projects are explained in detail on the dedicated website.³ These projects comprise the development of a standardised and interoperable Internet service platform (FI-WARE) over three years and eight use case projects over two years, as well as infrastructure and programme support.

The FI-WARE project aims to develop the set of core platform tools needed to build innovative future Internet services, and includes, among others, privacy, real-time processing and cloud computing capabilities. The toolbox will be open for anyone to use and extend (European Commission, 2011a). The eight use case projects are set up as catalysts to the innovation process (see Table 1-1). They involve large-scale trials of innovative Internet-based services and applications in a number of European cities.

Table 1-1. Eight use case projects in the Future Internet PPP

ENVIROFI	Environmental data in the public domain
SMARTAGRIFOOD	Making the food value-chain smarter
FINSENY	Reaping the benefits of electricity management at community level
OUTSMART	Making public infrastructure in urban areas more intelligent and efficient, developing innovation eco-systems in London (transport & environment), Berlin (waste management), Aarhus (water & sewage), Santander (smart metering & street lighting) and Trento (water & environment)
FI-CONTENT	Networked media, including gaming
FINEST	Increasing efficiency in international logistics value-chains
INSTANT MOBILITY	Personal mobility
SAFECITY	Making urban public areas safer

Source: European Commission (2011a)

The first phase of the FI PPP will last for two years (2011-2012) and will develop a toolbox of generic services in preparation for the second phase (2013-14). This phase will include large-scale trials of innovative and complex Internet services and applications in a wide range of domains across Europe. Up to five such trials are currently foreseen. The third phase (2014-2015) will be dedicated to transforming these trials into viable digital ecosystems and connecting them to regional innovation policies (European Commission,

² In addition to the PPP, the European Commission is providing about €200 million for research in domains related to the Future Internet.

³ FI PPP Projects website: <http://www.FI-PPP.eu/projects/> (As of 19 April 2012).

2011a). This phase is expected to involve continuing work on underlying technologies, use case expansion and specific activities aimed at increasing innovation in SMEs.

Phase 2 projects are anticipated to receive €80 million in EU funding, with a further €130 million for Phase 3 projects. Project partners are expected to commit to collectively matching the EU funding.

1.2 Study scope and methodologies

The FI3P study supports the deployment and further development of a Future Internet PPP through objective research and analysis. This report focuses on the Internet industry, and aims to address the objectives laid out in Table 1-2.

Table 1-2. Scope and objectives of this report

Objective	Chapter
Characterise the current European Internet industry by identifying market and technology trends and determinants for growth and competitiveness	Chapter 2
Identify and elaborate on alternative future scenarios for the European Internet industry	Chapter 3
Delineate the potential future contributions of the European Internet industry to Europe's economy and society	Chapter 4
Estimate the economic impacts of the current FI PPP and its potential successor	Chapter 5
Reflect on the position of the EU Internet industry and the FI PPP in the global context	Chapter 6
Identify, assess and address the barriers to competitiveness of the European Internet industry	Chapter 7
Formulate recommendations to improve competitiveness of the European Internet industry	Chapter 8

The analysis in this report is largely based on three different methodological perspectives: 1) market research; 2) industrial economic theory; and 3) macro-economic modelling. We use market research to characterise the size and growth of the EUIL. We apply industrial economic theory to identify the determinants of growth and competitiveness for the EUIL and to derive the barriers to competitiveness. Finally, we estimate the economic impacts of the FI PPP with a macro-economic model. These methodologies are then combined with scenario planning to accommodate the uncertainties inherent to the future of the EUIL. These different methodological perspectives are schematically illustrated in Figure 1-1.

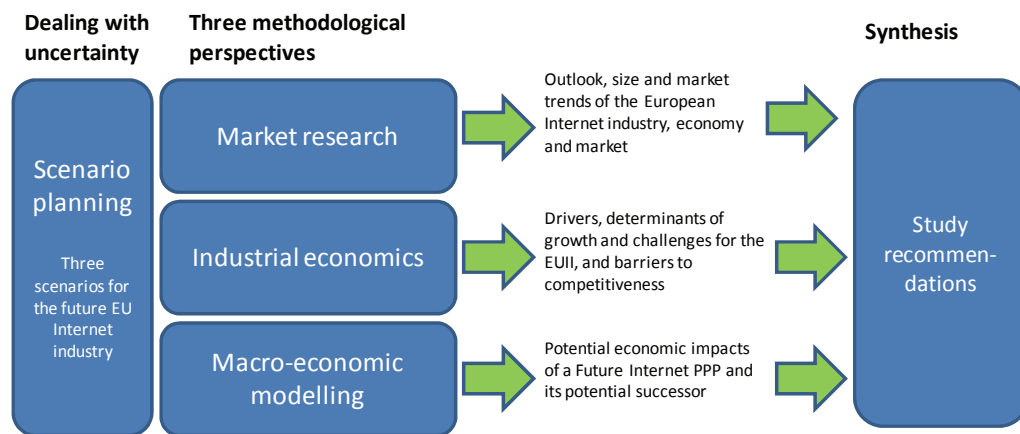


Figure 1-1. Schematic illustration of the study's scope

The following sections explain how we have addressed these objectives, and discuss the scope and approach used in this report.

1.2.1 The European Internet industry: key features that characterise its future (Chapter 2)

In Chapter 2, we focus on the European Internet industry (EUII). The methodological approach is based on market research (including an analysis of the top 103 EU players) as well as an in-depth review of literature on technological developments, regulatory and competition interventions, and innovation dynamics. An important source of information was IDC's databases (worldwide Blackbook model and the Digital Marketplace model), which collect and reconcile data on ICT supply and demand trends for all main world regions and provide forecasts for the next three years. Detailed results have been published in Deliverable 2 of this study (Cattaneo *et al.*, 2011). The chapter examines the structure and profile of the main players of the European Internet Industry, the dynamics of demand by business and consumer users, the main technology and market trends shaping the near future and the determinants of growth and competitiveness for the main industry segments.

Despite widespread recognition of its pervasiveness and importance, the Internet sector as such is not measured by statistical offices. Therefore, we have identified and defined three main dimensions of the Internet sector in order to enable measurement and analysis. These are in the boxes explained below.

Box 1-1. Defining and measuring the EU Internet Industry

The EU Internet Industry is composed of the enterprises providing hardware, software and services specifically dedicated to the Internet (not simply general purpose IT), with a relevant presence in the EU (headquarters, or production/ research facilities).

According to our study, about two thirds of the top EUII players are EU firms, about one third are of US origin, and a few others are from the emerging Asian markets.

The estimates of core Internet industry revenues include only the Internet-related revenues of all these players, excluding revenues from general purpose ICT.

The EUII is composed of three main layers: a “core” or traditional industry providing Internet IT and network products and services; a linking layer providing Internet telecom services; and a fast-emerging “web ecosystem”, whose actors provide web-based applications, services and content in a close and innovative relationship with users and with traditional players. Within these layers, we identify five main groups of actors or industry segments, based on their different roots and core business, and we analyse their competitive positioning.

Box 1-2. Defining and measuring the European Internet market

The European Internet market includes the business and consumer demand for specific Internet technologies and services and the additional spending in general purpose ICT driven by Internet deployments.

From the user’s perspective, Internet investments are not divided by technology but by purpose. Based on our analysis of demand dynamics, we have concluded that every €100 spent by European business users in Internet technologies and services in 2009-2010 generated (on average) an additional €40 spent on general purpose ICTs. The total value of the Internet market is therefore slightly larger than the revenues of the Internet industry.

We provide data on Internet spending by consumers and by business users segmented into nine industry sectors. We analyze the intensity of Internet spending by sector and the way Internet-based innovation is changing value chains and business models across the economy. These data are included in Chapter 2.

Box 1-3. Defining and measuring the European Internet Economy

The European Internet Economy presents a broader view of the impact of the Internet on the economy, by focusing on the value of the goods and services exchanged over the Internet, plus the investments made to deploy and/or use the Internet. This is measured by aggregating IDC's estimates of the value of B2C (business to consumer) eCommerce and of private and public investments to deploy and use the Internet (the Internet market).

The methodological approach is based on classic economic theory about the composition of GDP and is also used by Boston Consulting Group and McKinsey in their recent studies on the economic impact of the Internet (e.g. Pélassié du Rausas *et al.*, 2011; Dean and Zwillenberg, 2011; Dean *et al.*, 2012)⁴

The EU Internet economy measurements are presented as a component of the analysis of the socio-economic contributions of the Internet and the development of market scenarios (see Section 1.2.3 for a description of the methodology for Chapter 4).

1.2.2 Three future scenarios for the European Internet industry (Chapter 3)

The future outlook for the Internet industry will depend on a range of external forces in addition to the determinants for growth and competitiveness identified above. These external factors are subject to a range of uncertainties. Some are beyond the control of policymakers, such as the global economy or natural disasters, others may not be resolved until after critical decisions are taken. The impact of such external forces also depends on how participants and outside stakeholders act and react.

In Chapter 3 we identify a set of critical uncertainties and construct three possible scenarios for the future European Internet industry that are logically consistent, and which we term Realistic, Tipping Point and Slow Motion. These scenarios provide a narrative description of the range of plausible futures that the Internet industry may face in the next 10 to 15 years. These scenarios are used in different ways in the subsequent chapters, description in the next sections.

1.2.3 The future contribution of the European Internet industry under the three scenarios (Chapter 4)

Chapter 4 is concerned with sector-specific contributions of the European Internet industry. Aggregate levels of economic growth, technology adoption, etc. associated with the scenarios developed in Chapter 3 are used to project disaggregated outcomes of interest such as investment, revenues, employment, skill demand and other specifics.

⁴ It is based on the Expenditure method, which measures total spending on finished goods and services. While not perfect, this method allows using existing data and aggregating the contributions of all economy sectors. This includes four main components. 1) Consumption, i.e. spending over the Internet and for the Internet by end users. 2) Private Investments, i.e. capital investments by telecom companies and other sectors in the development and deployment of Internet networks and all other Internet-related private investments. 3) Public Investments, i.e. the public sector investments in Internet networks and Internet-related software and services. Investments by the government, health and education sectors are included in this segment. 4) Net exports, i.e. the net balance between the value of import and export of goods and services bought over the Internet, as well as of Internet-related technologies and services. Unfortunately, we were not able to measure the value of net exports for the EU27.

Deliverable 2 identified a wide range of potential future societal and economic contributions from the European Internet industry (Cattaneo *et al.*, 2011 pp. 18-19).⁵ While we recognise this broader scope, we focus on the following elements:

- the size of the Internet economy and market;
- diffusion of Internet-driven innovation by sector;
- contributions to employment, education and skills; and
- returns for SMEs and the impact on business models.

We applied the methodology used in Deliverable 2 (Cattaneo *et al.*, 2011) for the size of the Internet economy, using the key assumptions for the three scenarios to provide estimates from 2014 to 2020. For the period 2011-2014 we only calculated one forecast based on IDC's projections, validated with actual data until 2011. From 2015 we differentiated growth trajectories based on the 3 scenarios. Quantitative forecasts were developed as follows:

- The estimate of BtoC eCommerce is based on IDC's Digital market model and the variations by scenario are mainly linked with differentiated GDP growth and the number of Internet buyers;
- The estimate of home, private and public investment in Internet technologies and services was developed to 2020 for the realistic scenario, and then modulated for the two other scenarios, based on IDC's Blackbook database on worldwide IT spending, taking into account IDC's historical series of analysis of the link between IT investments and GDP growth. This was done of course estimating only Internet-related spending, excluding spending for general purpose IT (otherwise the Internet market would be identical with the total IT market).

Since these contributions will depend on various uncertainties underpinning the future Internet industry, we have assessed them separately for each of the three scenarios identified in Chapter 3. Figure 1-2 schematically illustrates how the three scenarios are used to inform the socio-economic contributions of the European Internet industry. It is worth noting that these estimates were calculated before the current public debt crisis drove the EU economy into a new recession. Hence they may now appear somewhat optimistic, but the underlying reasons driving demand dynamics will not change radically.

⁵ These include: social inclusion; social behaviour; democracy and participation; learning and thinking; and environmental performance in the context of the Low Carbon Economy.

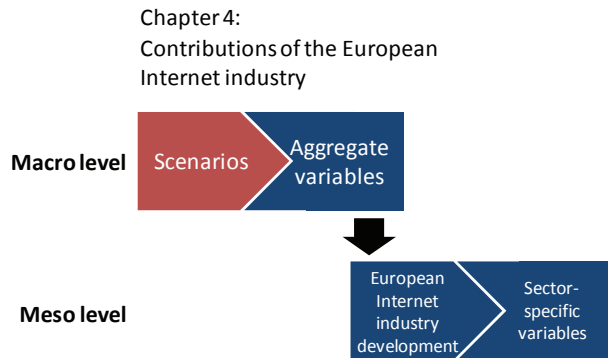


Figure 1-2. The role of the scenarios in Chapter 4

It should be noted that while these economic indicators are often used to inform policy decisions, they do not provide a complete picture of society's wellbeing. Contributions that are more difficult to measure, for instance, socio-economic effects supported by the use of social networking, are not captured in this analysis.

Table 1-3 summarises the approaches used to estimate and describe the societal and economic contributions of the Internet industry in the three scenarios.

Table 1-3. Approaches taken to estimate and describe the societal and economic contributions of the Internet industry in three scenarios

Type of contribution	Methodology	Output
Internet economy and market	Aggregation of the results from the segments below:	Contribution to GDP in the EU27, current and projected under different Future Internet scenarios:
Internet end-user (B2C) commerce	<ul style="list-style-type: none"> Estimates based on International Data Corporation's (IDC) global Digital Marketplace Model and Forecast (DMMF) 	<ul style="list-style-type: none"> Value of goods and services sold over the Internet in the EU27
Internet industry and market	<ul style="list-style-type: none"> Estimates based on IDC's Worldwide Black Book model + ad-hoc analysis of Top 103 EU Internet Suppliers Estimates based on IDC's European ICT Vertical Markets surveys cross-checked with supply-side data 	<ul style="list-style-type: none"> EU Industry actors' size, revenues, profiles, competitive positioning and strategies EU consumer and business users' spending for Internet technologies and services by sector and company size
Internet B2B commerce	<ul style="list-style-type: none"> Estimates based on IDC's global Digital Marketplace Model and Forecast (DMMF) 	<ul style="list-style-type: none"> Value of goods and services exchanged over the Internet in supply chain transactions in the EU27
Contributions to employment, education and skills, returns for SMEs and the impact on business models	<ul style="list-style-type: none"> Review of literature and forecasts in previous studies Projection of the value of Internet spending by company size (SMEs vs. Large and Medium-sized Enterprises (LMEs)) based on IDC's European ICT Vertical Markets surveys cross-checked with supply-side data 	<ul style="list-style-type: none"> Description of the main type of impacts and their diffusion into the system with a focus on net job creation, the eSkills gap, SMEs and new business models' implications

1.2.4 The macroeconomic impact of a Future Internet PPP and its potential successor (Chapter 5)

Chapter 5 considers the impacts of the Future Internet PPP and its potential successor—working through the European Internet industry—on aggregate macroeconomic variables, modifying the outcomes anticipated by the scenarios.

Investing in a Future Internet PPP is intended to stimulate the social and economic contribution of the European Internet industry. The magnitude of these impacts may vary under different scenarios. We recognise that the PPP may directly or indirectly affect different levels of European economy and society. This implies the three scenarios for the European Internet industry are used

Our assessment of PPP impacts focuses primarily on Internet-driven growth, productivity and employment. In doing so, we recognise that it may take time before the FI PPP begins to take effect, and further support might be needed before any impacts are realised.

In order to understand the possible impact of Future Internet PPP on policy interventions, we have modelled the overall European economy, reflecting economic flows among sectors and countries going forward, using a macroeconomic modelling tool known as GINFORS. In addition to a baseline projection, which represents the counterfactual, we modelled: a situation assuming a world where only the current Future Internet PPP exists; and a situation assuming that the PPP is followed-up with a successor between 2014 and 2020.

The macro-economic assumptions underpinning this analysis are consistent with those in the three scenarios described in Chapter 3. Figure 1-3 schematically illustrates that the scenarios are rendered in the GINFORS model by making different assumptions. Similarly, different assumptions are made for the (success of the) PPP actions and the development of the European Internet industry. Those and other assumptions and justifications underlying this approach are described in detail in a separate technical report (Elixmann and Schwab, 2012).⁶ We concentrate on two key macroeconomic indicators: real Gross Domestic Product (GDP) and employment.

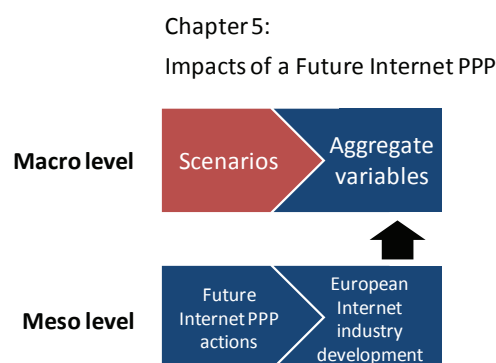


Figure 1-3. The role of the scenarios in Chapter 5

1.2.5 The European Internet industry and Future Internet PPP in a global context (Chapter 6)

The early chapters address the future contribution of the Internet industry to the European economy and society and the potential impact of a Future Internet PPP. What does this

⁶ Note that the model reflects only 19 of the 27 EU Member States, due to limitations in the availability of disaggregated data; however, they collectively represent more than 95% of the EU-27 GDP.

mean for the position of the European Internet industry in the global context? In Chapter 6, we analyse Europe's competitiveness in the context of the global Internet industry and in particular vis-à-vis the US, Japan, China, and India. We approach the issue from a number of different perspectives, summarised in Table 1-4.

Table 1-4. Sources and methodologies for analysing the competitiveness of Europe's Internet industry in a global context

Perspective	Source or methodology
1 Differences in the contribution of the Internet to the economy	Review of recent studies on the economic contribution of the Internet in specific countries
2 The relative position of European Internet industry players in the global context	Financial Times 500 index of world's biggest companies
3 Differences in the contributions of ICTs to productivity growth	Review of academic (Internet) industrial economics literature
4 Differences in imports and exports	Analysis of WTO International trade statistics: import-export of computer and information services; and office and telecom equipment.
5 Differences in Internet-related infrastructure and demand for Internet-related services	BCG e-Intensity index
6 Differences in the potential macro-economic effect of a PPP-like investment	GINFORS projection of the impact of an investment equivalent to the Future Internet PPP in Japan and United States

1.2.6 Barriers to the competitiveness of the European Internet industry (Chapter 7)

The Internet is clearly important for the future global economy. The success of Europe's growth strategy and in particular, the Digital Agenda for Europe (DAE), will therefore depend on the extent to which the European Internet industry is able to compete internationally. The Future Internet PPP is one initiative to encourage firms to invest in Internet-related R&D, but despite the introduction of the European single market, there are still various barriers impeding potential contributions of the European Internet industry.

In Chapter 7 we present the results of a comprehensive review and assessment of these barriers to competitiveness. Using Porter's competitiveness framework, we identified a long-list of potential barriers based on the results of the preceding chapters.⁷ In addition to these industry-specific barriers, we reviewed the industrial economics literature to identify barriers to European competitiveness as a whole.

For each of the barriers we assessed: their nature, their social and economic 'costs', their significance in the three scenarios, and a series of actions to address them. A separate annex (Appendix A) available on the project website provides a more detailed and elaborate analysis of these barriers.⁸ Chapter 7 highlights and clusters the most important barriers to the competitiveness of the EU Internet industry.

⁷ Five forces of competitive position, five-fold classification of industries, and "diamond" list of competitive factors (Porter, 1980; 1985a; 1985b)

⁸ See: <http://www.fi3p.eu>

1.2.7 **Recommendations (Chapter 8)**

The final chapter delineates a set of policy actions that can be deployed to remove or lower these barriers to the competitiveness of the European Internet industry. While we have systematically derived a series of potential actions for all of the potential barriers, we have highlighted those that we consider pertinent and feasible for the European Commission, Member State governments or industry players

CHAPTER 2 **The European Internet Industry: key features that characterise its future**

This chapter characterises the key conditions that the European Internet industry (EUII) faces at present, and which will be important in the future. “Key conditions” include the main drivers and barriers impacting the industry’s development and growth, including technology and market trends.

In Section 2.1 we analyse the EUII structure and the profile of its main players. Section 2.2 investigates Internet demand dynamics in Europe, and analyses the business and consumer demand of Internet technologies and services. Sections 2.3 and 2.4 review the main technology and business trends driving market change and Internet infrastructures evolution. Finally, Section 2.5 assesses the determinants of growth and competitiveness for the main segments of the EUII and Section 2.6 summarises its main challenges.

2.1 **Analysis of the European Internet industry**

The European Internet industry (EUII) is comprised of enterprises providing hardware, software and services specifically dedicated to the Internet, with a relevant presence, including their headquarters, production or research facilities, in the EU. This excludes firms that provide general purpose IT services or equipment.

According to our analysis (Cattaneo *et al.*, 2011), revenues for the EUII in 2010 were €136B, representing about a quarter of the total European IT industry revenues in that year (€544 B), but growth for EUII was faster than that for traditional IT sectors. According to our study, about two thirds of the top EUII players are EU firms, about one third are of US origin, and a few others are from the emerging Asian markets.

The EUII is composed of three main layers: a “core” industry providing Internet IT and network products and services; a linking layer providing Internet telecom services; and a fast-emerging “web ecosystem”, whose actors provide web-based applications, services and content in a close and innovative relationship with users and with traditional players (see Figure 2-1).

The emergence of the web ecosystem is changing competition dynamics and blurring traditional boundaries. A clear example is Amazon’s cloud computing services offering, which introduces direct competition with traditional IT vendors. Compared to the relatively linear value chain of the core Internet industry, the web ecosystem is

characterised by multiple interactions, where business users and consumers are also producers of content and services.

The three main layers of the EUII from technology to user can be segmented in 5 main groups, with different strategies and core businesses:

- **Internet network equipment** (e.g. Nokia Siemens Networks, Alcatel Lucent, Ericsson, Huawei)
- **Smart handheld devices dedicated to the Internet** (e.g. smart phone suppliers such as Apple, Nokia, RIM and Dell)
- **Internet software and services** (e.g. Microsoft, Oracle, IBM, SAP, McAfee). This includes enterprises providing servers and storage as cloud services, but excludes the revenues from servers and storage, as these are considered general purpose IT.
- **Internet-related telecom services** (all the telecom operators providing Internet access services, e.g. FT, Vodafone, BSB and Colt);
- **Web services and applications.** These providers are the emerging players of the web ecosystem, and are characterised by a wide range of rapidly evolving business models.

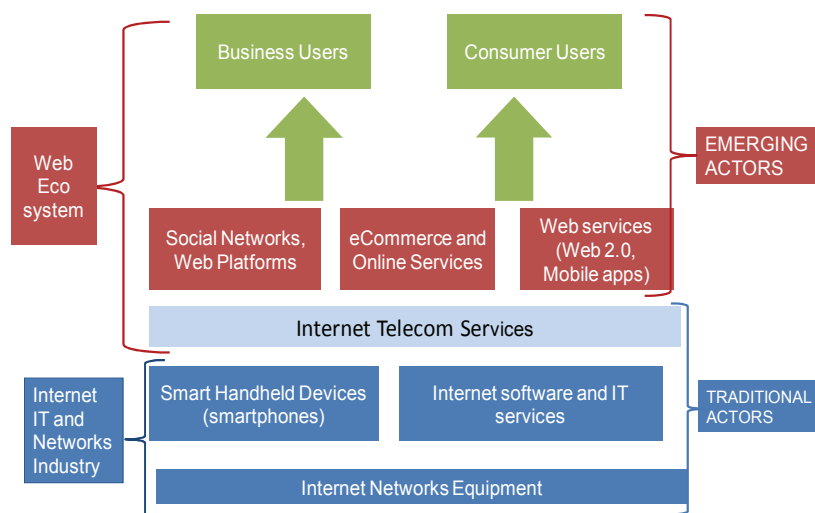


Figure 2-1. The main layers of the EU Internet Industry

Figure 2-1 provides a schematic illustration of the business relationships between these groups of actors. The players in the EUII are also users of each others' services and they collaborate as often as they compete.

The Internet industry segments are not of equal weight in economic terms (see Figure 2-2). Internet telecom services revenues account for the lion's share (59% in 2010). The other industry segments are more or less of equal size in terms of revenues, with Internet Network Equipment revenues slightly higher than the rest (13% of total in 2010).⁹

⁹ The web ecosystem revenues are not included in this estimate because they result mainly from advertising or online sales of goods and services which are not IT.

The global revenues of the EUII are projected to grow at an average annual rate of 7% between 2010 and 2014, slightly faster than the overall estimated growth of ICT revenues, but masking very different dynamics by industry segment (Figure 2-2).¹⁰

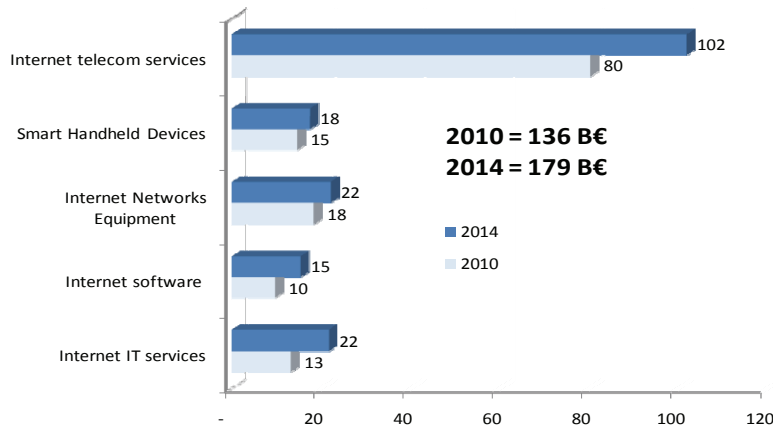


Figure 2-2. Core Internet Industry Revenues by Segment, EU 27, bn €, 2010-2014

Source: IDC 2010

Internet Telecom services revenues are expected to grow at an average growth rate (Compound Annual Growth Rate, CAGR) of 6%, balanced between higher-priced broadband services and commodity priced standard services.

Network equipment revenues are expected to grow at a slower rate (CAGR of 5%), as investments in new infrastructures are diluted in time because of the financial crisis and the expectation that the bulk of Next Generation Network (NGN) investment will occur beyond 2014.

The Internet software and services segments are expected to show the fastest increase in revenues (CAGR 13% and 12%, respectively).

Below we explore the different business models of the key segments outlined above and their competitive positioning, based on ad-hoc analysis of the top 103 industry players and on market research.

2.1.1 Internet Network Equipment Suppliers

The key field of activity for Internet network equipment suppliers is the development and provision of network-related infrastructure elements and functionalities. These are used by communications network operators (fixed or mobile) as well as by other sectors of the economy to build and/or use networks of all kinds. The leading players are Cisco, Ericsson, Nokia Siemens Networks, Alcatel Lucent, Juniper Networks, Aastra, Huawei, and Akamai.

In recent years, we have witnessed a blurring of boundaries in the historically clear-cut separation between the network manufacturing industry and the network operating industry. This has been partially related to the evolutionary dynamics of the mobile

¹⁰ These estimates were calculated by IDC for this study on the basis of its Worldwide Blackbook database and an ad-hoc survey of the top 103 European Internet industry suppliers.

network business, where equipment manufacturers have trended towards operating networks as well. However, more recently, several mobile operators have outsourced the operation of parts of their network, and now concentrate on specific services (e.g. marketing services). Equipment manufacturers are also likely to play a more significant role with regard to the deployment of fibre-based regional Next Generation Access (NGA) networks (networks providing ultra-high bandwidths), as they become the turnkey provider.

The business model for network equipment suppliers is also evolving towards web-based activities, mainly concerning platform operation, but generally excluding content management and online services provision (such as eCommerce). A key driver of this evolution is the migration to cloud computing services, suggesting that these actors are starting to move towards the web ecosystem.

While the legal entry barriers in this market are relatively low, economic entry barriers—such as economies of scale regarding R&D, capital requirements or existing patents—are *a priori* high. However, as the successful entry in the past decade of newcomers such as Huawei and ZTE from China has shown that these barriers can be overcome. Players in network equipment operate in a global market. This holds true for sales as well as R&D and production. Production and R&D locations are usually spread throughout the world, and each player tends to operate on a multi-country basis.

2.1.2 Smart Handheld Devices Suppliers

Smart handheld device suppliers provide terminal equipment (software and hardware) that enables the use of Internet technologies, services, applications, etc. These devices are distributed to end users via a multitude of sales channels, for instance via communications network operators (and their outlets), specific service providers, and department stores. Hence, suppliers of these devices have a range of different retail channels through which to reach end users. Apple, Nokia, RIM and Dell are considered to be the leading players in this segment.

From a technological perspective, smart terminal equipment at the end user interface needs to be able to interact with the network facilities to which it is connected. A recent trend is towards equipment that interacts not only with the network but also with a platform. This means that the market is extended by tying terminal equipment to exclusive provision of services and applications. From an end user perspective, these partially closed ecosystems bring about path dependency issues and subsequent lock-in effects, as there are vendor specificities and exclusionary contracts.

The business models of smart handheld device suppliers—traditionally based on hardware and software—have therefore moved from competing on product features to competing on the range of services and applications delivered through the device. Their new role as gateways to the web ecosystem creates a dramatic shift in competitive strategies.

Similar to the market for network equipment, legal entry barriers are low, economic entry barriers are relatively high, and suppliers in the handheld market also operate on a global scale. Apple's business model has shown that combining the provision of smart handhelds with an appropriate platform and service-based offerings from the web ecosystem can allow

successful market entry. Technical progress in the smart handheld industry is very dynamic and time to market is shrinking, driven by the expanding Internet value chain.

2.1.3 **Internet-related software and services companies**

The business model of software and services companies rests on developing and providing (sector- or company specific) software and IT-related solutions; implementing company specific software, applications and solutions for systems and processes; optimizing IT environments; systems integration; business process outsourcing etc. It is not always easy to distinguish between the part of the business that is Internet-related and the part which is not. This segment includes most of the global IT players (such as Microsoft, Oracle, IBM and SAP), several of the niche players (Symantec, McAfee, and Karsperski Labs) and a wide variety of EU players focused on their national market or a few countries within Europe.

IT services companies, even those that are not Internet specialists, are well positioned to benefit from the growing use of the Internet. The need to control data location and ensure data protection is driving some hosting companies to build European data centres for cloud services. This is an opportunity for European providers, but because of the scale of investments required, there will be strong competition from global companies to deploy such infrastructures and provide services. This is definitely a threat which might be faced through the development of EU-centric infrastructures. Most Internet-related software and services companies have already started activities in the web ecosystem, in particular web service provision and platform operation (for instance, server operation, storage, data centres and cloud-based activities). So far, few software and services companies have a business model based on advertising as a source of revenue. Equipment manufacturing is relevant only for some companies (e.g. Hewlett Packard, Fujitsu; Microsoft's X-Box).¹¹

Legal entry barriers to the market in which software and services companies are active are low. The economic entry barriers depend very much on the specific software focus and/or the focus of the IT services. Likewise, economies of scale might differ greatly. For example, capital, knowledge, or R&D requirements associated with the development of a new mobile operating system, are plausibly much higher than those associated with the development of a game or of an average software application. (That said, distribution of firm sizes in the market in which software and services companies are active is very diverse depending on the sub-segments.)¹²

2.1.4 **Internet-related telecommunication services providers**

The core activity of Internet-related telecom services providers is still the deployment and operation of physical network infrastructures (access networks to end users, concentration

¹¹ In this context the (relatively successful) switch that IBM made a few years ago from a hardware-based company (computers, mainframes etc.) to a company focusing on software and IT services has been suggested as a potential blueprint for repositioning in the market for those players that are still primarily hardware-based.

¹² There are world players like SAP in the software segment and the big international IT service companies with a focus on the multi-nationals, but also a multitude of niche players in the form of SMEs whose core market is national, if not regional. Broadly speaking, software companies can easily—and frequently do—operate on a multi-country basis since software is easy to sell and deliver remotely or via partners. Provision of IT services, on the other hand, is a local business and the economic (and cultural) barriers to creating scale and multi-country reach are much greater.

and core networks). This segment includes basically all the EU telecom services providers, fixed and mobile, and the Internet service providers (ISPs).

A considerable number of European Internet industry telecom operators also provide Internet-related software and/or IT-services, where the focus is on multi-national business customers, and activities in the web ecosystem are growing. The focus here is in particular on the operation of platforms (for example, Content Delivery Networks (CDNs), portals, Internet Protocol Television (IPTV) services. Overall, however, they do not belong among the international top players in the web ecosystem. Rather, the business model for European Internet-related telecommunication providers currently incorporates limited value added in advertising, eCommerce or online service provision.

There are significant economies of scale because of the enormous fixed costs of networks, in particular in the upcoming deployment and operation of NGA networks. Economies of scope between network operation and service provision are eroding as the migration towards IP/Next Generation Networks (NGN) allows the decoupling of transmission and service provision.

The market structure for physical access networks in a given region is mainly oligopolistic for both fixed and mobile networks. The economics of the deployment of NGA networks outside dense urban areas very often lead to a monopolistic market structure. The cost structure only allows a viable business case for a single NetCo (network company). Nonetheless, in such a case there might be several OpCos (operating companies), depending in particular on the respective regulatory regime.

There are legal entry barriers inasmuch as the operation of communication networks is regulated on a European as well as on a national scale. Would-be market entrants are not operating in a pure market environment based on private contracts.

Economic entry barriers for fixed access networks in a region are very high, particularly regarding the deployment of these networks. This is particularly the case for newcomers into the region. The barriers are much lower for newcomers that already have a regional presence, such as utilities.

Likewise, the scarce availability of frequencies leads to entry barriers regarding mobile networks. Entry barriers are much lower for the operation of IP-networks, which do not necessarily require a (network) facilities-based business model. Barriers to entry for the provision of services and applications in an IP world are low, making an IP/NGN market environment highly competitive and contestable at the service/application layer.

2.1.5 The web ecosystem

From the perspective of market structure and business models, the web ecosystem is the most dynamic segment of the European Internet industry. The players in this segment cover a wide range of activities. While acknowledging that boundaries are not clear-cut and are rapidly evolving, we can recognise three main groups of actors, based on their core business model:

- web platforms, social networks, entertainment and content providers (such as Google and Facebook), who tend to rely on advertising as a direct or indirect source of revenues;¹³
- eCommerce websites (active in wholesale and retail trade, such as Amazon)¹⁴ whose revenues come from their margin on goods and services sold on the Internet, as well as from advertising; and
- websites providing data processing, hosting, Web 2.0, Software as a Service (SaaS) or Cloud services over the Internet (such as Savvis)¹⁵ and applications stores (such as Apple's App store) whose revenues come from selling their services to end users or other service providers.

Many other players active in the web ecosystem have mixed business models (offline-online), for example the online banking services offered by major banks, or the “bricks and clicks” online shops launched by traditional retailers.

The business model of web platforms is still unstable. Currently, users are attracted by apparently free services, paid for by advertising but also by utilizing consumer data. However users are increasingly aware of the threats to their privacy in this use of their personal data, and this may increasingly limit the ability of web platforms to exploit such data. Leading players such as Facebook are moving aggressively towards more commercial strategies, for example developing e-commerce (see also Section 2.3.2)

Economies of scale in the physical operation of web platforms depend on the specific purpose of the platform. The fixed costs of platform operation are due to requirements for redundant energy supply, security, heat dissipation, etc. But the complex algorithms for optimizing operating specific platform sites in parallel can create economies of scale. Thus, scale advantages are lower for mere housing or hosting activities compared to activities related to supra-national content delivery networks.

From a broad perspective, the operation of web platforms in a given country is usually a competitive market in which a considerable number of players are active. However, the more complex the requirements of a specific platform, the smaller the number of market participants available to meet these requirements.

There is a trend towards tying platform-based activities to offerings of end user products or services, such as Apple's iTunes Store.

Apart from local or regional housing and hosting activities, the web platform business is typically multi-national, if not global. In such an environment, geo-political borders do not exist as long as the different locations of the platform are connected via transmission networks.

¹³ These actors are classified for example by the US NAICS 2007 statistical system as Other Publishing services - Internet Publishing and Broadcasting and Web Search Portals , (code 519130)

¹⁴ Classified by NAICS 2007 under Wholesale Trade (42) and Retail Trade sectors (44-45)

¹⁵ Some of them, but not all, fall under NAICS 2007 classification as Data processing, Hosting and Related Information services (code 518210); others can be found under Computer services (under sector 54)

The legal entry barriers to platform operation are low. Economic entry barriers, however, might be high inasmuch as there is a high risk of sunk costs and presumably there are strong learning curve effects, for example related to maintaining quality of service or optimizing traffic flows.

The economic barriers to entry related to aggregation, packaging, or versioning content, and to the actual provision of services, and depend very much on whether the size or reach of a market player is a crucial factor (network externalities, two-sided markets effects). The less the latter effects play a role, the more there is room for specialists (usually in the form of SMEs).

The market structure regarding content generation is very diverse. Legal entry barriers to content production are nearly non-existent provided the content is in accordance with the law, and for user-generated content, there are potentially as many content providers as there are Internet users. The economic entry barriers to content production depend very much on the specific form of content, being much higher for instance where exclusive content is concerned, such as Formula One races or English Premier League fixtures, much lower for games development, and approaching zero for user-generated content. The relevant market for content in whatever form might be global, but suitable packaging, versioning, aggregating of content will, however, often require taking into account country-specific aspects such as language.

There is also room for economies of scope across different forms of content. This is illustrated by the expansion of Apple's App Store and Amazon's portfolio. As to exclusive content, there is room for differentiation or for potentially becoming a gatekeeper. If entities active in this stage of the value chain—the aggregators—are not the content owners, there are *a priori* conflicts of interest between the aggregators and the initial content owners. Crucial issues could include: ownership of the respective intellectual property rights (IPR); agreeing on a suitable price; and/or agreeing on who is allowed to market the content together with advertising.

2.2 The European Internet Market: main demand trends

We define the Internet market as the demand for Internet technologies and services by business and consumers in the EU27, measured by their annual spending.¹⁶

Our research has confirmed that the relative intensity of Internet spending is lower in Europe than in the US, particularly in very large sectors such as Distribution and Business services (see Cattaneo *et al.*, 2011). However, the near future should see demand increase, particularly in the sectors that were previously laggards in the Internet market.

As shown in Figure 2.3 below, the growth rate of Internet spending in the near future is expected to be higher for utilities, healthcare, education, business services and distribution. The demand drivers are different, but the common element is that Internet innovation responds to new business needs and enables a deep transformation of an organization. The

¹⁶ This includes investments in Internet networks and equipment by telecom operators or by business users deploying private networks

following sections highlight the main trends in Internet demand for the major business sectors.

European Internet Market: Growth Rate of Internet Spending by Sector, 2010-2014

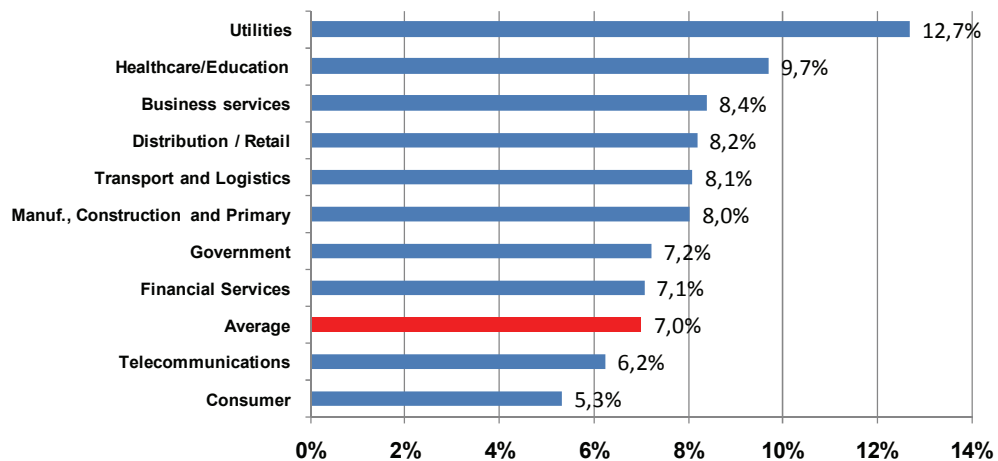


Figure 2-3. Compound Annual Growth Rate (2010-2014) of the Internet market by vertical sector
Source: IDC 2010

Utilities

The European utilities sector saw a unique structural change following efforts to create a competitive single market. Environmental and energy efficiency issues (influenced by the 20-20-20 Greenhouse Gas (GHG) emissions reductions targets adopted by the EU), the need for increased security of supply and the creation of a competitive energy market became crucial components.

The evolution of this sector is leading to increasing investments in ICTs and information infrastructures, enabling the adaptation and reengineering of production and management processes. The Internet sophistication of such processes is already higher than what is suggested by the absolute spending numbers, and is expected to grow further as smart meters and smart grid investments materialise across EU countries.

Healthcare

Second only to utilities, the healthcare sector is also expected to show a rapid increase in demand for ICT and specific Internet technologies and services, through a gradual shift from health to smart health.

Smart health is defined by IDC as an ICT-enabled health system, where technology is cost-effective, and therefore sustainable, and fulfils the needs of both healthcare providers and patients. Rapid advances in information and telecommunications technologies are making telemedicine more accessible to a broad range of healthcare organizations and consumers in terms of cost, ease of use, and distribution. Meanwhile, healthcare reforms, an aging population, and an increased focus on managing chronic conditions also add to the push for telemedicine. According to IDC, connected health IT strategies will focus on: consumer-facing mobile health applications; clinical mobility; and remote patient monitoring, sensors, and videoconferencing.

In the US, IDC expects the adoption of electronic health records (EHR) to surpass 50% in 2012, in all segments of the health provider industry excluding small practices. This adoption of electronic medical information will serve as the foundation for smarter healthcare services for patients, and lead to a consolidation of the highly fragmented electronic medical record market. The outlook for healthcare in Europe is very different from the US, but there are similar drivers towards adoption. Increasing diffusion is likely to promote similar needs for consolidation, even if the speed of change is likely to be lower.

Education

The education sector has shown interest in the widespread adoption of more advanced Internet services and applications, but will continue to suffer from lack of funding and the challenge of updating organizational processes.

Within the primary and secondary education systems, barriers to technology-based innovation remain high due to several factors, including the rigidity of the institutional context. This is not likely to change in the short and medium period, even if there are exceptions with front-runners in some countries and some types of schools (e.g. in Scandinavia). The university sector is much more open to Future Internet developments, but its potential investments are marginal compared to the total sector size.

Business services

Business services are characterised by a large number of micro-enterprises, and a low level of Internet spending compared to the sector's size and potential.

The majority of business services activities are based on human interaction and this sector has the highest percentage of mobile workers, therefore communication networks are essential—management consultants, lawyers, accountants and real estate agents need fast, secure and real-time interconnection capabilities. In addition, professional services, traditionally very much tied to their national markets, are starting to expand across borders, a development which should be supported by the EU Services Directive.

These trends, together with the evolution of flexible Internet services suited to these service activities, should generate increasing demand for Internet services in the next few years. This demand will also be driven by branding issues—the need to build a good reputation and a strong image in the Internet environment—as well as by stronger competition and the need to respond to increasingly demanding customers.

Distribution and retail

The Distribution sector (retail and wholesale) has been strongly hit by the downturn. Nevertheless, strong competition and the need to improve the customer experience will drive demand for Internet-based tools and services, in order to integrate loyalty management, customer relationship management (CRM), advanced retail demand intelligence (RDI), analytics tools, and modernized supply chain processes and management systems. Retailers will roll out new branded mobile applications, to be accessed by customers via iPhone, Android, Windows mobile, and other devices as customers increasingly require immediate interactions via any channel.

Other industries

The industries that were traditionally leaders in Internet spending will not stop investing, but their demand will grow more slowly. The financial sector—particularly hit by the current crisis—is cutting down on innovative projects (with some exceptions for cost-saving solutions such as cloud computing).

Internet spending in manufacturing is expected to grow above average, especially in selected sub-industries such as chemicals, pharmaceuticals and consumer products.

Spending growth in the telecommunications sector will be slow due to maturing investments in network equipment, which absorb a large share of Internet-related investments in the sector.

2.3 Drivers of market change

This section briefly reviews the main trends that may impact the European Internet Industry in the next few years, shaping the market for the Future Internet. This analysis is based on a review of literature and on market research.

The pervasive diffusion of mobile devices, applications and broadband networks, together with cloud services, Big Data analytics and social technologies, is causing structural market changes that are reshaping the competitive scenery for the Internet industry. IDC defines this as a transition towards the “third ICT technology platform” with impacts similar to the advent of the client-server platform 20 years ago. According to IDC, these new technologies and services account now for approximately 20% of the global ICT market, but they are expected to grow to 80% of the global ICT market by 2020. If this prediction is true, the EUFI will need to accelerate its evolution to keep pace with the main trends.

We have identified the following main drivers of future change for the Internet industry:

- The diffusion of cloud computing, new paradigm of computing services delivery and the most concrete manifestation of the Internet of Services;
- The growth of social networks, now a crucial element of the Internet landscape;
- The explosion of the amount of data managed and transported over the Internet;
- The fast growth of mobility as the key feature of the Internet landscape, which will have profound consequences for the EUFI.
- The increase of machine-to-machine (M2M) networks linking billions of devices and making the “Internet of Things” a reality;
- The increasing role of advertising in the emerging web ecosystem.

2.3.1 Towards the Internet of Services: the emergence of Cloud computing

Cloud computing represents a fundamental change in the way computing power is generated and distributed, transforming the delivery of IT tools and products into elastic, on demand services characterized by flexible “pay-as-you-go” payment models. Cloud computing enables the provision of specific applications, processes and functions as web services by virtue of Software Oriented Architectures (SOA). Moreover, cloud-based development platforms and service toolkits enable market players to develop new services in a simple way and to operate in the market as a supplier. The development of cloud-

based services is currently the most concrete manifestation of the vision of the Internet of Services (IoS).

IDC expects the global public IT cloud services market to reach \$72.9 bn in 2015 compared to \$21.5 bn in 2010, representing a CAGR of 27.6% (Gens *et al.*, 2011). This rapid growth rate is over four times the projected growth for the worldwide IT market as a whole (6.7%). By 2015, one of every seven dollars spent on packaged software, server, and storage offerings is predicted to be through the public cloud model. In light of the uncertain economic environment, these forecasts are regularly monitored and reviewed, but all indications are that cloud computing expenditure seems to be more recession-proof than most other ICT spending categories.

According to IDC (Gens *et al.*, 2012) almost two-thirds of cloud spending in 2012 will be on IT and end-user applications (SaaS), and about one-quarter will be on infrastructure hardware clouds (Infrastructure as a Service, IaaS). But the fastest-growing cloud services segment is expected to be Platform as a Service (PaaS).

Cloud computing is more advanced in the US than in the EU. More than half of EU businesses and consumers already use some kind of cloud services, but full adoption of the cloud model is still a long way off, hindered by a wide range of bottlenecks and barriers concerning security, data location and jurisdiction, data portability, and accountability of cloud providers (Cattaneo *et al.*, 2012).¹⁷ Despite cloud services being potentially attractive for SMEs, enterprises with more than 250 employees are currently more frequent adopters. Among SMEs, larger ones (with 100-249 employees) are willing to increase spending faster than smaller ones. Many SMEs adopt free cloud services.

EU enterprises claim to achieve tangible economic benefits from the adoption of cloud computing. 81% of the business users interviewed by IDC in 2012 reported lower IT costs (in the range of 10-20%, with some reporting savings of 30% or more). Other business benefits included more effective mobile working (46% of interviewees), higher productivity (41%), greater use of standard processes (35%), better ability to enter new business areas (33%), and the ability to open up in new locations (32%). According to interviews conducted by IDC, stakeholders generally believe that the cloud holds great promise and are quite bullish about what the impact could be if the barriers to wider adoption were removed. These considerations confirm the potential of the widespread diffusion of cloud services.

The level of adoption in the EU varies based on external factors, such as the availability of reasonably priced, reliable, and fast Internet connections (mostly an issue for consumers). But adoption is also dependent on whether or not the organisation has had any previous experience of using the cloud. For organisations that have used cloud services, the attraction for further adoption relates to efficiencies, agility and flexibility. For those that have not yet started, lower cost and ease of use are the main attractions.

In order to increase cloud adoption across the EU in the next few years, some fundamental issues need to be addressed, including:

¹⁷ According to this study survey, 64% of EU enterprises already use at least one or more cloud services, but cloud spending represented only 1.6% of total business IT spending in 2011.

- clarification and harmonisation of the legal framework;
- standardization and certification of cloud services across the EU;
- clearer rules on service provider accountability, guaranteeing data and application portability between cloud services providers;
- better and more reliable Internet connectivity (a specific SME concern); and
- EU-wide security certification.

The smallest SMEs (1-9 employees) would like fiscal or other incentives to adopt cloud services, while large enterprises would like EU-wide certification of cloud services vendors on suitability for government usage. In other words, if favourable framework conditions were implemented, there could be a large and rapid increase in cloud diffusion in the EU.

The migration to the Internet of Services must address a lot of different challenges.

An Internet of Services can only succeed if a number of challenges are met, including:

- the increased need for housing/hosting facilities (computing, storage and networking hardware and software to host cloud services) and new terminal equipment;
- the increased need for suitable transmission networks;
- the need for suitable performance (measurement) as cloud-based applications are more prone to performance issues (bandwidth guarantees, latency controls, end-to-end quality, etc.); and
- the integration of necessary complements like security and privacy “up the stack” into the platforms.

The Growth of Social networks

According to a recent survey published by BITKOM (2011), about 40 million out of roughly 80 million Germans are registered on at least one social network.

Approximately 96% of Internet users below 30 years of age subscribe to social networks, and the time spent online is increasingly concentrated in this area—about one third of the members of online communities log into the most commonly used social network at least once a day.

Furthermore, the survey indicates that social networks are becoming increasingly important as information channels, and 28% of all active users of online communities receive their daily news via these channels.

eMarketer estimates that more than half of Western Europe's (UK, France, Spain, Italy, Germany) online population will use social networks at least once a month in 2011, an increase of 16.2% from 2010 (see Figure 2-4) (New Media, 2011).

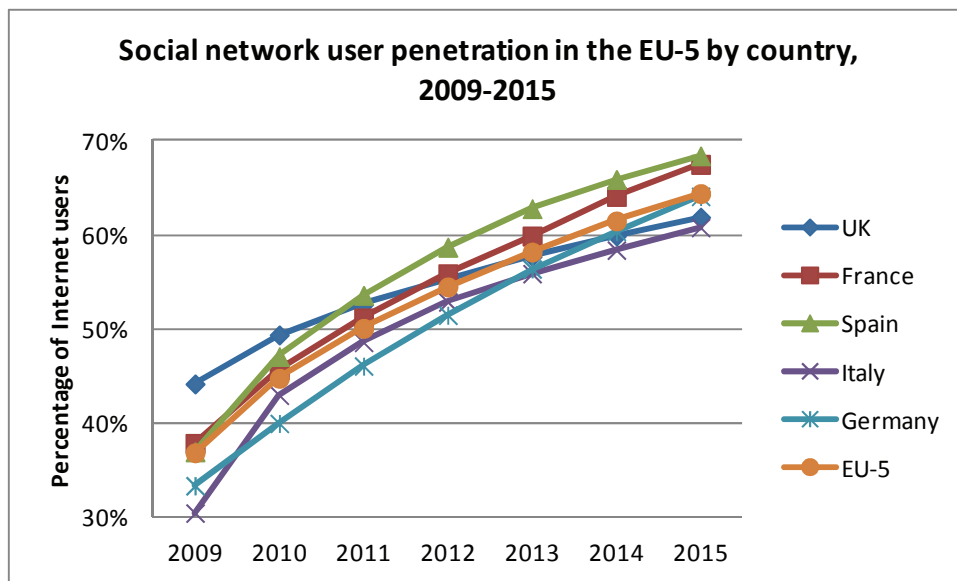


Figure 2-4. Social network user penetration in the UK, France, Spain, Italy and Germany, 2009–2015

Note: Internet users who use social networks via any device at least once per month.

Source: eMarketer, January 2011

By 2015, 64.4% of Internet users in the region, or 141.9 million people in these five countries, will be regular social network users, more than double the number of users in 2009.¹⁸

This thriving community will increasingly become the target of the business strategies of Internet industry players. Leading web platforms will explore the commercial opportunities of their user communities: Facebook is expected to move aggressively towards B2C e-commerce, to become the platform of choice for its users, leveraging partnerships with American Express, Microsoft, Oracle, IBM, and SAP to integrate commerce platforms into a seamless customer experience. Major enterprise IT vendors will try to enter the market of social technologies, often through acquisitions (there is talk for example of Microsoft buying LinkedIn). This will lead to increasing consolidation of the web ecosystem, with an increasing dominance of the leading global players (none of whom, apart from SAP, are European).

2.3.2 Big data, traffic, traffic management

The exponential growth of the amount of data managed over the Internet represents a qualitative change with the past. According to IDC (Gens *et al.*, 2012), the volume of digital content will grow to 2.7ZB in 2012, up 48% from 2011, and rocket toward nearly 8ZB by 2015. Over 90% of that data will be unstructured (e.g. images, videos, MP3 music files, and other files based on social media and Web enabled workloads), full of rich information but challenging to understand and analyze.

¹⁸ The figure shows in particular that social media usage in Spain, France and Germany will surpass UK penetration by 2015.

“Big Data” is used as a generic term to refer to a number of advanced data storage, access and analytics technologies aimed at handling high volume and/or fast moving data in a variety of different scenarios. Examples are social media sentiment monitoring or log file analyses. Big Data technologies, tools, and services that turn this information overload to information advantage can be an important competitive advantage opportunity for the global Internet industry.

Big Data is generated by all the Internet user communities: consumers, businesses, researchers and scientists. An increasing amount of data is being produced by the rising pervasiveness of sensors in non-scientific objects. For example, today’s smart phones have wifi, GPS, accelerometers, cameras, microphones, and gyroscopes. Citizens increasingly leave a “data shadow” in their online and offline behavior.

The availability of data on human behaviour produced by mobile phones and social networks has paved the way to the development of “computational social science”. This field is increasingly researched not only in universities but in private companies such as Yahoo and Google, and in government agencies in relation to security. The implications for monitoring and anticipating crises, such as health and epidemics, are invaluable.

The increase in scientific data is another important driver (High Level Expert Group on Scientific Data, 2010). Some areas of science are facing hundred- to thousand-fold increases in data volumes from satellites, telescopes, high-throughput instruments, sensor networks, accelerators, and supercomputers, compared to the volumes generated only a decade ago. Bioinformatics repositories are growing in size at an exponential rate. Given the increasing openness of scientific research, much of this data needs to be accessed, transmitted, stored, and managed over the Internet. This new demand requires innovative technology solutions to deal with such huge amounts of data and traffic over the Internet.

A recent survey addressed the issue of how the use of data management technologies might change over the next three years (Beveridge, 2012). The outcome was that, with the exception of legacy databases and file systems, which are anticipated to decline, all forms of modern data management and analytics solutions will be in greater demand in the short to medium term (see Figure 2-5).

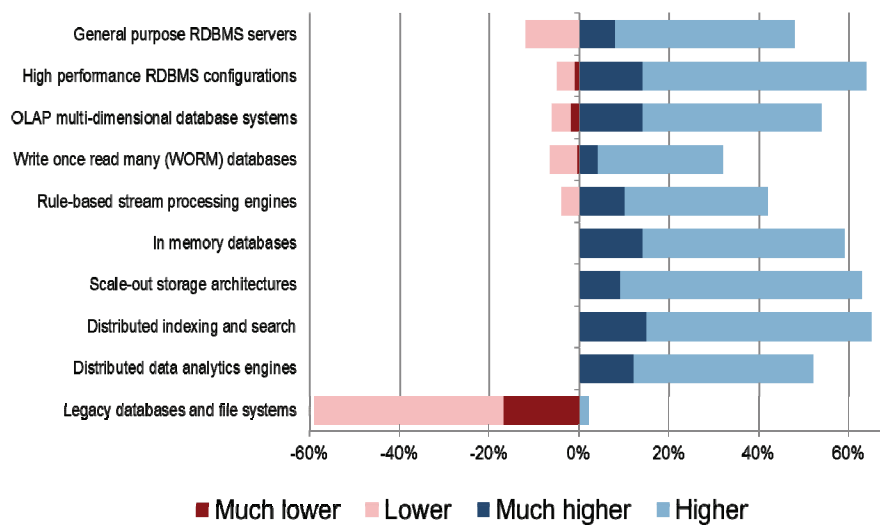


Figure 2-5. Anticipated change of the use of different approaches to handle “big data” issues

Source: based on Beveridge (2012). Online survey, 122 respondents, November 2011

Notes: RDBMS = Relational Data Base Management Systems; OLAP= On-Line Analytical Processing

DE-CIX, the German Internet exchange, is expecting data traffic to increase 20-fold between 2011 and 2015. DE-CIX (2011) identifies the increasing importance of HDTV content broadcasting as an important driver of this growth.

According to Cisco’s Visual Networking Index (2011), global IP traffic stands at 20.2 exabytes per month and is expected to quadruple by 2015 to reach 80.5 exabytes per month. Consumer IP traffic will reach 70 exabytes per month, and business IP traffic is forecast to surpass 10 exabytes per month (see Figure 2-6). Thus, future IP traffic in all likelihood will be dominated by consumer-related consumption of services and applications.

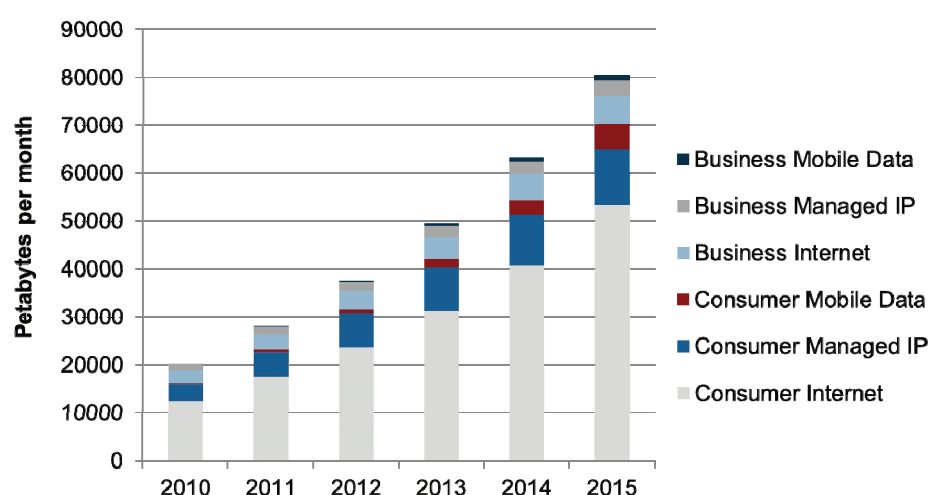


Figure 2-6. Development of global IP traffic and its components, 2010-2015

Source: Cisco Visual Networking Index: Forecast and Methodology

Figure 2-7 shows that consumer Internet traffic is mainly driven by Internet video to TV and PC, respectively, and file sharing.

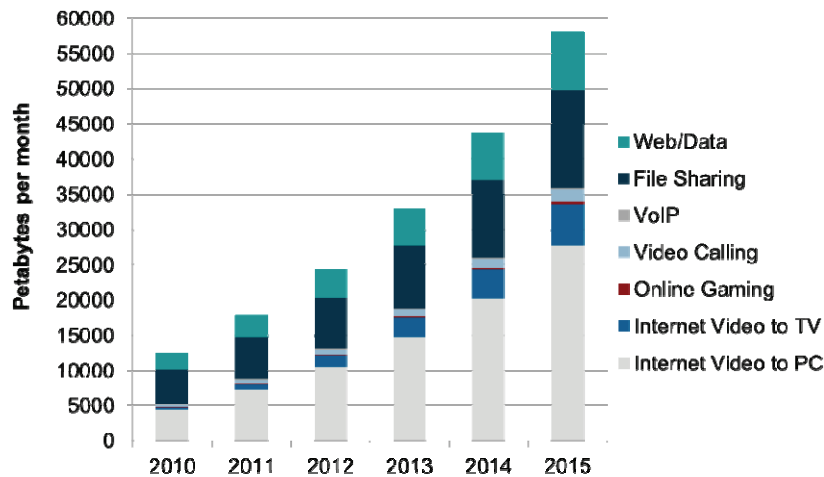


Figure 2-7. Composition of consumer Internet traffic, 2010-2015

Source: Cisco Visual Networking Index: Forecast and Methodology

It seems highly likely that the migration towards Internet video (to TV and PC) highlighted in Figure 2-7 is driven in particular by the migration from broadcast to unicast (Live TV and network DVR) and by new video formats (3DTV). As a result of these trends, there will be an unprecedented demand for new tools and applications for gathering and evaluating data (for example data mining, exploitation of data) and big data management on the one hand, and for solutions regarding the protection of data (conveyance and storage) on the other.

Symmetry may become an important issue with increasing data traffic.

An increase in upstream speed will become more important for the individual end user experience in view of all the services and applications that will become available in the future. It is, however, still open to debate as to whether this will also lead to an increased symmetry in overall traffic.

Cisco (2011) presented statistics which did not support the hypothesis that upstream bandwidth is growing faster than downstream, and that symmetric bandwidth therefore will be a requirement for the typical Internet user within a few years. Indeed, their traffic data analysis showed that upstream traffic as a percentage of total residential traffic has been flat for several years.

2.3.3 Internet of Things

Internet-based embedded solutions capable of linking billions of devices (cameras, sensors, etc.) and objects interacting intelligently and securely over a network are emerging to create machine-to-machine (M2M) networks and the Internet of Things (IoT). IPv6 leads to a virtually unlimited number of addresses, allowing a lifelong IP address to be assigned to all of these “things” and thus connect them. This may lead, for example, to silent commerce, where interconnected intelligent objects and machines capture data and deliver services in the background with little human intervention. M2M wireless connectivity is

beginning to see its profile rise in the business segment, largely due to the support it is receiving from the mobile operator and equipment vendor community.

In 2008, the number of “things” connected to the Internet exceeded the number of people on earth for the first time (Evans 2011). According to the Cisco VNI Mobile forecast, M2M mobile connections are expanding globally, along with other mobile connections. This is mainly due to the growth in hardware and software components for smart meters, business and consumer surveillance, inventory management, and fleet management.

As mobile data networks become ubiquitous in the enterprise, bandwidth-intensive M2M connections become more prevalent, see Figure 2-8. Traditional appliances and devices, such as home appliances, vehicles, energy meters, and vending machines, are now entering the network.

Estimates for the size of the Internet of Things range between 50 billion (McQuire and Cornelissen, 2011; Evans, 2011) to more than a 1 trillion in 2020 (Bobillier, 2011). IDC (Gens *et al.*, 2012) estimates a number of 100+ billion sensors and tags and 11.5 billion communicating “things” on the network in 2012; in the next two years, the number of installed intelligent communicating devices on the network will outnumber “traditional computing” devices by almost two to one. They include embedded systems, connected entertainment devices, appliances, and industrial automotive devices—all in addition to conventional computing devices.

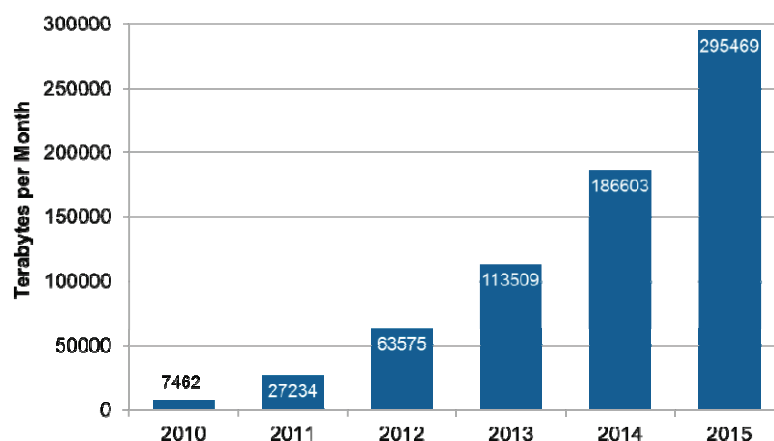


Figure 2-8. Machine-to-Machine traffic to increase 40-fold between 2010 and 2015

Source: Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010–2015

The application area of M2M solutions is broad, covering a multitude of segments and sectors of the economy.¹⁹ M2M communication has enormous potential since it might help companies to lower costs and increase efficiency. IDC estimates that in the near term (2-3 years) there will be over 3.5 billion industrial products (including cars, planes, and boats), appliances/toys, and entertainment devices connected and communicating over the Internet. These devices will have the ability to share information about their “state”, such as need for service, availability for use, time of arrival, and so forth.

¹⁹ Platform-as-a-service offerings might facilitate the respective application development.

M2M is likely to become more relevant to the home environment as well as to mobile money and m-Commerce, wireless health/mobile health and Ambient Assisted Living. It is therefore foreseeable that M2M will bring about a range of challenges, in particular with regard to standardization of M2M solutions—reducing fragmentation and complexity across the sectors will become crucial—and issues relating to security and data protection.

2.3.4 **Mobility over the Internet**

A number of technology and market trends related to mobility are relevant for the European Internet industry, in particular the form of mobile communications via smart phones, tablets etc, and the nomadic use of this terminal equipment. The growth of mobile devices and applications has reached a tipping point, and such devices are rapidly becoming the leading mode for accessing and using the Internet. This is confirmed by IDC data showing that in 2012, over 895 million smart phones and media tablets will be shipped, compared with fewer than 400 million PCs. At least as important, 2012 will be the first year in which spending from these devices (\$277 bn) will exceed that for PCs (\$257 bn). Demand for mobile devices is outstripping that for fixed IT by five times.

The increase in mobile applications in Apple, Android, and other app stores is also extremely rapid: in 2012 IDC expects 85 billion mobile applications downloads, more than double the number in 2011. Even if only a small number (8%) of mobile apps are paid, their revenues (almost \$14 bn) will make the mobile apps market about one-third larger than the mainframe market in 2012.

However, the most important implication of these developments is that the PC is losing its status as the dominant user device for the digital world, and being replaced by mobile devices. This means that traditional IT vendors must review their product strategies and that Internet software and services providers must adapt even faster than foreseen to a market driven by mobile applications.

Several trends can be identified with regard to mobile phones and mobile apps

Firstly, mobile phone penetration in the world will increase, primarily in continents that have been lagging behind. Secondly, we expect a near complete migration of handsets towards smart phones capable of broadband-like communication. Thirdly, smart phones will incorporate additional functionalities and allow more sophisticated user-interfaces, such as touch, gesture and voice-based operation.

In parallel, there will be a rapid increase in specific mobility applications and services. Examples of the latter are health information, data storage, access authentication and authorization, and mobile payment functionalities. Mobile apps will adapt to all the innovative trends; they will integrate Big Data analytics; connect to and be integrated with key cloud application platforms such as Amazon Web Services, Windows Azure, Force.com, and so forth; they will be integrated with in-app commerce offerings, including those from PayPal, Amazon, Google, and so forth.

One of the key technologies supporting this evolution is likely to be Near Field Communications (NFC), which has made great strides in countries such as Korea, Japan, and Australia as a way to streamline consumer applications like coupon redemption, pay TV, and travel. In the next few years, NFC pilots are going to be implemented in the US and Europe, supporting mobile payments and the emergence of the "digital wallet," as well

as revisiting the personal area network (PAN), an idea promised but never delivered by Bluetooth.

DigiTimes (2011) estimates that over half of smart phones will support NFC, which will enable mobile payment, by the end of 2014; a fivefold increase in three years. The overall market volume of the mobile NFC market is estimated by ABI Research (2011) at US\$1.3 bn in 2016. However, there are several implementation problems to be solved to achieve these numbers. DigiTimes identifies the main challenges regarding future growth to be the lack of standardized specifications and the need for a wider ecosystem.

ABI expects vendors to develop a variety of competitive solutions regarding security, which will in turn enable a number of new business models to be developed.

An interesting additional aspect is ABI's expectation that mobile network operators will lose some ground in this market and specialists will win market share (Gabriel, 2011). There are, for instance, arguments that advanced mobile payment solutions will enable new advertising models based on consumer interactions with real-world retail outlets (Dowling, 2011).

There will also be a rapid diffusion of tablet computers: iSuppli (Alexander, 2011) estimates global media tablet shipments at 60 million in 2011 and expects this figure to more than quadruple to 275 million in 2015.

Finally, there is an international trend in the business sector towards the accelerated use of simple mobile applications and integrated mobile solutions covering the entire supply chain. This trend is visible in particular in the logistics and health sectors. Previously existing market barriers to the development and implementation of complex mobile business solutions are about to be lowered substantially due to the deployment of nearly countrywide high bit rate mobile network infrastructures and decreasing tariffs (Büllingen *et al.*, 2011).

These developments underline the likelihood of convergence in the future regarding telecommunications, mobile services, and media, which will shape the future of the Internet industry.

We anticipate a rapid diffusion of IP-capable terminal equipment

On the one hand there will be a trend towards mobility and mobile services and applications comprising voice, data and video components. On the other, we expect an increased migration towards "smart home" technologies and networks, i.e. the convergence of various forms of terminal equipment like computers, smart handsets, TV-sets and game consoles.

Chandrapal (2011) cites five predictions from Cisco research for 2025: (1) the end of the TV channel concept, to be replaced by customized, on-demand streams; (2) the end of remote control, replaced by voice, gesture and interaction devices; (3) highly immersive content, new sensory interaction elements; (4) contextual, interactive advertisements; viewer is laser targeted; (5) social interaction and group participation at home and beyond.

Several researchers (e.g. Sattler, 2011; Deloitte, 2011) suggest that social media will become more important in entertainment electronics due to the functionalities of terminal devices and/or the integration of "like" functions. The business sector will also experience

an increased diffusion of convergent solutions, i.e. an integration of different applications across all relevant network interfaces.

The trend of convergence will probably also be observed in transmission networks capable of conveying voice, data and video over Internet Protocols. The migration towards NGN/IMS as a unifying platform, for instance, has already started (see Section 2.2.2).

In addition, there will be a convergence of the voice, data and video services value chains. The new enlarged Internet value chain encompasses transmission networks, production of content in whatever form, and the platforms in between (physical data centre facilities to store and disseminate content; services related to packaging, versioning, and aggregating content, etc). This value chain allows new business models with new revenue generating sources, in particular subscriber fees and advertising. Along this new value chain, there will be a tendency towards multi-screen, i.e. content will be compatible across all available access network alternatives.

2.3.5 Advertising

The current business model of offering access to the Internet is still mainly based on subscription fees paid by end users. However, the analysis in section 2.1 has identified that across the Internet value chain, in particular in the web ecosystem, there are vital players with business models that have widely varying dependences on advertising.

eMarketer (2011) estimates global advertisement spending will reach US\$ 500 bn in 2011. Digital advertising still accounts for only a small share of this. Figure 2-9 shows that market volume today is estimated at more than US\$ 60 bn. Just five companies control 64% of this market, and Google alone accounts for 46% of all online ad spending.

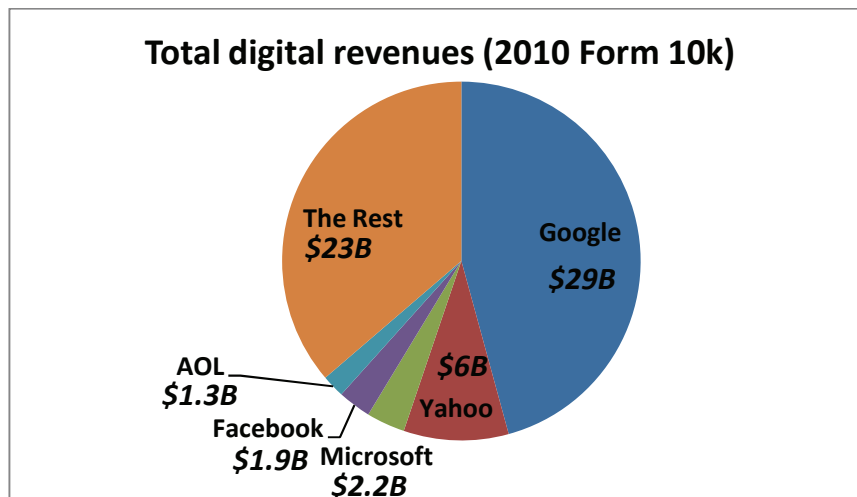


Figure 2-9. Market volume of online advertising spending 2010 and the main players

Source: darrenherman.com (2011). Adapted from BusinessInsider.com. (2011)

The market volume of online advertising spending is expected to increase very dynamically in the future, thus there are still high growth potentials.

eMarketer (2011) estimates the total volume of online ad spending in 2015 at US\$ 132 bn. Significant drivers are the increased diffusion of social media and smart phones. The form of the advertising itself will likely undergo substantial changes in the future. Along with the migration towards “ongoing engagement” with the Internet user, targeting

technologies, which identify and evaluate user profiles and contexts, are likely to become more significant.

2.4 Internet Technology and Governance Trends

This section reviews briefly the main technology and governance trends characterising the transition towards the Future Internet, based on a review of literature and market research. They are as follows:

- The evolution of network infrastructure technologies towards Next Generation Networks (NGN) and Next Generation Access (NGA), and the implications for the pace of investments;
- Net neutrality, or the need to insure transparent and non-discriminatory access and utilization of Internet services and applications; and
- Security, Data protection and privacy issues.

Towards Next Generation Networks (NGN)

The speed and scope of the migration to NGN or NGA will be an important element in investment decisions regarding future Internet infrastructures capable of providing smart services via appropriate interfaces, with additional functionalities regarding security, traffic management etc, such as those developed in the course of the Future Internet PPP.

Technical progress in the architectures and topologies of Internet networks will underpin NGNs able to respond to increasing demand for capacity and speed. These are likely to be based on the IP Multimedia Subsystem (IMS) standard, and are universal platforms for packet-based transmission and universal control across all different access network technologies (i.e. real converged mobile and fixed NGNs). They are characterised by massive increases in network capacity, speed (ultra-high broadband), ubiquity and flexibility. In parallel there will be a migration towards IPv6 now that the IPv4 address pool is exhausted.

Developments regarding NGA networks will be of particular significance for the European Internet industry. The Digital Agenda for Europe (DAE, European Commission 2010c), the guiding policy document for EU broadband policy, gives broadband targets for basic, fast, and ultra-fast broadband. Fast broadband access is identified as an Internet access speed of more than 30 Mbps, and ultra-fast as access of more than 100 Mbps.

The deployment of high bit rate broadband infrastructure is widely seen as a prerequisite for future growth and prosperity. The ITU (International Telecommunication Union) Broadband Commission for Digital Development, for instance, underlines the importance of a trans-sectoral approach based on the deployment of broadband infrastructure and development of synergies regarding applications. They expect significant multiplier effects due to positive developments unleashed in the areas of health, education, energy (efficiency), environmental protection, public security, and citizen's participation.

In nearly all EU Member States, there are ventures underway focusing on the deployment of high bit rate broadband infrastructure. These ventures differ in the geographical scope of the deployment within a country, the technology adopted, the time frame for deployment, the role of the State, and the business model envisaged.

There is, however, one common assumption: a purely market-driven approach—i.e. based on costs, profitability and risk expectations of a non-subsidized market entity—will only lead to limited coverage by ultra-high broadband infrastructure. The reason is that, besides cost considerations, there is considerable uncertainty about the demand side. In those countries which already have a high coverage of ultra-high broadband networks (e.g. Japan and South Korea), the take-up rate is still relatively low. One reason might be the lack of services and applications requiring ultra-high bandwidths, another is the likely low willingness-to-pay for ultra-high access and bandwidth. A recent German survey underlines that the vast majority of users are only willing to pay up to an additional €5 for ultra-high bandwidths (Hoffmann, 2010).

Although the European Framework Directive imposes a duty on national regulatory agencies to promote efficient investment and innovation in new and enhanced infrastructures,²⁰ it can be taken for granted that meeting the ultimate goals of the DAE will be extremely challenging, and in many cases impossible unless additional measures are implemented.²¹ The Commission has recently estimated the cost to be €270 bn (EIB, 2011; European Commission, 2011c).

2.4.1 Net neutrality

Net neutrality is a meta-concept addressing the transparent and open utilization of Internet services and applications without a discriminatory intervention, guaranteeing flexible network access (upload and download) and thus securing innovations and freedom of opinion.²²

In a recent study for the European Parliament, Marcus *et al.* (2011) outlined that:

there have been scattered complaints, some of them credible, of (1) mobile network operators (MNOs) blocking or charging excessive prices for VoIP, and of (2) blocking or throttling of traffic such as file sharing [...]. In its response to the Commission's public consultation,... the Body of European Regulators for Electronic Communications (BEREC) noted that the incidents to date are relevant but "may not necessarily represent breaches of network neutrality"; moreover, many were finally resolved "without any formal proceedings", and the incidents "have not led to a significant number of investigations by National Regulatory Authorities (NRAs)."

There appear on balance to be few, if any, documented, clearly problematic incidents in Europe to date, and no demonstrated, sustained pattern of systematic and abusive discrimination (*ibid*). BEREC (2011a; 2011b) addressed the issue of network neutrality recently, focusing on transparency and on Quality of Service.

²⁰ See Article 8(5)(d) of the Framework Directive.

²¹ A recent study by Oxera (2011) focuses in particular on a co-investment approach. This approach can be characterised on the one hand by an agreement between the regulator and the industry on long-term investment objectives for the sector. On the other hand the regulator provides long-term regulatory certainty over the treatment of the broadband investments carried out in accordance with these objectives. A (far reaching) alternative is the Australian approach where the State itself takes over the deployment of a nationwide NGA infrastructure.

²² Article 8 (4) (g) of the Framework Directive defines net neutrality as: "promoting the ability of end-users to access and distribute information or run applications and services of their choice".

Yet, despite the limited significance of net neutrality violations for the European Internet market today, it is obvious that any future developments that change the current market situation and/or regulatory regime might have important impacts on the investment behaviour and innovation potential of the European Internet industry.²³

2.4.2 **Security, data protection, privacy**

The migration of networks, platforms, and terminal equipment together with the increased adoption and diffusion of Internet-related services, applications and solutions, will give rise to completely new requirements regarding network security, data protection, privacy, etc.

These developments will affect how the market is able to develop solutions to address the three principles of security—confidentiality, availability and integrity. To meet these requirements, technological (hardware and software), legal, and regulatory measures and instruments need to be developed and implemented, raising both challenges and opportunities for the European Internet industry.

There are two main and linked drivers for the growth of the information security market as it relates to the European Internet industry. Firstly, the emergence of personal data as the “new oil” (OECD 2010a) means that the supply side has an incentive to offer products and services to assist in protecting this increasingly important business and organisational asset. This will become even more acute as the Internet ecosystem grows and the exchange of personal data over networked infrastructures becomes the means by which value can be generated.

Secondly, there is a significant rise in cybercrime. Cybercrime, whether through fraud or the theft of business secrets or company data, is generally economically motivated. According to recent statistics, the economic costs of cybercrime add up to US\$388bn per year (with direct cash costs of US\$ 114bn).

The rise of device convergence (between desktop PCs, smart phones, tablets) also presents increasing challenges for understanding market forces concerning security. The foreseeable widespread private and organisational use of cloud computing together with the bundling of “free” security software with other products (e.g. Microsoft Security Essentials) is already having an effect on the standalone security software market.

Other secondary types of markets are developing, too, for example, markets for smart phone apps have security software that aims to meet perceived or real confidentiality, availability and integrity concerns among smart phone users (for example, antivirus tools, password keepers, backup services, etc.). Security functionalities and components are also bundled into other products and services, such as web-browsers and email programs.

Finally, it is likely that security service providers, for instance firms like Symantec, will become more important because they can collect extensive data on security threats due to economies of scale. Such firms normally offer both retail and enterprise level services. At

²³ The potential effects regarding investment and innovation are complex due to the different stakeholders that a priori might be involved and which mirror different roles on the value chain. Indeed, there are at least five different stages to be taken into account: the content provider/ platform operator; the ISP that connects the platform; the backbone provider(s); the network access provider (ISP) of the end user; and the end user himself.

the retail end, common products include antivirus software which relies upon signatures pushed out from those able to reengineer viruses discovered “in the wild”. Many Intrusion Detection Systems (IDS) also work on a similar pattern-based model. Other types of security service providers include those that offer tailored feeds of data or metrics on Internet security, such as Dragon Consulting Services, which monitors certain specific malware-related trends (such as numbers of malware programs; percentage of botnets etc.).

According to Infonetics research, in 2015 the Security Service provider market will add up to US\$16.8bn (Market Watch, 2011).

This could imply that, for the European Internet industry, reaching its full market potential may not be simply a matter of market economics. One argument underlining this assertion is that the security and privacy threats might lead to complex strategic behaviour by the entities threatened. Indeed, some have argued that the security market exhibits market failure because firms have no incentive to spend on security software or services since the economic trade-offs favour taking the risk and either accepting losses or shifting liability onto others (Anderson and Moore, 2011).²⁴ Such incentive incompatibilities may also be seen with respect to the resilience of the Internet infrastructure as such (see for example: ENISA, 2011).²⁵

Regulatory uncertainties are also important for security, data protection and privacy. The regulatory approaches to privacy for example, especially regarding the use of personal data online, are still not coherent across Europe. Social networks, which rely to a large extent on advertising-based business models, are starting to use personal data as a way to better target responses to information queries or as a product in itself (see below). Consequently, companies like Facebook and Google have been involved in legal battles with regulators in the United States and Europe over the use of personal data.

The question of how the market realities for firms in this realm will evolve is yet to be concluded. Aside from behavioural and socio-economic discussions about whether people are actually concerned about their privacy (and willing to pay extra to have it protected, thus creating a market for privacy protection), there are of course open questions about how the approaches between the United States and Europe with their differing attitudes to the protection of personal data and intrusion into the private sphere, will play out. Currently, discussions on privacy in the context of cloud computing are a microcosm of these issues. Significant cloud computing providers are based in the US, whilst European regulatory approaches envisage geographic thresholds being placed on which jurisdictions cloud computing providers can store personal data of EU citizens. Within Europe, this may drive a ‘race to the top’ as countries set up macro-economic policies to attract cloud

²⁴ For example, onto consumers with respect to ‘click-wrap licensing agreements.

²⁵ The ENISA report focuses on risks for the resilience of the ‘Internet interconnection ecosystem, i.e. of all the networks that make up the Internet. As to the lack of incentives to meet the foreseeable challenges the report concludes: “Most of the things that service providers can do to make the Internet more resilient, from having excess capacity to route filtering, benefit other providers much more than the firm that pays for them, leading to a potential “tragedy of the commons”. Similarly, security mechanisms that would help reduce the likelihood and the impact of malice, error and mischance are not implemented because no one has found a way to roll them out that gives sufficiently incremental and sufficiently local benefit.” (ibid, p.9).

providers and customers on the basis of how well they can be shown to meet EU obligations concerning personal data protection (giving those operating from such jurisdictions a ‘badge’ of quality). However, outside of Europe, the variety of approaches to privacy protection may give some cause for concern.²⁶

2.5 Determinants of future growth and competitiveness

The meaning of the term “competitiveness” varies across economic literature and political discussions. In our analysis we have used the definition of the McKinsey Global Institute (Manyika *et al.*, 2010): “capacity [of a sector] to sustain growth through either increasing productivity or expanding employment.”

It is clear from the outset that the technological and market trends described in the previous section will have a decisive impact on the future development of the Internet industry in general and the European Internet industry in particular.

In order to identify and characterise the main factors determining the future, it is useful to focus on the five player groups which constitute the European Internet industry and their business models, as characterised in section 2.1. The analysis, which takes into account results from Deliverable D2 (see Cattaneo *et al.*, 2011), is summarised in Table 2-1.

²⁶ For more information see: Cave J. *et al.* (2011)

Table 2-1. Summary of determinants of growth and competitiveness in the five segments of the Internet industry

Segment	Determinants for growth and competitiveness
Internet network equipment suppliers	<ul style="list-style-type: none"> • Ability to incorporate technological developments into marketable products and solutions rapidly • Ability to manage price and technological competition, especially from Asian competitors but also other global actors • Ability to manage external growth (e.g. through alliance and acquisition strategies) • Growth crucially dependent on investment decisions of telecommunications network operators
Smart handheld devices suppliers	<ul style="list-style-type: none"> • Ability of European players to tie terminal equipment with exclusive provision of services and applications • Likely path-dependency and lock-in effects for end-users due to vendor specificities • Entry barriers due to considerable economies of scale regarding R&D, capital requirements and existing patents
Internet-related software and services companies	<ul style="list-style-type: none"> • High economies of scale due to R&D requirements, requirements to keep up with technological/market trends (e.g. cloud) and therefore high capital needs • Need of skilled personnel, sometimes lacking in the EU • Need of access to venture capital for start ups and SMEs • Management of external growth
Internet-related telecommunication providers	<ul style="list-style-type: none"> • Significant economies of scale due to high fixed costs of networks (e.g. regarding NGN / NGA networks), and therefore high capital needs • Intensive price competition on the end user side: low willingness-to-pay for access • Lack of competencies to establish new business models related to the web ecosystem rapidly (e.g. regarding content, advertising) • Managerial competencies for external growth (incorporation of innovators from outside) • Geographical fragmentation in Europe with respect to fixed link and mobile activities • Fragmentation of the European markets regarding pan-European business models for multi-nationals
Web ecosystem	<ul style="list-style-type: none"> • High investment needs for physical infrastructure in specific segments leading to capital scarcity (e.g. regarding cloud computing or platform business) • Lack of skilled personnel • Need of access to venture capital for start ups and SMEs • High transaction costs due to fragmentation, due to security and privacy rules, language, etc

2.5.1 Network Equipment Suppliers

The number of network equipment suppliers within the European Internet industry is small, but the companies themselves tend to be very large given the economies of scale and scope in this segment. They play a significant role with regard to R&D investments within the Internet industry. The key equipment manufacturers include European and North American companies, with Asian vendors becoming more important in recent years.

Several factors are crucial for the growth and competitiveness of network equipment suppliers. Firstly, they need to respond very rapidly to technological progress, incorporating new developments into marketable products and solutions within a short space of time. Secondly, they need to be able to face increasing competitive pressure on price and technological features, in particular from Asian vendors. Thirdly, it is becoming increasingly important to be able to manage external growth, i.e. to increase innovativeness, improve product/service development and reduce time to market via

acquisition and integration of specialist suppliers (usually SMEs) that are innovators in key areas.

Finally, an important factor for growth and competitiveness of network equipment suppliers is improving the future viability of the business model of their key customers, the telecom providers, in relation to Internet business. The transformation of the Internet sector in Europe and the world is of course opening up new opportunities for these actors. Yet, despite the large market potential, there is a severe caveat in that they are highly dependent on the investment decisions of communications network operators, which are themselves searching for a competitive and future-proof position in the market and a growth story that is accepted by the capital markets.

Network equipment suppliers are already finding they must not only supply the relevant network infrastructure elements (e.g. base station equipment), but also offer more complex services. Network equipment suppliers might help telecom providers to generate new revenue and differentiate themselves from the competition, e.g. by providing a faster time-to-market for end-user services, enhancing billing and charging capability, and providing more accurate business analytics. They might also help to improve the operational efficiency of their customers by developing their management processes, e.g. through outsourcing non-core activities, supporting and managing their networks with robust customer care offerings, and through ensuring fast and cost-effective implementation of new networks and network upgrades (Cattaneo *et al.*, 2011 p. 61).

2.5.2 **Smart Handheld Devices Suppliers**

The substitution of traditional mobile handsets by smart phones has led to a disruptive change in the business model of smart handheld device suppliers (and mobile network operators), with the development of content-based relationships with end users via apps and online stores.

The core competence of a smart handheld supplier is therefore no longer simply technical innovation, rather, it is the capability to set up a viable intermediary position between content innovators on one side and end users on the other. This requires an incentivising positioning vis-à-vis content generators and service providers that package, version and aggregate the content, and the ability to generate real value added for which end users are willing to pay. In this context, economies of scale play a decisive role.

In the field of smart handheld devices, companies with headquarters outside Europe are growing dynamically whereas the Europe-based manufacturers are struggling. Nokia is essentially the only European actor remaining in the sector.

2.5.3 **Internet-related software and IT services companies**

The European Internet software industry is traditionally fragmented and oriented to local and niche markets. In particular, SMEs play an important role. There are a few high profile actors in the EU, but only one of these, SAP, is a market leader.²⁷ Apart from SAP, the home market for the majority of the other major software companies in the European Internet industry is North America.

²⁷ SAP in Germany, Sophos in the UK, AVG Technologies in the Czech Republic, F-Secure in Finland, Emailvision and Hubwoo in France.

As Section 2.1.4 outlined, telecom network operators are also active in providing IT services, however, the dominant companies in this field are specialists (i.e. non-communications network operators and non-manufacturers). Depending on the actual IT service, the relevant geographical market for a particular service provider can be relatively small, ie regional or national, or very large, and thus global. The latter is particularly the case for companies that develop and implement services for multi-national organisations.

The growth potential for Internet-related software and IT services companies is high. This is due in particular to the migration to cloud services and solutions, increasing security requirements, and the implementation, operation and maintenance of Internet-related networks and applications. In view of the requirements due to technological and market developments (see Section 2.2), there are several crucial factors that are likely to determine the future growth and competitiveness of the Internet-related software and IT services market segment.

Companies from all sectors of the economy have an increasing need for assistance to make efficient use of the capabilities of the evolving Internet. Companies in the Internet-related software and IT services market segment therefore have to find an appropriate way to approach the convergence between software and services, the new disruptive delivery models such as cloud computing, the use of current and new Internet platform characteristics, and the adequate development of future Internet-based services, applications and solutions and their implementation. Crucial competencies here include the ability to develop suitable business models and the ability to assess risks as well as technical consulting and implementation skills. Cloud computing and M2M present a specific challenge because security concerns are a key factor determining adoption and diffusion.

Companies also have to find a viable market position in the face of new entrants to the market, strong competition from the Web ecosystem (see section 2.1), and new competitors from the telecom industry. This might, however, also open up opportunities for new partnerships.

Companies have to determine the extent of their own investment into cloud-oriented services and infrastructures (e.g. data centres) and find ways to meet the resulting capital requirements.

Finding ways to address the likely scarcity of suitably qualified personnel, particularly innovation business skills combined with domain knowledge in sectors such as healthcare, energy, smart cities, and entertainment, will be important to sustainability and growth.

Finally, the ability to manage external growth will become an ever more important competence, i.e. to increase innovativeness, product/service development and time to market via acquisition and integration of respective specialists (in particular SMEs) that are innovators in key areas.

2.5.4 Internet telecommunication services providers

The vast majority of the telecom providers in the European Internet industry are traditional telecom companies. These traditional companies possess extensive accumulated know-how and assets, including dense commercial networks and customer relationships. They are also Internet service providers (ISPs).

As telecom companies, they are in principle nationally oriented, i.e. they operate on a single or multi-country scale. As ISPs, they need to work globally inasmuch as their customers want to have access to all Internet addresses in the world. It is highly likely that only a few of the telecom companies in the European Internet industry belong to the group of tier 1 providers, thus most European telecom companies need transit arrangements for their upstream connectivity. It is fair to state that, in general, the telecom providers in the European Internet industry have not been able to fully exploit emerging Internet markets so far.

The biggest challenge for the European Internet-related telecom providers is not market entry from outsiders into the traditional key markets. Rather, it is:

- fierce competition within the market;
- technological progress (particularly disruptive), e.g. migration to IP, NGN and NGA, migration to the cloud, but also migration towards one or more new future Internet platform(s);
- new business models that threaten the once strategic asset of comprehensive end-user contacts regarding network access and services; and
- the considerable investments necessary in new infrastructure and innovative services and applications.

An open discussion about the currently still very geographically fragmented industry in Europe, both with respect to fixed link and mobile activities, might lead to new approaches towards consolidation.²⁸

A range of factors are crucial for the future growth and competitiveness of Internet-related telecom providers.

Quantity and price patterns are working in opposite directions. Internet and core network traffic is still increasing rapidly (although the growth rate is declining) (Marcus and Monti, 2011), but pricing faces strong competition on the demand side and willingness to pay for access (and bandwidth) by end users is very limited (see Section 2.2.2). Willingness to pay for the portfolio of services and applications offered so far by telecommunications providers is also limited.²⁹ Price competition is also fierce for IP transit and prices for a connection with a given bandwidth are still declining. Based on general price trends in IP-based networks, we would expect that prices for international transit should be declining fairly rapidly, possibly in the 25-30% per year range (TeleGeography, 2011).

The traditional markets are mature. Although technology is a key driver for future development, the deployment and operation of transmission networks has only limited growth potential, if any, and deployment of access networks is costly and risky (capital market perceptions are crucial for financing). Overall, there is a clear tendency for the pure

²⁸ Companies like AT&T and Verizon in the USA or NTT in Japan have total turnover above 100 bn US \$ whereas a lot of European operators exhibit a turnover (sometimes far) below 30 bn. US\$.

²⁹ Deutsche Telekom e.g. has 1.4M. customers subscribing to its (IPTV) entertainment package. The potential market base is, however, much higher. Indeed, the entertainment package is marketed to potential VDSL and ADSL 2+ customers, i.e. to a potential market base of 20 million households across Germany.

physical network assets of incumbent companies to become commodities, i.e. it is hardly possible to differentiate one business from its competitors on the basis of network characteristics. Differentiation for specific telecommunications providers might be possible by, for instance, offering high-demand next generation devices, and this might help them to reduce churn and retain customers. It is, however, likely that the margins of this kind of business are much more in favour of the manufacturers rather than the telecom providers.

Telecom providers face options for preventing their service from becoming dumb pipes, but these come with their own challenges. Particular examples include enhancing or optimizing the physical infrastructure for providing cloud-based services, and making the infrastructure more intelligent in order to be able to successfully provide smart services/applications, QoS, complex custom-tailored solutions, etc. (for example Barraclough, 2011).

Development and provision of these smart services relies on at least two crucial requirements. Telecommunication providers have to get accustomed to the shorter time to market conditions in an Internet world compared to the old telecoms world. They also need to find a stable and pertinent solution for the issue of “make or buy”, i.e. the efficient division of labour between network operation and (smart) service development and provision. It is highly likely that SMEs will play a particularly important role in future Internet-related innovation and therefore the ability to integrate outside innovation into internal processes and product/service portfolios will become a crucial competence.

Adding a content-based element to the telecom provider business has not yet been proved viable. Several attempts by network operators to integrate content-based activities into their business models have not been very convincing. The examples of Time Warner and AOL, Telefonica and Endemol, and Vivendi and NBC Universal all show how difficult it is to combine the different basic economics as well as the different corporate cultures in a single entity. Despite this, recent developments in the market show that network operators still believe in the viability of integrating network and content-based activities.

Recent market developments in the Internet industry have demonstrated the success of advertising-based business models. This is particularly challenging for telecom providers, as the size of the online advertising market is likely to grow rapidly (see Section 2.2.11) whereas the willingness to pay for mere physical broadband access as well as for bandwidth seems to be very limited (see above). In order to get a share of these revenues, market reach and a product and service portfolio that delivers value to end users are indispensable requirements. The telecom providers still have a large customer base which gives them reach, but this asset is contestable as the multitude of existing services and applications on top of IP shows.

2.5.5 The web ecosystem

The web ecosystem is the fastest growing segment of the Internet industry. The web ecosystem comprises many different business models, including web service providers, web platforms and content providers, and eCommerce and online service providers (see Section 2.1), with a multitude of different players. The growth potential for this segment of the Internet industry is very high, in particular because a multitude of business models are based on advertising.

The key players active in the web ecosystem in the European Internet industry have their roots in Europe and North America. This is true of both sides of the business, operating the underlying technical platforms (e.g. housing/hosting, CDNs), and operating e-commerce, search, social network sites etc. However, the dominant companies in this field are specialists operating in the layer on top of IP.

The business of many market participants in the web ecosystem is regionally focused, i.e. there are smaller market participants with activity portfolios that cover only a region within a country, a single country or a few countries. There are also companies that focus on the world market. This is particularly the case regarding companies that develop and implement services for multi-national companies, and those with a business model that focuses on making content (in whatever form) available worldwide.

The actors in the web ecosystem are riding the wave of expanding web services, from eCommerce to social networking, and from mobile applications to IT services (through cloud computing). They are also expanding into the market segments previously dominated by telecom operators and IT software and services companies. This growth is very recent and the respective market developments have not yet stabilized.

Several factors are likely to determine growth and competitiveness of the web ecosystem within the European Internet industry.

Players have to meet the requirements of dynamically increasing data traffic volumes (see Section 2.3.2). The increased significance of video-based communication, the migration to cloud services, the proliferation of social networks and social media, and the migration towards unified communication and collaborative networks are particularly relevant. The increasing traffic volumes will require expansion of platform capacities, thus there might also be room for external growth (M&As) driven by economies of scale.

A key factor shaping future growth and competitiveness will be the ability to develop and design marketable services, applications and tailored solutions for sectors such as e-health, e-energy (for example “Green” IT at home and at work), education, and knowledge management, and to support their implementation. Marketization of services and applications will often be based on a trial and error approach regarding acceptance/willingness to pay by end users. The willingness to pay for new services and applications depends very much on the specific form of the actual content and the respective pricing model. Overall, it is fair to state that the pricing model for the provision of Internet-based services and applications is still not stable.

The ability to make suitable R&D investments is particularly crucial. It seems likely that start-ups will continue to be an important driver of technological development and marketization. Their ability to work efficiently through their lifecycle rests, however, to a large degree on an appropriate funding environment (business angels, venture capital, IPOs, etc.).³⁰

Players will have to meet future requirements for network security, data protection, access to data, etc, for both private and business users. A crucial element here seems to be the

³⁰ R&D investment in Europe and market conditions for start-ups have been addressed in Deliverable D2. See Cattaneo *et al.* (2011, p.69).

location where data is processed and stored. If the European market demand for web-based platform services exhibits a preference for European locations for housing and hosting facilities, this would provide a competitive advantage for European players vis-à-vis competitors from outside Europe. There might, however, be a trade-off when costs come into play, if concentration on European locations leads to diseconomies of scale and, in turn, higher costs. Willingness to pay for European locations, therefore, is also crucial.

As in the case of software and IT services (see Section 2.1.3) companies in the web ecosystem will have to find ways to handle the likely scarcity of qualified personnel with the appropriate IT skills, particularly innovation business skills combined with domain knowledge.

To the extent that advertising is a component of the business model, a key competence will be the adaptation of online advertising to make it suitable for application across all network access channels (fixed, mobile, terrestrial) and the development of context-aware, location-based advertising focusing on individual habits, preferences, and needs (personalization). The image and brand of a player will be an important asset. Advertising activities will in particular require competences in handling big data.

The quantity of content (in whatever form) is increasing exponentially, while pricing varies widely across the different forms of content. At one extreme, the price is often zero, for instance end users do not charge for all the information uploaded on social networks/social media. This information does have, however, a positive or high value inasmuch as it allows profiling of the habits/needs etc. of end users. This information, in turn, can be used to target advertising. At the other extreme, prices might be very high for exclusive content, such as Formula One races, Premier League football etc. The key challenge here is refinancing this content.

2.6 In sum: challenges for the EU Internet industry

The challenge of entering and developing competitiveness in higher growth markets and value chain segments

The European Internet industry is currently concentrated in manufacturing terminal and network equipment (including the respective software) and in operating networks. It has only a limited presence in software and IT services and the web ecosystem, and advertising-based business models only play a minor role for the vast majority of players.

The industry is still split between IT suppliers and telecom suppliers, with different histories and cultures, one dominated by the US, the other by Europe. Unfortunately, the Europeans tend to dominate the more mature segments. Indeed, the major Internet players that have headquarters in Europe are mainly communications network operators.

Technological innovation and market developments are crucial factors for competitiveness and profitability along the different stages of the Internet value chain. New market players with new business models have entered the European Internet industry and will continue to do so in the future as the legal and economic entry barriers for the most interesting (i.e. growing and profitable) parts of the value chain are not decisive hurdles.

The next decade will therefore be critical for the European Internet industry. Demand for Internet-based innovations will grow rapidly in all business and consumer segments, which will in turn entail unprecedented requirements regarding interoperability and standardization. At the same time, the competitive game is fundamentally changing and past strengths and strategic assets are being wiped out due to technological and market forces.

The incumbent players within this industry must adapt and/or reorient their existing business models.

The industry faces challenges with respect to network infrastructures and in developing and providing Internet-based applications and services that generate value for end users. In order to secure and increase innovativeness, unprecedented investments with varying degrees of risk will be required in R&D, deployment of infrastructure, marketization of service/application offerings, etc. Having access to suitable financing sources therefore becomes essential, along with measures that help to decrease risk-aversion among entrepreneurs.

The significance of different stages in the Internet value chain is changing, and many actors in the European Internet industry will need to find new ways of allocating their activities across the value chain. This will affect the “efficient border” of the firms in question, and the players have to make new decisions about which activities should be done within the firm, which activities can be carried out via various forms of co-operation, and which activities should be left to market transactions (Coase, 1937; Williamson, 2002).

Finally, in the past, many of the players in the European Internet industry have based their growth and innovativeness on external acquisitions to a greater or lesser extent. This will continue to be important, and acquisition targets will include not only European innovators but also those from international markets, particularly the emerging ones. Successful market positioning in the future will rely on integrating the innovation capabilities of acquired entities successfully into the acquiring company’s own processes and product/service portfolios.

The challenge of effectively managing supply and demand-side determinants of competitiveness

The crucial issues for the future are not only supply-side oriented. Growth potential also depends heavily on adoption and diffusion characteristics on the demand side.

A particular challenge here is to identify any obstacles to an innovation-friendly demand side. Economic conditions (costs and in turn prices) will remain an important factor. It is highly likely that future Internet-based innovations will have the characteristics of experience goods, i.e. where time and explanation are needed to understand the characteristics of a good or service, and bandwagon effects might become relevant (for example Rohlfs, 2003). Reducing the transaction costs represented by end users needing to understand new Internet-based services and applications to exploit their potential might be a vital source for future growth

CHAPTER 3 Three future scenarios for the European Internet industry

The future development of the European Internet industry is subject to a range of uncertainties. Some are beyond the influence of policy makers, firms or other stakeholders. Other uncertainties may not be resolved until after critical decisions are taken, meaning that important actions will be determined by imperfect, and possibly conflicting, expectations by the key players.

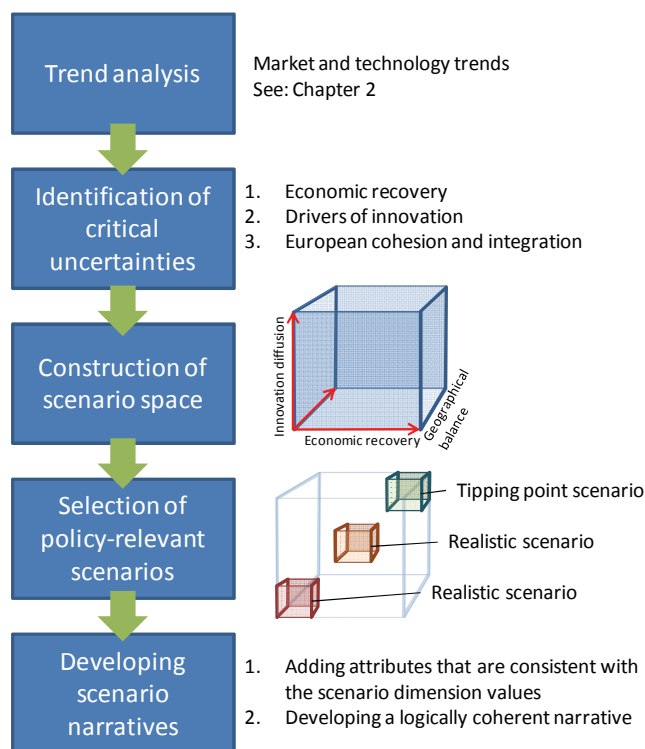


Figure 3-1. Schematic illustration of scenario developing process

In order to assess the potential economic and societal contributions of the Internet industry and to shed light on the potential impacts of current PPP activities and their successors, it is necessary to incorporate these uncertainties into the analysis. We do this by means of a set of logically coherent possible futures, or scenarios.

Our scenarios for the future of the Internet industry are constructed along the dimensions of three critical uncertainties. These highly uncertain external drivers that affect key actions or outcomes are identified from the analysis of market and technology trends for the future Internet industry (see Chapter 2). The possible resolutions of these uncertainties are then translated into three dimensions of a “scenario space” and describe possible combinations of “high” and “low” values along each of these dimensions.

We identified three policy-relevant scenarios from the logically possible combinations. These scenarios were then elaborated into a logically coherent narrative and characterised by additional attributes consistent with the scenario elements. The process of scenario development is schematically illustrated in Figure 3-1. The three scenarios and their development are explained in the following sections.

Given the large number and profound variety of critical uncertainties, the set of possible scenarios is too large to provide useful insights. In addition, not all logical combinations are equally plausible; for example, in a world of prolonged economic recession and falling real incomes, private sector infrastructure is unlikely to grow under the stimulus of consumer demand alone. Therefore, we concentrate on a small set of consistent scenarios.

Finally, scenarios are not forecasts, though each is characterised by a set of quantitative assumptions that support model projections. In other words, while we can estimate the economic contributions of Future Internet development within each scenario, it is not possible to say in advance which scenario will occur. For example, the Realistic scenario is based on realistic assumptions for today, which may be unrealistic tomorrow. In particular, the three scenarios collectively ‘span’ a relevant range of outcomes that may result from the (uncertain) combination of secular economic development and policy (including the FI PPP actions).

3.1 Three critical uncertainties for the future Internet industry

We view the evolution of Europe’s Future Internet as driven by market forces; technology, service and business model innovations; and governance and policy decisions.

We clustered the market and technology trends into a set of factors driving future change in the Internet industry. From these we selected three high-impact factors with the highest levels of uncertainty. They tend to focus on economic developments rather than on major unforeseen technology or social breakthroughs.³¹ This is mainly because of their time horizon and level of uncertainty. The selected critical uncertainties are each complex and multifaceted, so we indicate their meaning via the answers to a series of questions (see Table 3-1).

³¹ A set of (potential) disruptive changes that may unfold over the period under analysis is described in Chapter 2. We anticipate that the timescale of other new major breakthrough developments or disruptive technologies potentially leading to paradigm shifts in the Internet market would have an impact after the 2020 time horizon which is the focus of this report.

Table 3-1. Three clusters of critical uncertainties for the future Internet industry phrased in questions.

1. Economic recovery
<ul style="list-style-type: none"> • How rapidly and securely will the European economy recover from the current (ongoing) recession and related troubles? • How will the rest of the world develop? • How are economic returns (profits, incomes, etc.) distributed and embedded in local economies? Will recovery be led by demand or supply? • Will the Future Internet industry and sector lead or follow the recovery in the general macro-economy? • Will incomes, profits and tax revenues grow quickly enough to sustain private and public investment in Future Internet capabilities and services necessary for robust economic progress? • Will recovery ease the pressures currently distorting current public expenditures and facilitate the pursuit of medium- to long-term broad-based social welfare improvement and other collective policy goals? • Will specific sectors be dominated by large firms or effectively competitive? • Will economic development be balanced across sectors or concentrated on areas of comparative (or historical) advantage? • Will the incomes and multiplier effects of the macroeconomic recovery - and its Future Internet components – be concentrated in a few regions, homogeneously spread across Europe or differentiated by local comparative advantage? • Will Europe's Internet Industry and sector be competitive: a) in outputs and inputs, b) at home and abroad; and c) in terms of cost and/or quality? • As a result of Future Internet service development, will the competitiveness of Europe's other sectors advance? • Will the uptake of Future Internet services be driven by specialised or 'utility' services?
2. Drivers of innovation
<ul style="list-style-type: none"> • Will the uptake of Future Internet services be driven by specialised or 'utility' services? • Although the Internet arose from top-down government use of technological advances, its recent development has bottom-up elements driven by economic and societal innovation. Will the Future Internet follow a cyclic path in which waves of technological innovation are followed by waves of service and business model innovation, or will technology-push and demand-pull converge? • Will future innovations arise from profit-motivated inventive activity or function-orientated user-driven innovations? • Will intellectual property be protected by patents, standards, secrecy and barriers to interoperability, or not at all? • Will technologies, business processes and services be equally subject to patent protection? • Which types of innovative activity will be collaborative and undertaken in significant part over the Internet? • Will technological innovations be focused and inherently global? Will service and business model innovations reflect local conditions? • Will innovative activity be evenly spread across the globe, or will the current stagnation in Europe and the US (as measured by e.g. patenting rates) persist in the face of rapid growth in the emerging economies? • Finally, will innovative activity continue its recent pro-cyclical trend (falling in times of recession) or will it revert to a more classical countercyclical pattern that drives long-term growth?

3. European cohesion and integration

- To what extent will policy coordination, economic cooperation and other forms of partnership be effectively implemented across countries, between policy areas and among public-, private- and civil society sectors?
- In particular, will national economies within the European Union compete, cooperate or make exclusive arrangements?
- Will regulation and other policies continue the implementation of an open and globally competitive Single Market as a key factor in European development, or will the pendulum swing towards protectionism or non-market mechanisms for social welfare enhancement?
- In particular, will the availability of Future Internet Services facilitate or impede realisation of the Digital Single market (e.g. via interoperability, shared standards and the provision of truly pan-European supporting services and infrastructures)?
- Will there be effective alignment of potentially divergent policy objectives (e.g. economic development, innovation, competition and welfare)?

3.2 Scenario dimensions

To make the analysis tractable, we recast the critical uncertainties as three dimensions within which the scenarios of interest can be positioned. These dimensions correspond closely to assumptions and parameters used in the GINFORS model to project the range of plausible estimates for the economic impact of the full deployment of the Future Internet PPP after 2014. They are:

1. *Economic recovery in Europe.* This dimension comprises GDP growth and progress in related macroeconomic outcomes. The quantitative aspects are based on the economic scenarios prepared by the Economic and Financial Affairs DG of the European Commission (Hobza and Mour, 2010).³² Beyond this, the economic recovery dimensions include outcomes below the resolution of both the official economic scenarios and the GINFORS model, such as the wage premium earned by skilled workers, the quality and security of employment in various sectors and occupations, and the availability of venture capital.

A high value along this dimension indicates rapid growth and employment, stable wage premiums, high-quality jobs with a reasonable degree of turnover and adequate supplies of medium- to long-term, risk-tolerant venture capital.

2. *Breadth and pace of diffusion of Internet-driven innovation.* This dimension comprises the rate at which Future Internet related innovations are adopted, the lead sectors and the degree to which both large and small enterprises benefit.

³² The compound average growth rate (CAGR) for real EU 27 GDP up to 2020 is 1.57% in the GINFORS 'baseline pure' forecast, close to the central ECFIN forecast of 1.5%. It should be noted the ECFIN scenarios were published in 2010, prior to the most recent Eurozone financial crisis. Therefore, the economic assumptions underpinning the Realistic scenario are probably somewhat optimistic - though no authoritative alternative has yet been identified.

A high value means rapid adoption and diffusion evenly spread across large and small firms and a strong bottom-up or user-led orientation, and quality, functionality or performance rather than cost as the primary consideration.

3. *Geographical balance.* This dimension indicates the degree to which Internet-driven innovation and its economic returns are homogenous or differentiated within the EU, and the related issue of whether differentiation takes the form of differences based on comparative advantage or a geographic digital divide.

A high value means a balanced distribution of economic returns and societal benefits, deriving from an Internet industry offering comparable, high-quality services throughout the EU and supporting an Internet economy differentiated along comparative advantage lines, with regional differentiation reflecting local supply and/or demand variation and economic clustering.

3.3 Three scenarios for the future EU Internet industry

Along the dimensions described above, we developed three scenarios for the EU Internet industry 2015-2020. The magnitude and trends of key variables in the different scenarios are based on plausible assumptions about the future. The scenarios are described in the following sections, and their key characteristics are summarised at the end of this chapter in Table 3-2.

3.3.1 Realistic scenario

The Realistic scenario represents intermediate economic prospects, a modest pace of innovation and a homogeneous pattern of Future Internet deployment and exploitation. This leads to continuing volatility and a weak position for small firms and potential service innovators.

In the absence of additional stimulus beyond current PPP activities, the Internet industry on its own will not deliver an enhanced and sustained stimulus capable of delivering macroeconomic stability, and European firms are more competitive within the Single Market than internationally.

This scenario is based on an extrapolation of existing trends and realistic—if somewhat optimistic in light of recent events—assessment of Europe’s macroeconomic future. Economic performance in this scenario shows modest recovery corresponding to the baseline ECFIN (EU Directorate General for Economic and Financial Affairs) forecast. It features moderate innovation primarily taken up by ICT-intensive sectors and larger firms. Governance is well-coordinated, leading to relatively homogeneous Future Internet deployment and exploitation, and to stronger domestic than international competitiveness.

The underlying structural volatility of the world and European economies persists and employment is strongly pro-cyclical, especially in Internet-related industries, where low-skilled jobs are both common and relatively insecure. The Internet sectors continue to occupy a prominent place in the economy and in investors’ expectations.

Services, especially in the financial and utilities sectors, enjoy adequate flows of capital and lead the economic recovery, making increasing use of advanced Future Internet services. This leads to a rebalance of power, moderating the dominance of traditional telecom providers.

Young, agile, highly innovative SMEs that are keen users of ICTs and Future Internet services (so-called “Gazelles”) do well, but conventional (“Classical”) SMEs struggle to realise the full potential contribution of Future Internet applications in a services ecosystem largely driven by system integrators.³³

The moderate pace of innovation reflects a mix of bottom-up and top-down drivers; it is focused on those best able to pay for enhanced capabilities to cement their market positions and thus delivers significant but variable returns.

As a result, in the absence of additional stimulus, for example the application-led innovation and open architecture promised by the Future Internet PPP, the Future Internet on its own will not deliver an enhanced and sustained stimulus capable of delivering macroeconomic stability and European firms are more competitive within the Single Market than internationally.

3.3.2 Tipping Point scenario

The Tipping Point scenario reflects the most favourable realisation of underlying uncertainties and provides optimum scope for realising the potential benefits of the Future Internet.

Economic development is demand-led, with rapid and balanced recovery, a good mix of pre-competitive and intra-European cooperation and coordination with service competition on open platforms and in world markets and a socio-economically-mediated evolution of the Future Internet.

In the Tipping Point scenario, economic development is demand-led with rapid and balanced macroeconomic recovery. There is a good mix of pre-competitive and intra-European cooperation and coordination; service competition on open platforms and in world markets; and a socio-economically-mediated evolution of the Future Internet.

The volatility of the economy remains, but this owes more to dynamic innovation-led competition than to speculative instability. Employment levels are high; job quality and security are both increasing along with the skill development and upward mobility of those working in the Internet economy.

While the Internet economy led the recovery, it brought along other Internet-using domains ranging from financial and other services to more embedded manufacturing, transport, health, etc. sectors. Service and business model innovation are rapidly expanding, with the Internet economy seeding waves of development throughout the economy and across all firm sizes.

There has been a quantum leap in business dynamism and diversity. Many SMEs continue to generate sustained productivity, employment and customer value contributions without the imperative to grow beyond their chosen size, while business failure is increasingly recognised by policymakers and the financial sector alike as an inevitable, even positive, aspect of innovation-led economic competition.

³³ See Chapter 4 for a more elaborate explanation of this typology of SMEs and their position in the different scenarios.

This dynamism translates into greater mobility within the service ecosystem, with complex or high-level services provided by self-organised groups of SMEs using open standards and business models rather than by monolithic integrated service providers or systems integrators using restricted or closed service and technical architectures. As a direct consequence, global competitiveness, regional economic differentiation, cross-border trade and user-led innovation are all stimulated and the benefits spread rapidly to all sectors of the economy.

The global competitiveness of the EU Internet industry is based on delivering high quality—including enhanced privacy and openness—directly to end-users or as inputs to overseas value chains. Domestic competitiveness also benefits from cost advantages of shared services and regulatory compliance.

Competitiveness is further enhanced by access to improved human, financial and knowledge capital. Firms outside the EU Internet industry are strengthened by accelerated uptake of Future Internet functionalities, which improves framework conditions for market access and innovation. This is driven by broader partnerships; key ICT users are better able to participate in extended FI development as the boundaries of Internet and non-Internet sectors blur as a direct result of core platform synergies and access to utility services.

This dynamic approach particularly suits the kind of application-led use cases initiated within the Future Internet PPP. The resulting network of (mainly small) European service providers can rapidly respond to new opportunities by developing specific services and using their relationships with core platform providers to ensure that common functional requirements (for example for security, privacy, or data repository services) are pushed “up the stack” towards utility status. The deep pool of small-scale suppliers and customers reduces the dangers of lock-in. Risks are diversified rather than concentrated, improving access to investment and innovation capital.

The supply network sustains the SME ecosystem benefits of employment and diversity. It also enhances demand side networks by helping Future Internet service users exchange ideas and explore common requirements.

The economies of open interoperability and scope outweigh the exclusive arrangements and scale economies behind the dominance of large monoliths at the beginning of the decade. Local monoliths, such as telecommunications companies, will gradually concentrate on providing essential infrastructural services. Global Internet service monoliths will increasingly concentrate on supplying open platforms for self-assembly of needed services. This development is reinforced by the deployment of alternative infrastructures regulated as “common carrier” utilities or by facilities-based competition.

On the policy side of the Tipping Point scenario, public R&D and deployment support specifically aims to counterbalance any private-sector bias towards large incumbents. Ultimately, this will lead to mixed innovation clusters, co-creation, shared services, collaborative production and “prosumers”.

All this innovation is not free. The Tipping Point scenario was preceded by a period of creative destruction in the first half of the decade. This gave agile SMEs access to resources previously locked up in inefficient investments, obsolete business models or moribund

sectors, and to the associated skilled human and organisational capital. This boosted their relative performance, and networking allowed them to create innovative collective investment vehicles.

3.3.3 Slow Motion scenario

The Slow Motion scenario is dominated by weak and faltering economic recovery, which strikes first at consumers and the home sector.

Adoption of Internet-based innovation is slow, top-down, limited across all sectors, weak among SMEs and primarily cost-driven. Europe's Internet Industry fails to keep pace with technological developments or to invest in foreign markets and gradually loses competitiveness abroad.

In the Slow Motion scenario, Europe's economy is still struggling to recover from the aftermath of a deep and enduring economic crisis. The adverse impacts initially fell on consumers and the home sector. Over time, most sectors faced reduced consumer spending, especially on new goods and services; they responded by scaling back major capital investments, delaying replacement and slowing service improvement; at the same time, the squeeze on public sector budgets continued. These developments in turn retarded service improvement and deployment of user-led applications, especially in areas such as health, transport and education, where public sector expenditure plays a major role.

Europe's telecommunications providers concentrated on core business models and consumer bases and on vigorous price competition. They successfully defended their markets, but offered fewer value-added services. The dominance of the Internet services sector by global players strengthened.

Internet services markets are dominated by global monoliths that lock customers into pre-determined bundles of connected services and innovate only to protect their market positions. These monoliths are not telecom-based, but control crucial layers of Internet services. Their power was reinforced by strategies that included buying up producers of complementary services, foreclosing downstream markets and manipulating interoperability. The reputations and network externalities that lock end-users into the most popular platform constituted a soft entry barrier, which providers raised by limiting interoperability or by facilitating it in order to attract innovative service providers. Finance for innovative projects was hard to obtain on reasonable terms, so deployments tended to focus on cost-reduction within established business and service models.

The EU Internet Industry broadly failed to keep pace with technological developments or to invest in foreign markets, gradually losing its global competitive advantages. The Future Internet is advancing slowly and in fragmented fashion, driven by cost reduction, risk aversion and a preference for operational expenditure (OPEX) over capital expenditure (CAPEX). One area that has benefited from this squeeze is cloud computing, though quality of service remains problematic. Privacy, mobility and other secondary considerations take a back seat, not least as a result of budget pressures reducing demand for innovative solutions by the public and home sectors.

Weak and unstable commercial returns reduced trust among businesses and inhibited technical and commercial interoperability. This has impaired the prospects for SMEs. Rapidly-growing and innovative SMEs are starved of the venture capital, partnership

opportunities and affordable and unlocked access to advanced supporting services needed for market access. Other SMEs—who constitute the majority of this important element of the business population—are marginalised and locked into the closed value chains of monoliths. The resulting margin squeeze keeps them from growing and reduces their ability to deliver traditional economic and societal benefits.

In this scenario, additional stimuli, such as a Future Internet PPP, also struggle to attain wide adoption and self-sustaining development, but may provide vital assistance to the growing need for public services and for Internet innovation.

Table 3-2. Scenario characteristics

Scenario characteristics		Realistic scenario	Tipping Point scenario	Slow Motion scenario
The Economic Dimension	GDP growth			
	Rate of growth	As projected	Higher than projected	Lower than projected
	Demand-or supply-led	Demand and supply	Demand	-
	Volatility	Moderate, with crises	High but controlled	Low
	NNP, value-added	Moderate	High	Low
	Employment			
	Number of jobs	Cyclic variations	Stable	Underemployment equilibrium
	Job quality(full/part-time, security)	Moderate/low quality, security	High quality, moderate security	Low
	High skilled employment	High	High	Low
	Low skilled employment	Low	High	High
	Sectoral balance			
	Internet	Leads	Leads initially	B2B strong; others weak
	ICT	Telecoms slow	Stable growth	Telecoms retrench; hardware stagnates
	Services	Finance leads	Broad range of new services	Stagnate due to public and home austerity
	Other	Utilities, high ICT-intensity	Many sectors approach Internet Economy	Utilities grow but delay adoption.

Scenario characteristics		Realistic scenario	Tipping Point scenario	Slow Motion scenario
The Economic Dimension (continued)	SMEs			
	Type of SMEs ³⁴	Gazelles and seedlings	Mix of all types	Classical and seedlings
	Growth prospects	Weak	Good, but not required	Grow or die
	Service ecosystem			
	Dominant architecture for Future Internet services	Large scale orchestrators or service integrators	Self-assembly of small agile specialised service providers	Monolithic integrated service providers
The Innovation dimension	Innovation			
	Technology or socioeconomic	Slight technology-push; mix of cost/quality driver, top-down/bottom-up	Socioeconomic lead; performance driver; bottom-up	Innovation slows and concentrates on cost; top-down
	Breadth across sectors	Esp. ICT-intensive sectors, few SMEs	All sectors and sizes	Slow diffusion, uptake, SMEs lag
	Speed of adoption	Medium	Fast	Slow
The Balance Dimension	Geographical balance (specialisation, shares)			
	Within EU	Homogeneous	Differentiated; comparative advantage	Inefficient differentiation
	Domestic, international competitiveness	Stronger domestically	Domestic and international	Weak

³⁴ Combining the typologies used by OECD (2011b) and Kalapesi *et al.* (2010), we can distinguish three types: Gazelles, Classical and Seedlings (see Table 4-1).

CHAPTER 4 **The future contribution of the European Internet industry under the three scenarios**

The economic and societal contributions of the Future Internet have been sketched in many existing studies (e.g. Blackman *et al.*, 2010; Cave *et al.*, 2009; Dean and Zwillenberg, 2011; Péliissié du Rausas *et al.*, 2011). In this chapter we analyse the future societal and economic contributions of the European Internet *industry*. We focus on the following elements: the size of the Internet economy and market, diffusion of Internet-driven innovation by sector, contributions to employment, education and skills, returns for SMEs, and the impact on business models. Since these contributions will depend on the various uncertainties underpinning the future Internet industry, we have assessed the contributions separately for each of the three scenarios presented in Chapter 1.

4.1 **The contribution of the Internet economy to the EU socio-economic system**

The European Internet Economy measures the contribution of the Internet to EU GDP and its relevance for the economic system, by focusing on the value of the goods and services exchanged over the Internet and the investments made to deploy/ use the Internet. This is measured by aggregating IDC's estimates of the value of B2C (or BtoC, business to consumer) eCommerce and of private and public investments to deploy and use the Internet (the Internet market)³⁵.

The value of the Internet Economy was estimated at 498 B€ in 2010, corresponding to 4.1% of EU27 GDP (Figure 4.1). The lion's share of the European Internet economy

³⁵ It is based on the Expenditure method, which measures total spending on finished goods and services. While not perfect, this method allows using existing data and aggregating the contributions of all economy sectors. This includes 4 main components: Consumption, that is spending over the Internet and for the Internet by end users; Private Investments, i.e. capital investments by telecom companies and other sectors in the development and deployment of Internet networks and all other Internet-related private investments. Public Investments, i.e. the public sector investments in Internet networks and Internet-related software and services. IDC included in this segment the investments by the Government, Health and Education sectors. Net Exports, i.e. the net balance between the value of import and export of goods and services bought over the Internet, as well as of Internet-related technologies and services. Unfortunately, we were not able to measure the value of net exports for the EU27.

(65%) is generated by end-user spending for goods and services over the Internet (BtoC)³⁶. In other words, the value of the investments made to enable the Internet is only a fraction of the value generated by its use in end-user consumption.

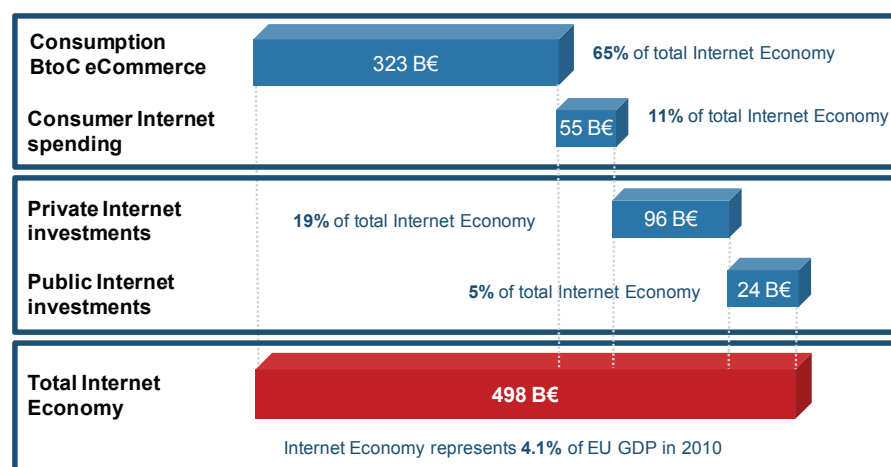


Figure 4-1. The Internet Economy in 2010

Source: IDC, 2011

The perspectives of growth of BtoC eCommerce are very positive. The penetration of Internet buyers on the population is expected to continue to grow fast across the EU, reaching 56% in the EU27 by 2014, corresponding to 282 million buyers. As the current crisis is showing, eCommerce is resilient to the recession (thanks to the promise of lower prices and greater transparency of transactions). There is also a trend of gradual increase of the number of transactions by buyer and of the value of purchases over the Internet, faster than the number of buyers, in a process of maturation of the BtoC eCommerce market. Thanks to these growth trends, BtoC eCommerce is expected to be one of the most important drivers of the Internet economy in the next years, as shown in the scenarios estimates presented in the following paragraphs, which are based on the projections of IDC's Digital Marketplace and Forecast Model.

4.1.1 Internet Investments

The perspectives of development of Consumer Internet investments and Consumer spending are also positive, but growing at a lower pace than eCommerce, as shown in the following paragraphs. Therefore their relative weight in the Internet economy will tend to decrease slightly, even if they will increase in absolute value. The analysis of demand dynamics by sector (Section 2.2) underlies the projected estimates of increase of public and private investments and consumer spending, which are presented in the next paragraph under three alternative scenario trends to 2020.

As shown by Figure 4.1, private Internet investments represent the second largest component of the Internet economy, followed by Consumer spending (in access and subscription fees, and *smart phones* and the like). This includes business investments in the development and deployment of Internet networks, for example by the telecom operators,

³⁶ BtoC estimates are based on IDC's DMMF, Digital Marketplace Model and Forecast, which in turn is based on data collected worldwide about the value of purchased on the Internet by the population of Internet users.

but also by private operators. The relative weight of the public sector (which includes Government, Education and Healthcare) is smaller (5% of the Internet economy in 2010), but its importance cannot be undervalued, because it enables Internet-based innovation in a very important component of the socio-economic system.

4.1.2 The Value of BtoB eCommerce

There is one important aspect of the economic impact of the Internet which is not included in the definition of the Internet economy discussed above: Business-to-Business commercial transactions over the Internet (BtoB).³⁷ This is also known as Supply chain eCommerce, and its value is higher than BtoC because in a typical supply chain there will be many transactions involving raw materials or sub components, while the final sale to the end user is only one. The value of BtoB cannot be aggregated to BtoC as a component of GDP, because this would lead to double counting of the value of the intermediate transactions between enterprises.

According to IDC estimates, the value of the goods and services sold through BtoB eCommerce reached €1,874 bn in 2010, and is expected to grow to €2,746 bn by 2014. This is almost 6 times as much as the value of BtoC. BtoB is strongly correlated with company size, with a much higher presence in large enterprises, and with the extent of adoption of eBusiness applications in general. For example, 40% of large enterprises engage in electronic information sharing with suppliers and customers, while only 17% of SMEs do.³⁸ The diffusion of BtoB is one of the multiplier mechanism by which the use of the Internet enables innovation, productivity and efficiency improvements in the economy,

4.2 The size of the Internet economy correlates strongly with economic growth

We applied the methodology used in Deliverable 2 (Cattaneo *et al.*, 2011) for the size of the Internet economy, using the key assumptions for the three scenarios to provide estimates from 2014 to 2020 (See Section 1.2.3 for a explanation of the methodology).

Our estimates for the value of the Internet economy in Europe are strongly correlated to the performance of the European economy. The baseline projections are based on the DG ECFIN central economic forecast (Hobza and Mour, 2010) with a cumulative annual GDP growth rate of 1.5% and proportionate increases in employment and other macroeconomic indicators.

Under the Realistic scenario, our projections suggest 11% annual growth in the Internet economy as a whole, primarily driven by a 13% CAGR of BtoC eCommerce between 2014 and 2020 (see Figure 4-2). Private sector investment growth in the Internet economy during this period (6% CAGR) compares to growth of public sector investment of 7% and

³⁷ IDC defines BtoB as the value of products/ services purchased by businesses by clicking an order button on the Internet, and incorporated into the products/services they offer IDC definition includes Electronic data interchange (EDI) transactions but only if they involve a Web-enabled gateway as a front end of the EDI system and excludes simple orders placed via email, even if the email system uses the Internet. There must be a formal engagement of funds.

³⁸ Based on the 2010 Community survey on "ICT usage and eCommerce in enterprises" (Eurostat, 2010)

end-user investment of 5%, and will comprise 57% of total investment in 2020 (excluding eCommerce from the total of course)

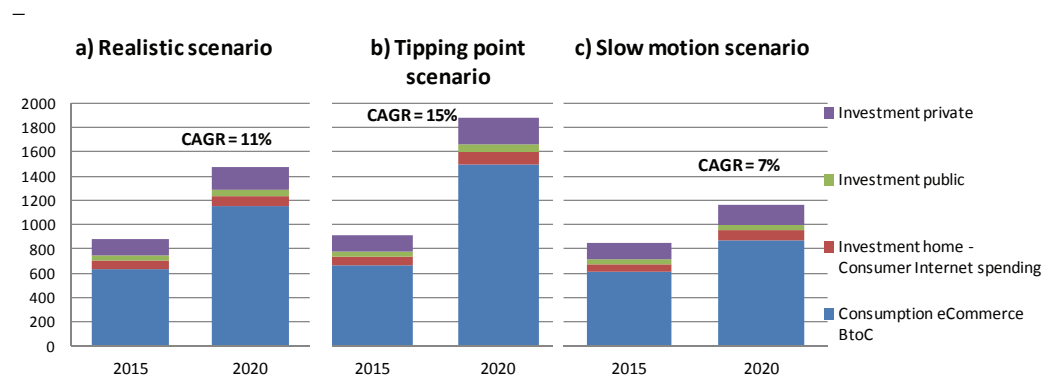


Figure 4-2. Estimates of size and growth of the EU Internet economy in 2015 and 2020: a) Realistic scenario; b) Tipping Point scenario; c) Slow Motion scenario.

Source: IDC (2011)

The economic contributions of the Internet industry in the Tipping Point scenario are substantial, at €1,877 bn in 2020 compared to €1,474 bn for the Realistic scenario in the same year (at current pricing values). The increase is due to positive feedback between innovation and growth and the greater scope for exploiting and extending Future Internet services provided by the strong economic recovery. This is largely demand-led; consumption grows 5% faster than in the Realistic scenario, compared to 3% faster growth in investment.

Under the Slow Motion scenario, the Internet economy would grow by only 7% in the same period, reaching €1,163 bn in 2020. In this scenario, investment in the Internet is much lower, economic and market barriers to adoption of Internet innovation are high, and the potential multiplier effects of Internet innovation are not realised to the same extent as in the other scenarios.

In the Slow Motion scenario, cumulative annual growth is less than half of that in the Tipping Point scenario and home and public sector investment growth is 3% slower than under the Realistic scenario. Business investment is only 1% lower, though the slow pace of innovation suggests that this mainly goes to replace existing capacity.

4.3 The diffusion of Internet-driven innovation varies by sector

The estimates of development of the Internet market under the Realistic scenario suggest growth will be spread across all sectors. However, failure to overcome the organisational and market barriers currently slowing down adoption of Internet innovation in several sectors will lead to uneven growth between sectors.

Internet spending by Utilities is projected to more than double between 2015 and 2020, Healthcare and Education are expected to grow by 58%, while Transport and Logistics will grow by 40%. The component markets with slowest projected growth are Government (30%); Manufacturing, Construction and Primary (29%); and

Telecommunications (25%) The latter is probably due to a shift of value from basic infrastructure to the service and applications layers.

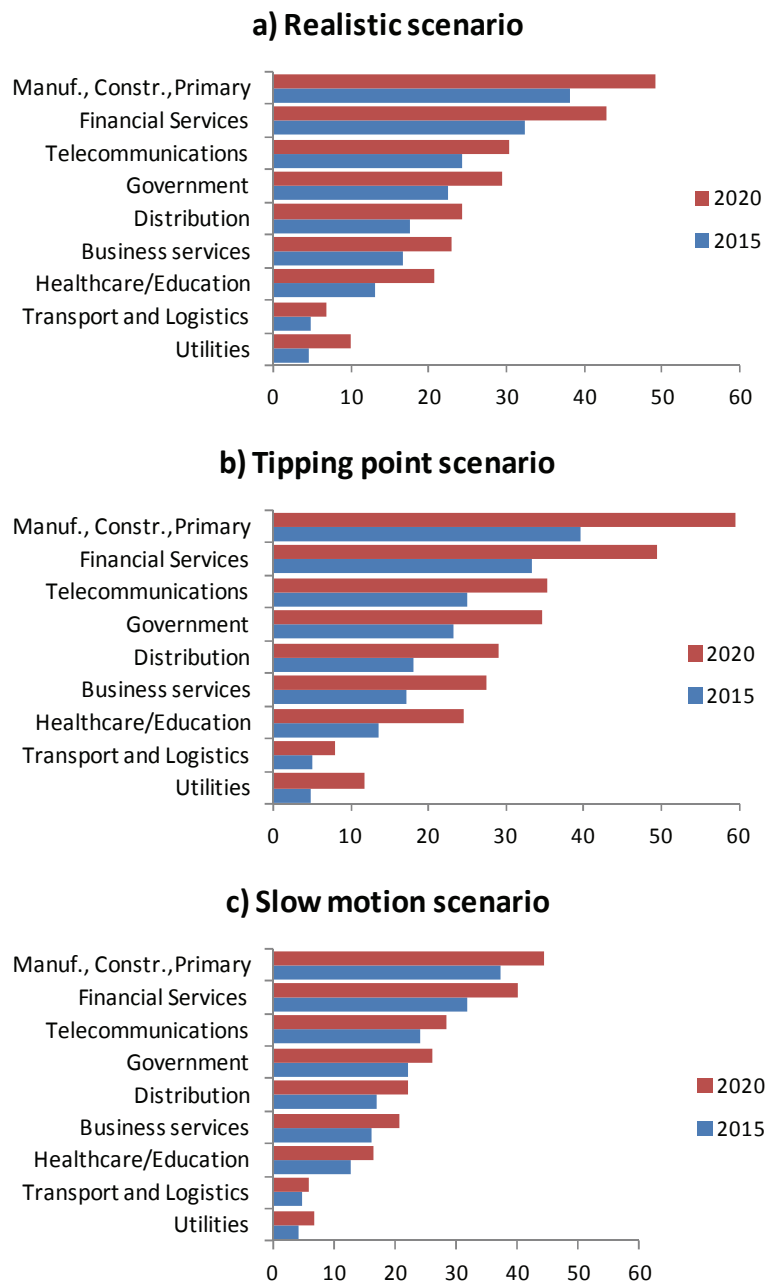


Figure 4-3. Growth of Internet investments by sector 2015-2020: a) Realistic scenario; b) Tipping Point Scenario; c) Slow Motion scenario.

Source: IDC (2011)

These projections suggest that the balance of economic activity within the European economy will probably gradually shift down the value chain, away from telecommunications services towards services, applications and end-user sectors. Companies will try to leverage more sophisticated IT Internet infrastructures and launch new Internet-related projects aimed at meeting compelling business needs. This may

primarily come about in response to imported service innovations and cost competition in an economic climate of modest recovery and strong foreign competition.

Services and utilities represent the fastest growing component of business demand for Internet-enabled services. Even if only a fraction of their spending in these areas is captured by Internet ICT, there is a clear indication that utilities will outperform all other industries in terms of growth.

Health and Education, Business services, and Distribution, three sectors currently characterised by low expenditure on Internet services, are expected to increase the intensity of their investments as new services become available and competitive pressures for adoption increase. However, Health and Education are not expected to achieve the full potential of Internet innovation within the period, because the need for organisational and cultural transformation will require more time and effort. In addition, issues such as privacy and consumer protection, cross-border data transferability, trust and confidence, are particularly sensitive in these sectors and are reflected in regulatory barriers to Internet adoption. These barriers are expected to decrease, but not disappear completely, during the scenario period. Even if the financial crisis may postpone some investments, the need for efficiency and productivity increases especially in the Health sector will remain a strong driver of the adoption of Internet-based innovation. The Government sector is expected to continue spending in Internet innovation for similar reasons, even if spending will increase at a lower pace than in previous years, due to the financial crisis.

SMEs in the Distribution and Business Services sectors—where they are particularly numerous—will present a slower rate of adoption of Internet innovation, particularly of cloud computing, due to a combination of immaturity of supply tailored to their needs, their own organizational barriers, and the moderate economic growth environment.

More mature Internet-intensive sectors, such as Financial Services, will grow more slowly, especially as the competitive advantages of Internet investment become saturated.

At the downstream end of the value chain, end-user expenditure on Internet services will continue to increase, but at a decreasing rate. This is not a consequence of saturation per se, though purchases of smart Internet devices are likely to move from penetration to replacement demand. It will be driven by hardware innovation, which will likely be slower than software and service innovation. The adoption of relatively open standards will reduce lock-in; the resulting competition among apps and the growth of user-developed applications spread through social networks will further moderate revenue growth—though not the growth in value to consumers.

Compared to the Realistic scenario, overall Internet Market performance in the Tipping Point scenario shows an accelerated shift away from telecommunications towards downstream and upstream sectors of the overall economy. This may be explained by the accelerated diffusion of advanced services into previously immature Internet-using sectors, which in turn develop new services. Compared to the Realistic scenario, the main difference is the growth of intensity of Internet investments in the previously low and medium Internet intensity sectors.

The Internet market in the Slow Motion scenario shows much lower growth across the board between 2015 and 2020. The division of total market value across sectors in Slow

Motion differs from that in other scenarios. Although the telecommunications market is only 18% larger than in 2015—compared to 41% in the Tipping Point scenario—its share of the overall market increases slightly due to retrenching. Healthcare and Education and Utilities sectors show the slowest growth, while ICT-mature sectors like Financial Services increase their share of the total market.

We have also estimated the evolution of BtoB and BtoC eCommerce under the different scenarios. In all three scenarios we expect BtoC to grow faster than BtoB (given the larger value of BtoB transactions, and on the other hand the high potential for growth for BtoC). However the gap between the two is smaller in the Slow motion scenarios (where both grow much more slowly) and opens up in the Tipping Point scenario, where thanks to the better economic climate, consumption grows faster. In all three scenarios the value of BtoB remains substantially higher than the value of BtoC.

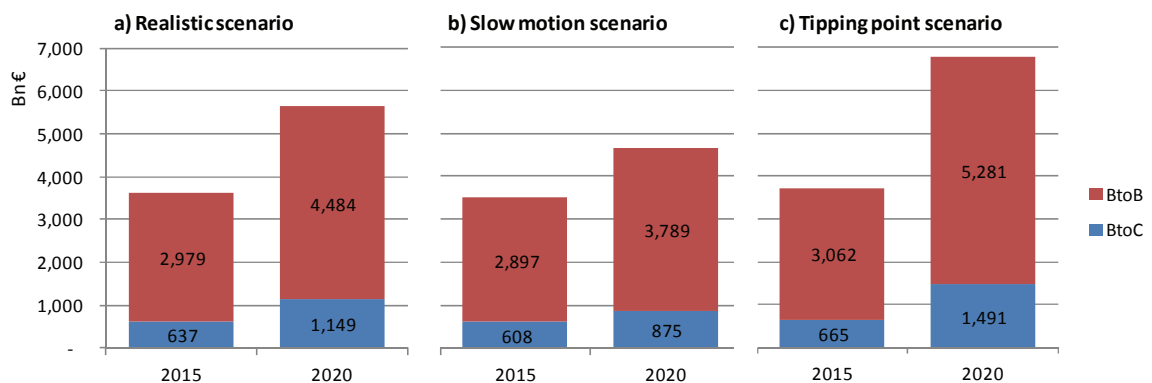


Figure 4-4. BtoB and BtoC growth dynamics for: a) Realistic scenario; b) Tipping Point; and c) Slow Motion scenario

Source: IDC (2011)

4.4 Cloud revenues will represent between 15% and 22% of the Internet Market by 2020

Estimating the value of cloud computing requires caution, since it is still a relatively new and emergent market. Recent IDC research (see par.2.3.1) shows already high diffusion in Europe. The EC is also determined to promote cloud-proactive policies, which should contribute to reduce the regulation and market barriers currently slowing down adoption. In addition, the explosive growth of mobility services is positively linked with cloud services delivery mode. Under these assumptions, we believe that cloud computing will be one of the main Internet-based innovations driving the transformation of the Internet market and industry in the next decade. We have estimated the range of cloud services diffusion and value under the three scenarios.³⁹

Under the Realistic scenario, cloud services are expected to diffuse relatively quickly across the EU economy for the main sectors. The projections suggest that the main security, data protection and cross-border data transfer/storage issues will be solved to the satisfaction of

³⁹ The assumptions underpinning these projections are included in Appendix A.

most advanced users. This would happen gradually, accelerating after 2014-2015 when these barriers are expected to be overcome, at least in the main European markets.

According to these estimates, public cloud revenues could treble from €15 bn 2015 to €58 bn in 2020 in the Realistic scenario, growing from 6% to 18% of the total Internet market estimated by IDC (that is, of the total spending in Internet technologies and services by public and private sectors as well as consumers). This implies that spending for cloud services will substitute for some of the current traditional IT spending, but the total IT market will also grow (of course much more slowly). This implies that those sectors most closely resembling the “open platform, competing services” model likely to characterise the Future Internet may see significant growth.

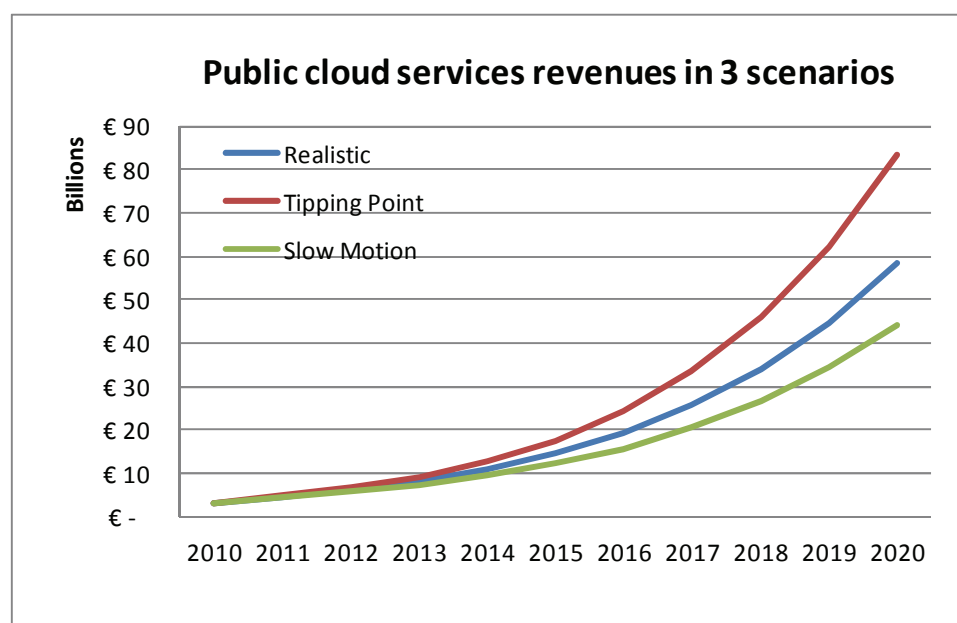


Figure 4-5. Projection of public cloud services revenues in: Realistic, Tipping Point and Slow Motion scenarios (2011-2020).

Source: IDC (2011)

The economic growth and fast and wide adoption of Internet-based innovation in the Tipping Point scenario enables a paradigm shift in the European economy towards pervasive, widespread ICTs with positive multiplier effects on efficiency and productivity. More companies move to cloud services and the intensity of adoption increases as companies come to rely on the cloud for different functions, and even start experimenting with the cloud for some core systems. In this scenario, public cloud computing revenues would amount to €83 bn in 2020, representing 22% of the Internet market.

Cloud revenues in the Slow Motion scenario would constitute only half of those in the Tipping Point scenario (€44 bn), representing 15% of the total EU Internet market. Enterprises in this scenario postpone investment in new cloud services and large IT users focus on maintenance of current IT infrastructures. While cloud computing promises cost savings and might appear as convenient in a slow growth economic climate, it implies adaptation and reorganization investments which become an obstacle in poor economic

conditions. In addition, business users will be less inclined to use cloud-based IT to improve and expand their own goods and services offerings.

There is some discussion whether these projections, which were developed initially in early 2011, still hold in view of the current economic crisis. IDC sees some evidence that, like e-Commerce, cloud computing could be anti-cyclical and therefore spending is still growing for two main reasons: because enterprises simply cannot survive without IT and because cloud leads to cost-savings. 97% of the EU business users interviewed at the end of 2011 confirmed they had achieved cost savings, between 10-20% on average, and over 20% for a sizable minority (IDC 2012). In the short term, up to 2015, cloud revenues estimates will probably lie somewhere between the Realistic and the Slow Motion scenarios, but up to 2020 we stand by our Realistic scenario estimates. Of course, this may mean that the cloud share of total Internet spending may grow even faster than we estimated here.

Concerning the potential of cloud computing to promote growth, that depends on the intensity of adoption of the cloud model and its implementation to core business processes. According to the same study (IDC 2012), EU business users indicate as benefits from cloud adoption improvements of the mobility of the workforce, of productivity, of the standardization and rationalization of core processes. More important, about a third of cloud users indicate as actual or expected benefits the ability to open new offices in new locations and to enter new businesses, without capital investments in new IT systems. Even if some cloud services simply substitute existing applications, they allow for greater efficiency and flexibility and therefore can have a positive impact on companies' growth.

There are however several barriers preventing further diffusion of cloud in Europe, of which the most relevant concern the complex regulatory framework of data location, data protection, data jurisdiction, and the uncertainties about the accountability and liability of cloud service providers if sensitive and core business data is entrusted to them. Many of these barriers are related with the lack of the Digital Single Market, are complementary or the same as those identified in this study preventing Future Internet developments, and will require specific policy action to be overcome.

In conclusion, we expect demand for cloud computing services up to 2020 to increase within the range of values suggested by our scenarios, at a level probably closer to the lower level of the range. Concerning the potential "multiplier effect" of cloud computing on the European economy (due to the launch and growth of new services and innovation) this will require overcoming specific barriers, and may have become less likely due to the current economic climate. However, our original assumptions about its positive potential remain valid.

4.5 The Internet creates jobs, but destroys them as well

The growth of the Internet industry generally leads to an increase in employment in the industry itself. This does not automatically imply an increase in total employment, let alone improvements in the remuneration, quality and security of jobs.

Several recent publications underlined the job creating power of the Internet. The results from McKinsey's global SME survey, for instance, suggest that the Internet has created 2.6

jobs for every one destroyed (Pélissié du Rausas *et al.*, 2011). However, many of the new jobs in the Internet sector represent displaced employment.

As capital flows to the Internet industry and the Internet-intensity of a broader range of services increases, jobs are likely to follow. Our macro-economic modelling results suggest that, as Future Internet technologies and their adoption in other sectors mature, adoption will be driven more by quality improvements than cost savings, and net employment will recover (see also Section 5.3). The efficiency of the labour market is likely to improve as well, as a result of labour force networking, improved job search and better matching of workers to jobs (Goyal, 2011; Kalleberg, 2006; Caliendo *et al.*, 2010).

Off-shoring may generate considerable increases in competition with workers in China, India and, internally, from the New Member States (Freeman, 2007). Although the number of jobs that have been off-shored to date appears rather modest, potential future effects seem much more substantial (D'Amuri and Peri, 2011; Gál, 2010; Marin, 2010). Indeed, the global competitive threat to wages may affect high-skilled workers. However, over the next two decades, we anticipate a gradual equalisation of real wages overall and a rebalancing of economic activity based on comparative advantage (Holinsheid and Hardy, 2010; Doogan, 2011; Sass, 2010).

The employment contributions of the Future Internet are not limited to the number of jobs. Earnings gains from productivity growth have been heavily concentrated among high-income workers and families.⁴⁰ It is not clear whether economic insecurity has truly increased. Recent increases in perceived inequality and insecurity have been attributed to changes in the stability and quality of jobs available (Rosenblum *et al.*, 2010). But job destruction may lead to insecurity, even if matched by job creation. Displaced workers have difficulty fully replacing previous earnings and tenure (Rosenblum *et al.*, 2010).

In the Tipping Point scenario, the rich ecosystem of highly dynamic and networked SMEs is more likely to produce high-quality employment. The Internet-fuelled expansion provides many job options, while enhanced job matching and social support services help workers who wish to trade stability for career development and progression without sacrificing wages or quality of life. At the same time, healthy macroeconomic growth and wide diffusion of Future Internet innovations create stable jobs in both large enterprises and classical SMEs (see Table 4-1) for those who want them.

The economy is irreversibly and profoundly globalised in the Tipping Point scenario, but value created by diversified SMEs is still embedded in local economies and the share of labour in overall growth is stable, thanks to the development of personalised services and cooperative business models. At the same time, because firms need skills that are not all locally available, many skilled workers can find remote employment.

Finally, this dynamic economy will see the birth and death of many firms and jobs linked to specific services, technologies and market niches. However, rich social networks may facilitate re-employment or re-training (Caliendo *et al.*, 2010; Goyal, 2010). Spells of unemployment will be shorter and job-seekers will not lose societal contact. Indeed,

⁴⁰ Inequality in ICT-intensive sectors has increased both between and within skill classes (Card and DiNardo, 2002).

individuals may contribute on an ad hoc or short-term basis while searching for new jobs, or may even choose a portfolio career on a permanent basis (Curry and Schultz, 2009). This is not limited to the core ICT sectors, either; we already see crowd sourcing and reverse auction markets being used to mobilise and apply skills and to coordinate economically productive activity in sectors ranging from business processes to transportation.

Total employment is also likely to increase as innovation moves from cost reduction and value capture towards value creation. Not everything will be for sale, but much that is now done for free will be supported by various forms of subsidy or cooperative social enterprise. Whether part of formal employment or not, the level and distribution of economically productive activity will improve.

In the Slow Motion scenario, these same forces produce less desirable results. The worsening position of SMEs spells loss of income and job security for their employees; strong cost-reduction imperatives mean that Future Internet innovations will primarily be used to save labour. Larger firms will use the new technologies to increase their labour market power, squeezing both high- and low-skill workers. Overall contraction in demand for specific skills combined with decreased public expenditure on Internet-based job market and human capital services will further consolidate the power of large employers and limit expansion of niche and service-orientated sectors. Total employment will likely decline in this scenario as the economy settles into an underemployment equilibrium.

4.6 **The shortage of eSkills will eventually decrease**

In Chapter 2 we identified a scarcity of qualified personnel with the appropriate IT skills as a potential barrier to growth for the Internet industry. This is a serious concern in a number of European countries. In Germany for example, June 2011 saw the number of vacant engineering jobs reach an all-time high of 76,400 (Blau, 2011). In the near future, this gap between the number of vacancies and qualified personnel to fill them is expected to widen. The eSkills Monitor estimated 384,100 potentially unfilled vacancies by 2015 in its baseline scenario for EU-27, corresponding to a shortage of 7% (Cattaneo *et al.*, 2009). The fast pace of innovation and the increasing demand for a new range of e-skills applied to business sectors is likely to lead to a mismatch of demand-supply across Europe, with scarcity of skilled personnel in many countries and regions, particularly affecting innovative SMEs, accompanied by unemployment of personnel with obsolete skills.

But this trend is not necessarily expected to continue. The supply of more highly educated, high-skilled workers is expected to increase (Van Stolk *et al.*, 2011), and work-related and life-related Internet skills will tend to converge. This means that young people in the future will enter the job market with a more complete set of the necessary skills, acquired in schools and in their social networks (Vickery, 1999; Keep and Mayhew, 2009). In addition, Future Internet technologies are gradually becoming more user-friendly and thus less reliant on specialised skills (Ritchy and Brindley, 2005). However, a combination of technical skills and other non-technical skills, such as business, communication, and customer relations (Pratt, 2012) is also increasingly demanded from ICT specialists, quite different from skills in using generic technologies. The real problem in this complex scenario remains the mismatch between demand and supply of skills, with the fragmented

European market playing a further role in inhibiting the migration of specialized workers from areas of low demand from areas of high demand (as is the case for the unfulfilled demand in Germany now).

In the Tipping Point scenario, the demand for eSkills is expected to rise more quickly than in the Realistic scenario. The eSkills Monitor projections (Cattaneo *et al.*, 2009) show a 10% excess of demand over supply (a shortage of 579,500 EU-27 jobs by 2015) in the scenario that most closely resembles the Tipping Point (Investing in the Future). Fortunately, the effective supply is also projected to increase during that time. A combination of factors will likely combine to reinforce the incentive to acquire eSkills, whether in formal education, at work or as part of one's social life. These factors include the wide diffusion of Internet-based innovations and business models, the high premiums for these skills resulting from the near-term shortage, and the relatively high probability of employment.

The Slow Motion scenario will likely see a correction of the current overshoot of supply in at least some countries (e.g. e-skills UK 2010) to a modest excess demand condition. In this scenario, cost-reduction imperatives would encourage labour-saving ICT adoption, especially to substitute for low-skilled workers and extend the productivity of high-skilled workers. The eSkills Monitor projections, which recorded a surplus of 36,800 in 2010, anticipate a shortage of 1.7% (86,500 jobs) by 2015 (Cattaneo *et al.*, 2009).

4.7 **Returns are substantial for SMEs able to overcome the barriers to adoption of Internet services**

For SMEs, the Internet can help achieve considerable economies of scale and scope by facilitating geographic expansion, access to online tools, staff recruitment, payments, customer relations and marketing. However, these contributions are not the same for all SMEs, because the population of SMEs is not homogenous. They also play different roles in different sectors.

Combining the typologies used by OECD (2011b) and Kalapesi *et al.* (2010), we can distinguish three types of SME: Gazelles, Classical and Seedlings (see Table 4-1).

Table 4-1. SME types

Type	Characteristic	Future Internet contributions
Gazelles ⁴¹	Young, agile, highly innovative, keen users of ICTs and FI services. Many start as spinoffs from larger firms; may grow rapidly and/or incubate ideas for larger firms. Low risk aversion, costs of failure and risks of capture by dominant paradigms; good place to nurture talent and ideas;	Access to advanced services for collaboration; access to high-skilled human capital; support for specific security, computing needs; toolkit for business model and service innovation; scalable services
Classical	Less innovative, less likely to adopt advanced ICTs. Often in marginal niches (e.g. Small local markets, dependent positions in supply chains, etc.) and unlikely to grow fast. Offer short communication lines, high-welfare employment, local economy/community engagement, close attention to client needs. Serve 'long tail.'	Access to advanced 'utility' (or cloud) services to level ICT and market access playing field; support for value chain participation, self-organisation into virtual enterprises
Seedlings	Grow into big firms by adopting advanced ICT/Internet services, exploiting emergent economies of scale (including reputation), providing trusted platforms and services and managing conversion of 'long tail' niche services into new 'core' services.	Access to global input and output markets; advanced CRM, BPO, SCM, etc. functionality. ⁴²

Source: Kalapesi *et al.* (2010) and OECD (2011b)

SMEs seem to face a number of barriers to adoption of Internet services (see Section 2.3). But for those able to overcome the barriers, the returns are substantial; in a survey of 4,800 SMEs in G8 countries (Pélessié du Rausas *et al.*, 2011), those with a Web presence, using email and active in online commerce grew more than twice as fast, had 10% higher productivity and exported twice as much. Of course, this does not imply that all SMEs would experience such benefits; it could simply be that better-performing firms anticipate higher returns against adopting ICTs and competing over the Internet.

Our projections suggest that SME demand for Internet technologies and services will grow in the next decade, albeit not always as fast as that of larger enterprises. Under the economic conditions assumed in our Realistic scenario, their annual Internet investments will grow from €55 bn in 2015 to €70 bn in 2020 (Figure 4–1). The annual growth rate of investment is projected to peak in 2015 and taper off to 5% (Figure 4-6). By 2020, we estimate that SMEs will still only constitute 30% of the total Internet market value.

In the Tipping Point scenario, SMEs are able to participate fully in the development of the European Internet economy, through its extended value chains. As a result, their investment in Internet services increases.

By contrast, SMEs fall behind in the Slow Motion scenario. They struggle for access to Future Internet innovations and many of the sectors in which they are most active are slow

⁴¹ High-growth enterprises have average annualised growth in employees (or in turnover) greater than 20% over a three-year period and ten or more employees at the beginning of the observation period. Gazelles are high-growth enterprises born five years or less before the end of the three-year observation period.

⁴² Customer Relations Management (including communications and interactive feedback); Business Process Outsourcing (magnifies capability, drives down cost, increases resilience); Supply Chain Management.

to reap the benefits as well. Figure 4-7 shows that Internet investment by SMEs grows much more slowly in the Slow Motion scenario. More significantly, while SMEs adopt advanced Internet services somewhat faster than large firms in the Tipping Point scenario, this is strongly reversed in the retrenchment of the Slow Motion world.

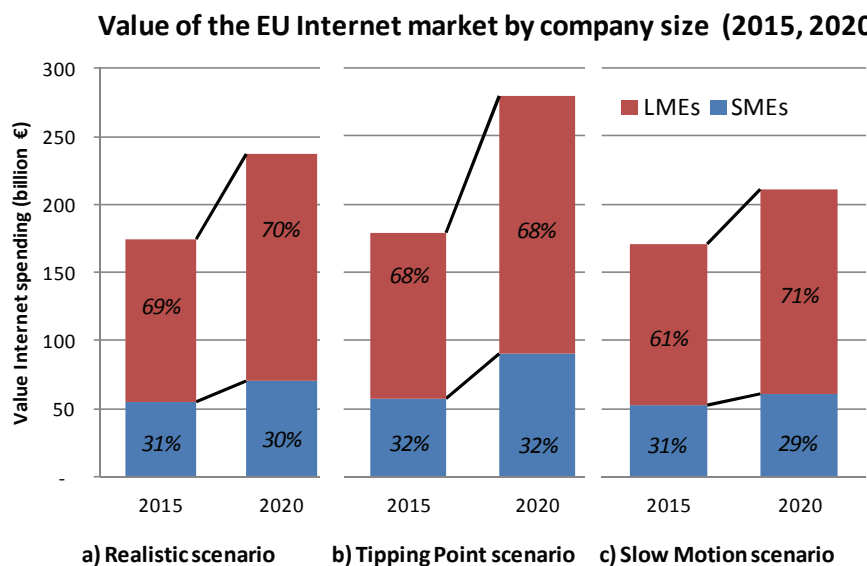


Figure 4-6. Value of the EU Internet market and proportion (%) by company size: a) Realistic scenario; b) Tipping Point scenario; c) Slow Motion scenario.

Source: IDC (2011)

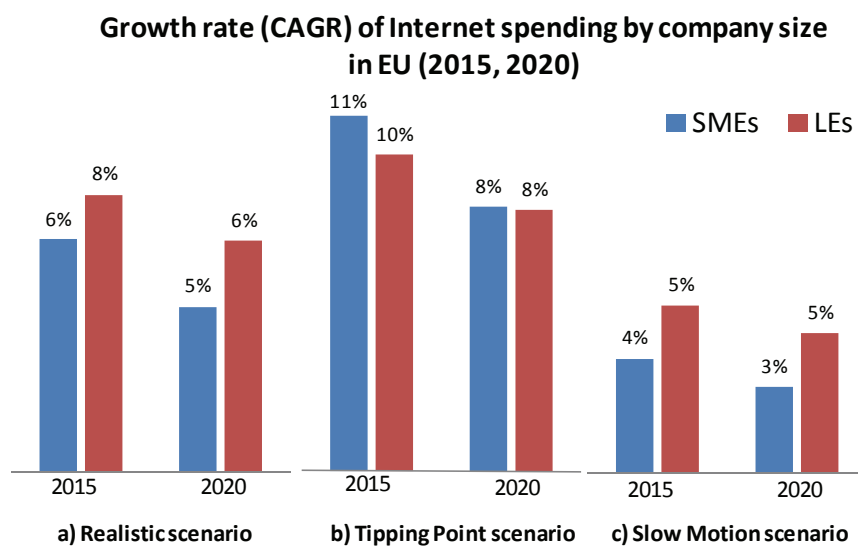


Figure 4-7. Annual growth rate of Internet spending by company size and scenario in 2015 and 2020 for: a) Realistic scenario; b) Tipping Point scenario; c) Slow Motion scenario.

Note: Small to medium enterprises (SMEs) are defined as firms with up to 249 employees; Large Enterprises (LEs) are firms with 250 employees or more.

Source: IDC (2011)

The composition of the population of SMEs will change as well. In the Tipping Point scenario, Gazelles thrive, growing as a proportion of the SME population and feeding a steady stream of innovative technologies, applications, services and business models into the rest of the European Internet economy.

In the Slow Motion scenario, as noted above, value capture shifts to the large providers of utility (primarily telecommunications) services; these firms tend to withdraw from vertical integration and value-added services. However, their niche is likely to be occupied by large-scale, primarily foreign-based service providers, leaving SMEs in an exposed and uncertain position and greatly increasing the proportionate share of classical SMEs.

4.8 **The Internet may fundamentally transform European business models**

The long-term transformative power of the Future Internet is likely to rest largely on its potential to drive the evolution and modernisation of European business processes (Cavanillas, 2010). The Future Internet shapes these by enabling greater flexibility in the development of applications, services and business models, and by enhancing capabilities for co-operation and feedback.

We have examined the potential of transformation of the business models under our three scenarios.

The Tipping Point scenario (as pointed out by its name) envisages a turning point of the adoption of Internet-based innovation across the EU economic system. This is bound to favour end-user empowerment, and therefore the many emergent Internet business models, centred on the end user. For instance, personalised information may be used to transform the contribution of knowledge to welfare, for example via avatars acting on behalf of the individual. But this is not altruistic or wholly benign; there has been an explosion of business models for collecting and exploiting the “new oil” of personal information (OECD, 2010a), raising concerns for privacy and other societal interests (Cave *et al.*, 2011).

A diversified Tipping Point Future Internet will encourage infrastructure service providers to favour competitive and/or utility-service provision. Even if the core platform(s) and other infrastructures in Tipping Point are dominated by large firms, they will still be able to attract many small service suppliers seeking the speed, creativity and volume of large and diverse populations to develop (e.g. crowd sourcing) and to consume (e.g. the long tail) new formats and applications. Therefore, this scenario offers greater societal benefits to net neutrality (across different content and services). But this cannot be guaranteed without complementary policy intervention.

Tipping Point business models for innovative services will also provide and/or rely on a high degree of customisation to the needs of different customers. This may impede switching while at the same time enabling cost-effective provision of niche or mass-customised services. In this setting, utility computing services provided over open or community clouds decrease the ICT-based advantages of large service and applications providers and increases the ability of consumers to take control of and exploit their own profiles (including activity records and other personal data).

On the other extreme of the scale, the harsh competition and retrenchment of the Slow Motion scenario will favour personalisation that limits mobility and attaches lower priority to privacy.

From the societal perspective, it may be more important to consider the way the Future Internet affects the interaction of enterprises via value networks (Allee and Schwabe, 2011). Tipping Point technologies and services that preserve openness favour net value creation; Slow Motion innovations have limited diffusion and enhance proprietary restrictions, favouring value capture business models (Cave *et al.*, 2009).

In the Slow Motion scenario, the powerful role of large local telecommunications and global service firms brings high quality, enhanced functionality and interoperability via integrated services, but encourages rivals to develop incompatible products to limit customer mobility. The resulting technological and commercial lock-in may threaten diversity and competition.

However, this does not mean that business models that treat individuals differently will only occur in the Tipping Point scenario. The advertising model currently paying for many Internet services, apparently free, has some strong limitations. The combination of increased joint costs (for serving different users) and new technologies and business models that allow greater differentiation in pricing, quality of service, or content, make some degree of discrimination inevitable and the right kind desirable. Licensing models to pay for Future Internet services are likely to emerge and be present to some degree in all 3 scenarios. The main difference between the scenarios is whether the wide range of business models potentially emerging will be able to multiply and flourish, thanks to positive economic and framework conditions, as in the Tipping Point scenario, or will be restrained and limited as in the Slow Motion scenario.

CHAPTER 5 **The macroeconomic impact of a Future Internet PPP and its potential successor**

While Chapter 4 focused on the Internet industry and its likely economic and societal contributions, this Chapter concentrates on the Future Internet Public Private Partnership (FI PPP) and the possible successor (henceforth FI PPP+). The following sections aim to quantify the potential mid- and long-term impacts of FI PPP and FI PPP+ on the EU 27 economies.

The approach we followed resembles that used to empirically assess the effects of a specific autonomous change in a particular part of the economy on the economy at large. This could include the impact of a governmental program on GDP, on employment, etc. We have made use of a comprehensive dynamic empirical macroeconomic model, GINFORS, covering most of the EU 27 economies.⁴³

Section 5.1.1 and 5.1.2 present the main model assumptions simulating the impacts of the FI PPP, with different degrees of success of the PPP activities. Section 5.1.3 lists the assumptions regarding FI PPP+. Section 5.2 presents our empirical evidence on the potential economic impacts of the current FI PPP. Section 5.3 addresses the potential economic impacts of a FI PPP+. This is done on the basis of three different model runs mirroring the different scenarios defined in Chapter 3.

5.1 **Assessing the potential impacts of FI PPP**

In order to assess the potential impact of FI PPP policy interventions, we modelled two distinct versions of the GINFORS model, reflecting two distinct sets of detailed economic assumptions:

⁴³ The model called GINFORS (Global INterindustry FORecasting System) is a sectorally disaggregated macroeconomic model. It comprises the complete input-output relationships for 48 sectors which are consistently embedded into the different accounts of national accounting like e.g. production, origination of GDP, GDP demand components (private consumption, gross capital formation [investments], consumption of the State, exports and imports). The model contains several thousands of econometrically estimated equations. The model reflects only 19 of the 27 EU Member States, due to limitations in availability of disaggregated data; however, they collectively represent more than 95% of the EU-27 GDP. Overall, GINFORS has a global coverage of 94% of world GDP.

- “baseline pure” represents the world with no Future Internet PPP;⁴⁴ and
- “baseline PPP” includes the existing Future Internet PPP.

No other public policy interventions are assumed. Comparing baseline pure with baseline PPP enables us to assess the economic outcomes of FI PPP.

We focus here on the overall macroeconomic impacts of FI PPP at European level from roughly the present to 2020, taking into account spill-overs from the European Internet industry and market.⁴⁵

5.1.1 The key model assumptions for the diffusion of a Future Internet PPP

This type of analysis by definition yields a conditional forecast, i.e. one that is based on assumptions.⁴⁶ Our basic assumption regarding how FI PPP activities and developments are transmitted into the economy and society can best be described by Van Ark’s (2011) cycle of new technology in a social environment.

Hence we assume FI PPP activities to be more or less “successful” to the extent that they support the development of new technologies, related services and applications, which are introduced in the market and adopted in the economy. Over time, an innovation cycle might develop, as uses are modified and new needs, ideas and application contexts arise, resulting in new or improved technologies, and so on.⁴⁷ Each stage in the cycle will in one way or another impact individuals, communities and society at large. In a nutshell, our approach therefore rests on two types of assumptions: (1) the activities related both to the infrastructure platform (FI-Ware) and to all of the use cases are “successful”; (2) these activities unleash widespread effects across the economy, due for example to technological changes, demonstration effects, etc. (see below). The assumptions regarding the FI PPP cycle and all of the other assumptions and justifications underlying this approach are described in detail in a separate technical report (Elixmann and Schwab 2012).

⁴⁴ Other actions –under the Framework Programme and on the part of the Member States– are assumed to remain in place.

⁴⁵ The GINFORS model and its database do not incorporate the recent macroeconomic turbulence. However, if we included the higher overall volatility of the economy it would be part of both baselines, and since our approach is based on the *comparison* of two model runs (baseline pure and baseline PPP), it is likely that the difference between them would not be affected that much. The difference would be zero for a linear model. Of course GINFORS is not a linear model. Yet, the plausible variations of the exogenous variables to take account of the higher volatility of the economies are relatively small compared to the respective overall levels of these variables. This means that a “linear approximation” still is feasible and we can therefore expect only marginal variations of the overall results.

⁴⁶ The assumptions have both qualitative and quantitative characteristics inasmuch as they (1) specify “transmission mechanisms” that reflect how FI PPP (or FI PPP+) related activities and developments (concerning infrastructure, applications and services) might affect the Internet industry and, in turn, other industries of the economy, (2) relate to the identification of suitable indicators characterising the transmission mechanisms, and (3) specify actual values for these indicators. The actual values for the indicators, in turn, are used as “exogenous shocks” for the macroeconomic model which then calculates the impacts of these “shocks” on the economy.

⁴⁷ The aforementioned cycle by no means excludes failures. In Section 5.2.3 we mitigate the assumptions about the success of FI PPP and allow that FI-Ware activities and specific use case activities, respectively, are not or only partially successful.

The key assumption for our empirical assessment is that developments of the FI PPP core platform and the use cases as well as the induced effects across firms in the user case domains will in effect lead to so-called “primary pushes” on:

- investment behaviour in the different sectors of the economy;
- private household purchases of goods and services; and
- productivity within sectors and intermediate input demand and supply between sectors.

In this section, we summarise the most important assumptions for the baseline PPP. While the robustness of some of these assumptions is debatable, we believe that they are reasonable and defensible.

Investments

First of all, we have assumed that FI PPP will lead to different investment pushes on different sectors of the economy. The identification of sectors and the extent of the investment pushes are based on our interpretation of FI PPP characteristics. We have summarised them in Table 5-1.⁴⁸

⁴⁸ We assume that, in each of the sectors listed in column (3) of this table, a small, sector-specific fraction of the investments can be assigned to FI PPP activities and outcomes. The table shows in column (4) the assumed fraction for the peak period, i.e. the year 2020. We perceive all Future Internet PPP related project work to be finalized already several years before 2020. Yet, we have chosen this later point in time in order to capture all indirect (inter-temporal) effects that might be relevant. The assumed relative percentage increases of the sectoral investment levels in other years of the forecasting period are (partly substantially) lower than the respective levels of the peak period.

Table 5-1. Assumptions regarding investments due to FI PPP.

FI PPP activity (1)	Assumptions about investment (2)	Sector of the economy that is involved (3)	Increase of investment level in 2020* (4)
<i>Agriculture/ environment</i> (SMARTAGRIFOOD)	Companies in the agricultural sector make investments in order to make use of "smart" agricultural services (i.e. purchases of agricultural machinery as well as of trucks, cars, tractors etc. with particular functionalities)	Agricultural sector (Sector 1)	0.23 %
<i>Energy efficiency</i> (FINSENY)	The migration towards electric vehicles requires investments in charging stations	Coke, refined petroleum products (Sector 8)	0.30 %
<i>Energy efficiency</i> (FINSENY)	The migration towards electric vehicles requires investments in charging stations The decentralization of energy production (e.g. the migration to wind energy, solar energy) and the political requirement to save energy require the energy industry to invest in "smart" networks (smart grids, smart metering)	Production, collection and distribution of electricity (Sector 26)	0.38 %
<i>Transport, logistics</i> (FINEST, Instant Mobility)	Transport and logistics companies have an incentive to make investments: <ul style="list-style-type: none">• into innovative new smart technologies, e.g. via purchase of trucks with additional "smart" functionalities (embodied technological progress)• to get access to specific ICT platforms, e.g. investments relating to physical or logical interfaces, and the adaptation of data and company specific processes to upload data onto or download data from the platform(s)	Land transport (Sector 33)	0.20 %
<i>Transport, logistics</i> (FINEST, INSTANT MOBILITY)	Transport and logistics companies have an incentive to make investments to get access to specific ICT platforms, e.g. investments relating to physical or logical interfaces, and the adaptation of data and company specific processes to upload data onto or download data from the platform(s)	Water, transport, air transport (Sectors 34 and 35)	0.06 %
<i>Infrastructure</i> (FI-WARE)	Fixed-link and mobile network operators as well as ISPs implement FI PPP (and FI PPP +) related features in their network infrastructures (access network, "transport layer", "control layer"), they invest in developments on the "application layer" and they make investments into provision of cloud services	Post and telecommunications (Sector 37)	+4.3 %
<i>Smart cities</i> (SAFE CITY)	State agencies have an incentive to make investments relating to hardware and software in the context of improving public safety in cities	Public administration (Sector 44)	0.16 %
<i>Potential future activities in the fields of health and ambient assisted living</i>	Investments by hospitals, doctors etc. in specific communications and medical equipment; investments in energy efficient buildings	Health and social work (Sector 46)	1.17 %
<i>All use cases</i>	Incentive to purchase "better/more appropriate" software and hardware in order to be able to utilize "smart" services and applications available in the market	All other sectors of the economy	47 sectors ≤ 0.16 % (thereof 39 sectors ≤ 0.027 %); 1 sector 0.338 %

Note: * Relative percentage increase of investment level of sector in column (4) in peak year 2020

Private consumption

We make several assumptions about private household purchases of goods and services. The PPP is expected to contribute to improving efficiency and/or quality of products and services that in some way are attractive to consumers. We assume that individuals and/or households have an incentive to purchase goods and services with specific characteristics. These are outlined in Table 5-2.

Table 5-2. Assumptions regarding private household purchases of goods and services due to FI PPP

FI PPP activity (1)	Households have an incentive to... (2)	Sector involved (3)	Percentage change of household consumption*
<i>Energy efficiency (FINSENY)</i>	<ul style="list-style-type: none"> purchase electric vehicles; adoption and diffusion of electric vehicles in turn leads to <ul style="list-style-type: none"> lower fuel consumption higher energy consumption 	Coke, refined petroleum products (Sector 8)	- 0.68 %
		Production, collection and distribution of electricity (Sector 26)	0.27 %
	<ul style="list-style-type: none"> save energy consumption and to purchase related <ul style="list-style-type: none"> intelligent equipment (e.g. smart meters) "services" from service providers 	Electrical machinery & apparatus (Sector 18)	0.31 %
		Production, collection and distribution of electricity (Sector 26)	0.045 %
<i>New forms of content (FI-CONTENT); other smart services/ applications</i>	<ul style="list-style-type: none"> upgrade their terminal equipment (computer, smart phones, etc.) infrastructure at home (in terms of performance, functionalities, protection against cybercrime, privacy, security etc.) in order to use smart services. 	Office, accounting and computing machinery (Sector 17)	0.93 %
		Electrical machinery and apparatus (Sector 18)	1.19 %
		Radio, television and communication equipment (Sector 19)	0.52 %
	<ul style="list-style-type: none"> purchase access line (network connection) services with higher performance (e.g. bandwidth, security features, etc.) 	Post and telecommunications (Sector 37)	0.20 %
<i>Potential future activities in the fields of health and ambient assisted living</i>	<ul style="list-style-type: none"> purchase intelligent health equipment (e.g. remote home-based monitoring for chronic-disease patients and the aged; wearable diagnostic sensors etc.) beyond the equipment that is financed by the health insurance system 	Health and social work (Sector 46)	0.10 %
<i>FI PPP activities at large</i>	<ul style="list-style-type: none"> purchase services related to education (lifelong learning) 	Education (Sector 45)	0.26 %

Note: * Percentage change regarding household consumption of goods and services provided by sector in column (3) in the peak year

Similarly to investments, the effects highlighted in column 2 of the table are not necessarily exclusively caused by FI PPP. We assume, however, that a percentage of each expenditure

category can be attributed to FI PPP. The table shows the assumed percentage values for the peak period.⁴⁹

Sector input-output relationships and productivity

We assume that FI PPP will also have an effect on intermediate input demand and supply between sectors. The respective assumptions are outlined in Table 5-3.

Table 5-3. Assumptions regarding changes in sector input-output coefficients due to FI PPP

Across all sectors of the economy companies have an incentive to ... (1)	Sector involved (2)	Percentage increase in peak year* (3)
<ul style="list-style-type: none"> purchase additional transmission services (more conduits and/or more bandwidth), more server space etc. from telecommunications network operators/ISPS in order to get access to (electronic) platform locations, link company locations, link nomadic employees, etc. 	Posts and telecommunications (Sector 37)	1.5 %
<ul style="list-style-type: none"> improve the performance of their IT and communication (terminal) equipment in order to benefit from the respective smart services and applications available; they are also incentivized to purchase additional services (e.g. software apps) and specific support and enabling services for implementation (company specific configuration), maintenance, upgrading etc. as well as to set up and maintain their access to specific B2B and B2C platforms 	Computer and related activities" (Sector 41)	1.5 %
<ul style="list-style-type: none"> purchase services for vocational training 	Education (Sector 45)	1.5 %

Note: * Percentage increase of row of the sector indicated in column (2) in peak year (i.e. sector in column (2) delivers more to sector j , $j = 1, \dots, 48$). The respective entire row in the input-output matrix has been increased.

Finally, we assume that the adoption and diffusion of developments related to FI PPP will bring about productivity effects in the economy. We have assumed a respective productivity increase of 0.2% across all sectors of the economy.⁵⁰

In order to assess the sensitivity of the empirical results generated by GINFORS in view of these assumptions several model runs were carried out, reflecting different levels of success of FI PPP activities (see Table 5-4)⁵¹.

⁴⁹ The assumed fractions in other years of the forecasting period are even (partly substantially) lower than the respective percentage changes in the peak year.

⁵⁰ The assumed productivity effect as well as the assumed effect on the input-output coefficients in other years of the forecasting period are (partly substantially) lower than 0.2% (productivity) and 1.5 % (input-output coefficients), respectively.

⁵¹ These model runs are discussed in detail in Elixmann and Schwab (2011, Section 1.5). If specific FI PPP activities are not successful, then part of the respective effects of FI PPP on investment, consumption, intermediary input, and productivity outlined above are not taken into account in the model runs.

Table 5-4. Assumptions regarding the varying success of the FI PPP to test sensitivity

Across all sectors of the economy companies have an incentive to ...
<i>Model run I:</i> complete success of infrastructure activities (FI-Ware), complete success of all use cases (the optimistic variant)
<i>Model run II:</i> FI PPP infrastructure activities (FI-Ware) do not deliver anything useful; the majority of the use cases also produce nothing; only three use cases are successful: Energy, transport/logistics, and agriculture (the pessimistic variant); ⁵²
<i>Model run III:</i> FI PPP infrastructure activities (FI-Ware) not successful at all; however, all current and the foreseeable use cases regarding health and ambient assisted living are assumed to be a complete success;
<i>Model run IV:</i> FI PPP infrastructure activities (FI-Ware) partially successful; only three use cases are successful: Energy, transport/logistics, and agriculture.

5.1.2 Assumptions about FI PPP+

There are three main differences between the model runs based on the current FI PPP and those for FI PPP+.

Firstly, we have good reasons to believe that the overall macroeconomic impacts⁵³ of FI PPP+ will take longer to become visible than those for FI PPP. Consequently, we have extended the forecast period up to 2025.

Secondly, although the key directions of the primary pushes within sectors, and on the intermediate input demand and supply between sectors, are the same as for FI PPP, we have changed the assumptions regarding the primary effect of FI PPP+ on investments, private household purchases of goods and services, productivity increases and input-output coefficients. These are assumed to be slightly higher in the peak period than in FI PPP (see Section 5.1.1), and their effects over time are assumed to be different.⁵⁴

Finally, since FI PPP+ will be employed further into the future than the current FI PPP, there is even more uncertainty with regards to the diffusion effects. Taking the aforementioned assumptions as a definition for the Realistic scenario, we therefore also assess the impacts of the two other scenarios identified in Chapter 1: Tipping Point and Slow Motion.

5.2 The potential economic impacts of the current FI PPP

Given the reasonable assumptions outlined above about the diffusion of developments related to FI PPP, we estimate the potential impacts on the economy at large. The results

⁵² Of course, the most pessimistic variant would be to assume that all of the FI PPP activities are not successful. But for this case no model run is necessary to derive the conclusion that the macroeconomic impact is equal to zero (in the frame of our approach using the GINFORS model there is no difference between baseline pure and baseline PPP).

⁵³ That is, effects after all sectoral and macroeconomic spillovers have been reflected in the economy.

⁵⁴ Such an assumption shall reflect that a longer lasting FI PPP+ (compared to FI PPP) is likely to provide a basis for more intensive cooperation across industries and “cycles” of marketable innovations; see Elixmann and Schwab (2011).

concentrate on two macroeconomic indicators: real Gross Domestic Product (GDP) and employment.⁵⁵

5.2.1 The impact on GDP might be positive and significant

Our results suggest that FI PPP might have a significant positive impact on GDP in Europe (see Figure 5-1) compared with baseline pure (where no FI PPP is present). If we assume that FI-Ware and all use cases are completely successful (i.e. model run I), the outcome is as follows:

- The annual overall positive impact on European real GDP reaches a maximum of €28 bn in 2020, which corresponds to 0.24% of the total real GDP of the EU;
- The cumulative overall positive impact on European real GDP in 2020 is €126 bn;
- The contribution of the European Internet economy (as defined in Chapter 1) to overall European real GDP is 5.7% higher in 2020 than it would be in the absence of the current FI PPP.

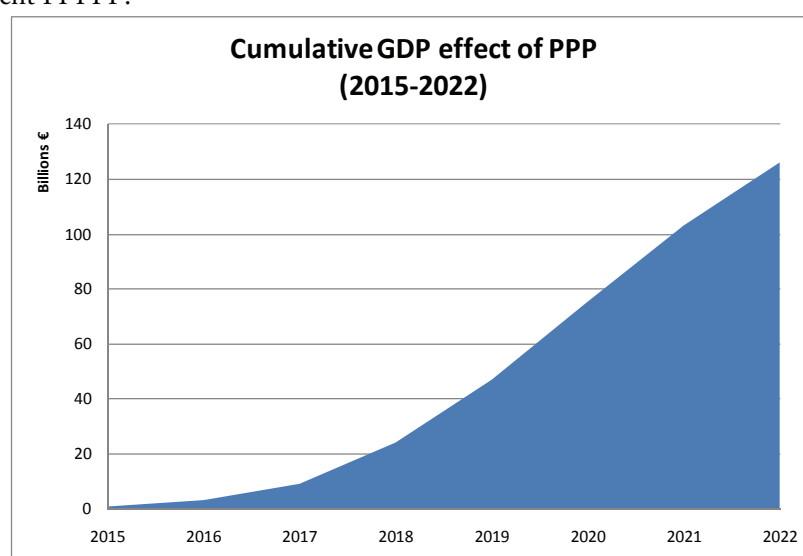


Figure 5-1. The cumulative impact of the current Future Internet PPP on European real GDP.

Source: WIK-Consult and GWS

The positive effects of FI PPP on real GDP vary among Member States. Not surprisingly, the absolute magnitude of these impacts tends to be greatest in Member States that have large real GDP overall. The projected impact in 2020 is greatest in Germany (€8 bn), the UK (€5 bn) and France (€4 bn).

Expressing the effects as a percentage of overall real GDP per Member State reveals some interesting differences. Member States with a comparatively high effect relative to overall real GDP include the Czech Republic, Hungary and Luxembourg. Member States with a comparatively low effect relative to overall real GDP include Italy, France and Austria.⁵⁶

⁵⁵ Note that *real GDP* is adjusted to correct for inflation or deflation, while *nominal GDP* is based on prices that are not adjusted. We have based our computation of real GDP on year 2000 prices.

⁵⁶ Countries are affected in a different way in particular because they differ as to their structures of production and the extent to which they are integrated in international trade. Hungary and the Czech Republic e.g. benefit much stronger than the other countries from gains in international trade. Luxembourg experiences in particular

5.2.2 Productivity is the main driver behind the impact on GDP growth

The FI PPP is expected to impose primary pushes on investment behaviour, private household purchases of goods and services, and (labour) productivity. But depending on the characteristics of the Member States' economies, there are considerable differences in the relative weight of each of these drivers of GDP growth. Despite these differences (see: Figure 5-2), productivity enhancements driven by FI PPP appear to have a particularly significant impact on GDP growth in the EU.

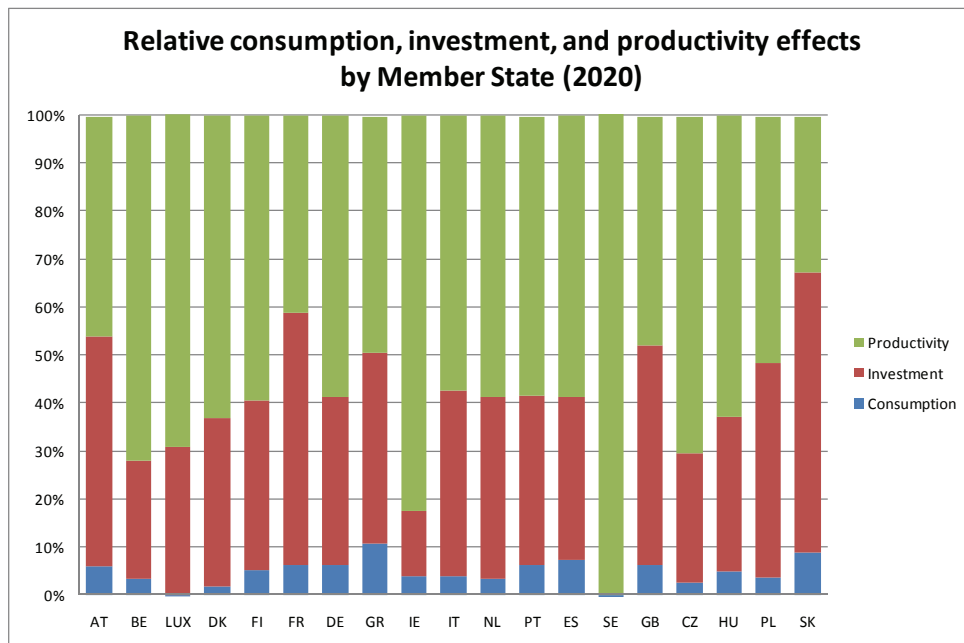


Figure 5-2. Relative weight of effects of the current FI PPP on real GDP attributable to "pushes" in household consumption, investment and productivity (2020) by Member State.

Source: WIK-Consult and GWS

Productivity enhancement affects real GDP in many ways. Rising productivity reduces factor inputs and costs. In competitive markets, if costs fall, prices fall. This fall in prices induces rising purchasing power and consumer demand.

Falling prices would also tend to enhance Europe's ability to compete internationally, thus reducing imports and increasing exports. If European countries become more competitive, they may be able to reduce their use of price-dependent imports (including many intermediate and finished goods).

However, the use of imported raw materials such as oil and gas may not change much (i.e. demand is relatively inelastic). A fall in imports would imply more value added and more income, which in turn would imply increased final demand. Any improvement in Europe's international competitiveness would also tend to raise exports, which would induce further consumption and investment.

effects on account of the induced investment activities, which are generated not only directly by the investment push but also indirectly by the other pushes.

These positive impacts are accompanied by some negative impacts. Reductions in factor demand imply reduced sales and employment in the relevant industries. The strength of this effect depends on many factors, including the structure of production and the involvement of the country in question in international trade. These effects could vary considerably from one country to the next, as shown in Figure 5-2.

In all of the countries that we modelled, the consumption changes engendered by the current FI PPP have less relative effect on real GDP than changes in productivity or investment. This may reflect the fact that an improvement in productivity tends to benefit all sectors of the economy, whereas changes in consumption or investment tend to be limited to specific sectors.

5.2.3 The size of the GDP effect depends significantly on the assumptions about the success of FI PPP

If we assume that FI PPP activities are only partially successful the effects on GDP are significant, see Table 5-4.

Table 5-5. GDP effects of FI PPP subject to alternative assumptions on the degree of success of FI PPP activities (sensitivity analysis)

	Model run II: FI-Ware not successful at all, only the three use cases on energy, transport/logistics and agriculture are successful	Model run III: FI-Ware not successful at all; however, all current and the foreseeable use cases on health and ambient assisted living are successful	Model run IV: FI-Ware partially successful; only the three use cases, energy, transport/logistics and agriculture, are successful
GDP effect (peak year 2020)	€1.3 bn	€24 bn	€3.5 bn

Table 5.4 reveals two important conclusions: First, the degree of success of the infrastructure activities (FI-Ware) and of the use cases both determine the overall macroeconomic impact of FI PPP. Second, the size of the GDP effect depends much more on the success of the use cases than on the success of the infrastructure related activities (FI-Ware).⁵⁷

5.2.4 The impact on employment is complex

The impact of the current FI PPP on employment is complex, because different forces are at work and they operate on different timescales. If we assume that FI-Ware and all use cases are completely successful (i.e. model run I) the outcome is as follows: For the nominal study period of 2015-2020, the maximum positive effect of the current FI PPP on

⁵⁷ Compared to the most optimistic assumption, where both the infrastructure related activities and all of the use cases are successful (GDP effect: €28 bn, see above), the assumption that FI-Ware is a complete failure reduces the GDP effect by only €4 bn (overall GDP effect: €24 bn). If we assume, however, that FI-Ware is a complete failure and that only the three use cases regarding energy, transport/logistics and agriculture are successful, the GDP effect is very small (€1.3 bn). In this situation, assuming a partial success of FI-Ware would increase the GDP effect substantially (from €1.3 bn to €3.5 bn). Yet, the overall order of magnitude of the GDP effect (€3.5 bn) is rather small compared to the GDP effects when we assume that all of the use cases are successful (€28 bn and €24 bn, respectively).

employment in a particular year is +42,000 jobs in the year 2016 (see Figure 5-3). A greater positive impact occurs later, after 2023. In the interim, however (from 2018 to 2022), the impact on employment appears to be negative.

This is due to the interaction of two distinct effects on employment. An increase in production raises employment, whereas an increase in the real wage rate tends to reduce employment.

At the beginning of the study period in 2015, positive effects in consumption and investment drive positive effects in employment. In the year 2017, productivity effects start to induce a reduction in prices, which raises the real wage rate (the relation between the nominal wage rate and the prices of products). Since the real wage rate influences employment with a time lag, the resultant reduction in employment is first observed in 2018. We find a tendency for the real wage rate to rise and to induce negative employment effects. After 2020, the productivity gains of the current FI PPP are likely to have run their course, at which point the effect of rising real wage rates is eliminated and employment could be about 60,000 higher than in the absence of the current FI PPP.⁵⁸

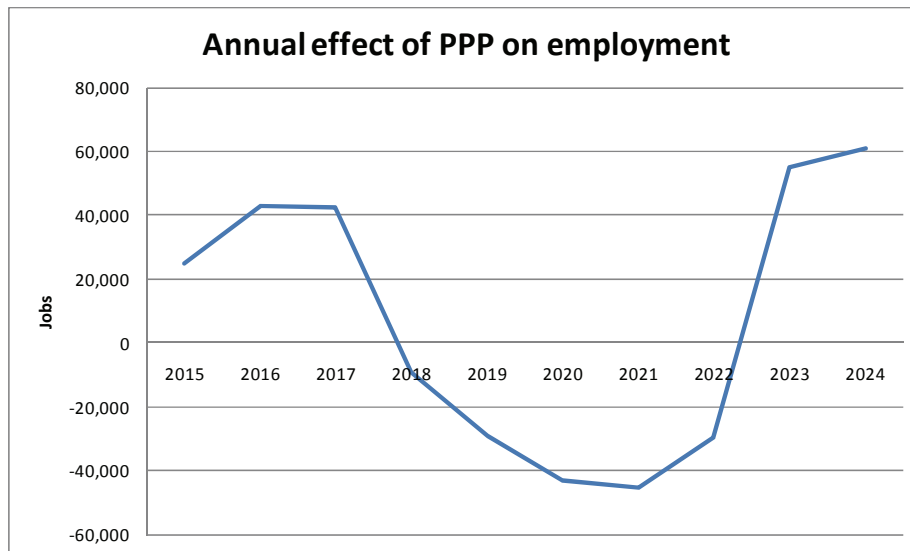


Figure 5-3. Overall impact of the current FI PPP on European employment.

Source: WIK-Consult and GWS

As with GDP, the effects on employment also change considerably if we assume that FI PPP activities are only partially successful, see Table 5-6.⁵⁹

⁵⁸ Note that the cumulative change in employment does not necessarily equal the sum of the annual changes.

⁵⁹ Under the most optimistic assumption, in which both the infrastructure related activities and all of the use cases are successful the employment effect in 2020 is equal to -43,100, see above.

Table 5-6. Employment effects of FI PPP subject to alternative assumptions on the degree of success of FI PPP activities (sensitivity analysis)

	Model run II: FI-Ware not successful at all, only the three use cases regarding energy, transport/logistics, agriculture are successful	Model run III: FI-Ware not successful at all; however, all current and the foreseeable use cases regarding health and ambient assisted living are successful	Model run IV: FI-Ware partially successful; only the three use cases regarding energy, transport/logistics, agriculture are successful
Employment effect (year 2020)	14,700	-94,500	39,600

5.3 The potential economic impacts of FI PPP+

While there is more uncertainty associated with its impacts, we estimate that FI PPP+ can produce significantly positive incremental economic effects.

In this section, we present the results in the three different scenarios for the future EU Internet Industry, Realistic, Tipping Point and Slow Motion.

5.3.1 The GDP effects of the follow-up PPP strongly correlate with economic recovery

We estimate that following up the current FI PPP with FI PPP+ might produce a significantly positive incremental effect on real GDP (compared to baseline pure with no FI PPP at all) (see Figure 5-4).⁶⁰

- The annual overall positive impact on European real GDP compared to baseline pure reaches a maximum of €48 bn in 2025, which corresponds to nearly 0.4% (0.38%) of the total real GDP of the EU.⁶¹
- The cumulative overall positive impact on European real GDP in the period 2015 - 2025 is €270 bn.
- The contribution of the European Internet economy (as defined in Chapter 1) to overall European real GDP increases by 10%.

⁶⁰ As a reminder, *real GDP* is adjusted to correct for inflation or deflation, while *nominal GDP* is based on prices that are not adjusted. We have based our computation of real GDP on year 2000 prices.

⁶¹ We have conducted a sensitivity analysis in which each FI PPP+ related push is lowered by 50 % (see Elixmann and Schwab, 2011). Under these assumptions the overall real GDP effect in 2015 is equal to 0.23 %.

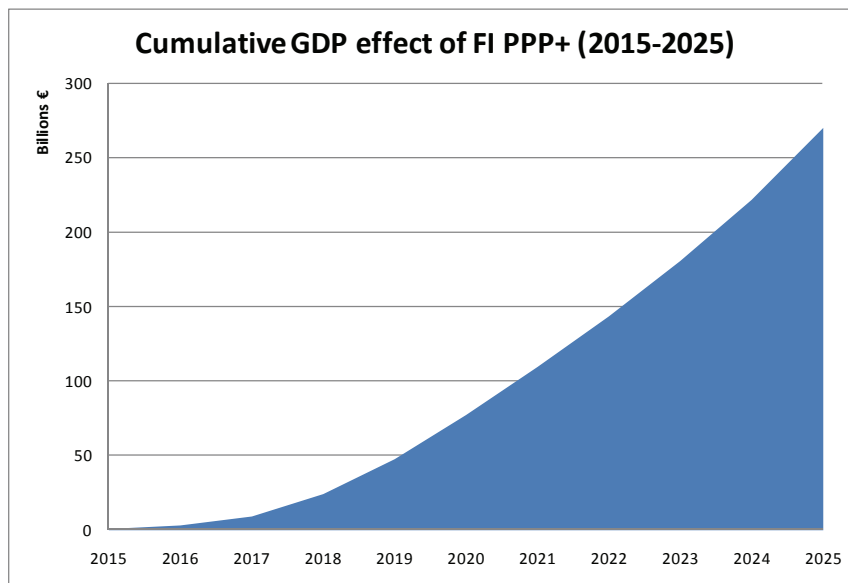


Figure 5-4. Real GDP effect due to FI PPP+ 2015 – 2025 in Realistic scenario (billion Euro, sum of 19 GINFORS countries; in prices of year 2000)

Source: WIK-Consult and GWS

As with the current PPP, the positive effects of FI PPP+ on real GDP vary among Member States. The relative effects, expressed as a percentage of overall real GDP for each Member State, are for most purposes more relevant and more interesting than the absolute magnitude of effects. Member States with a comparatively high effect relative to overall real GDP include the Czech Republic, Hungary and Luxembourg. Member States with a comparatively low effect relative to overall real GDP include Italy, France and Austria.

Perhaps unsurprisingly, the speed of recovery from the current, ongoing financial crisis plays a crucial role in regard to real GDP growth, even though our scenarios alter it only moderately from current values (+/- 0.3 percentage points relative to the current growth rate for the EU 27).

Under the Tipping Point scenario, European real GDP increases by €460 bn in the year 2025, of which €58 bn is attributable to FI PPP+. This is €10 bn more than in the Realistic scenario.

Under the Slow Motion scenario, European real GDP decreases by €570 bn in the year 2025; nonetheless, an increase of €37 bn is attributable to FI PPP+. Thus, in the Slow Motion scenario and leaving aside the effects of the economic downturn on the broader economy, FI PPP+ generates €11 bn less in terms of benefits to real GDP than in the Realistic scenario.

5.3.2 The economic impacts are driven by productivity effects

FI PPP+ is expected to stimulate investment behaviour, private household purchases of goods and services, and (labour) productivity. Figure 5-5 displays the relative weight of each of these drivers of GDP growth in the Realistic scenario.

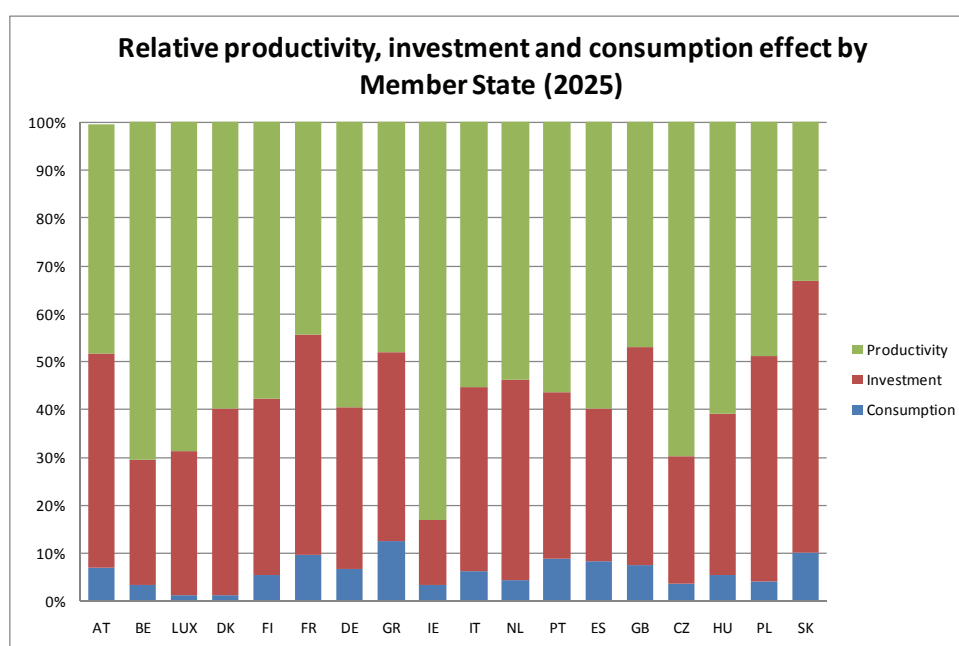


Figure 5-5. Relative weight of effects of the FI PPP+ on real GDP attributable to “pushes” in household consumption, investment and productivity (2025), by Member State.⁶²

Source: WIK-Consult and GWS

The results are similar to those for the current FI PPP (see Section 5.2). In most countries, productivity gains play a preeminent role in the growth of real GDP.

Employment effects of FI PPP+ are potentially larger than for FI PPP

The overall annual employment effects are significantly higher than under the current FI PPP; however, the drivers are similar and so the curves have similar shapes, although the effects develop somewhat later. Employment grows until 2017, then falls as real wages rise. Growth in employment reaches its maximum after 2025.

As before, the explanation is that employment is driven by production and by the real wage rate. Higher production means more employment but a rise in productivity raises the real wage rate, which diminishes employment. After 2025, the effects of FI PPP+ are assumed to be expended, thus there is no further rise in the real wage rate and the higher level of production against the baseline dominates.

The additional employment effect in the Tipping Point scenario is equal to more than 88,000 jobs in the year 2025, which is again higher than in the Realistic scenario. Not surprisingly, the annual employment effect in the Slow Motion scenario is negative: 16,000 jobs lost in the year 2025.

⁶² Sweden is omitted from the graph because anomalies in the Swedish economy lead to results here that are not cross-comparable with the other countries.

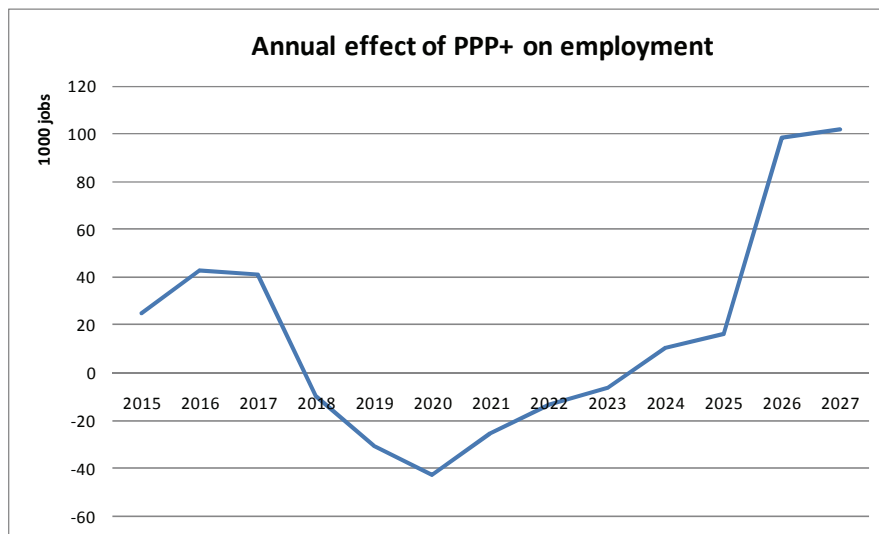


Figure 5-6. Overall impact of the FI PPP+ on European employment.

Source: WIK-Consult

Europe has many reasons to seek a rapid recovery from the ongoing financial crisis. Future Internet may not be the first reason that comes to mind for most people, but it is not an insignificant factor. It appears that European policy could improve the positive impacts of a FI PPP+ program if it manages to improve the expectations of investors about the prospects and coherence of the European economy. Conversely, should it fail to do so, the effects of FI PPP+ could be significantly worsened.⁶³

⁶³ There are, of course, other complementary policy actions that could also be considered. See the discussion on barriers in Chapter 7.

CHAPTER 6 **The European Internet industry and Future Internet PPP in a global context**

Previous chapters addressed the future contribution of the Internet industry to the European economy and society and the potential impact of a Future Internet PPP. What does this mean for the position of the European Internet industry in the global context?

In this chapter we analyse Europe's competitiveness in the context of the global Internet industry and in particular vis-à-vis the US, Japan, China, and India. We illustrate that, according to recent studies, there are differences in the contribution of the Internet to economic growth in different countries. Although some EU countries are frontrunners, American companies dominate the global Internet industry. The potential for productivity improvements in Europe is huge, but the analysis suggests that there are shortcomings compared to other hemispheres. Internet-related investments have been higher in the US, and they have generated more productivity growth than in Europe. The chapter summarises some of the causes for this productivity gap from the literature and estimates the effect of a PPP-like investment in other regions of the world.

6.1 **Some Member States do well internationally, but the EU does not have many global players**

There is overwhelming evidence that the Internet has made a significant impact on developed economies.

OECD figures suggest that the Internet contributed an average of 20% to GDP growth in mature countries between 2004 and 2009, and several recent studies conclude that the economies of a number of European countries have benefited substantially from the Internet. McKinsey Global Institute's estimates suggest that the contribution of the Internet to national GDP in UK and Sweden was 5.4% and 6.3%, respectively. In terms of their contribution to economic growth, these EU Member States have outpaced other frontrunners such as the US (3.8%), Japan (4.0%) and South Korea (4.6%) (Pélissié du Rausas *et al.*, 2011).

However, as Chapter 2 concluded, the Internet industry of Europe as a whole does not demonstrate strong global competitiveness. Very few European firms play an international role across the specific segments of the Internet industry. Of the 500 largest companies of the world in 2011 (as measured by market capitalization), 73 companies are involved in sectors that can be considered part of the Internet industry (Financial Times 2011). Only

15 of them have their headquarters in Europe, with most being traditional telecom companies in the fixed link and mobile telecommunications category (see Chapter 2). The United States hosts the large majority of global leaders in the Internet industry.

Table 6-1. World's biggest players in the global Internet industry

Segment in FT500	Number of companies	Number of companies with EU headquarters	Companies
Fixed link and mobile telecommunications	29	9	Vodafone, Telefonica, Deutsche Telekom, France Telecom are among the top 10 companies
Media	13	3	Two European players are involved in network operation: Vivendi (rank 6) and BskyB (rank 10) ⁶⁴
Software and computer services	12	1	SAP
Technology hardware and equipment	19	2	Ericsson (rank 10), Nokia (rank 13)

Source: IDC, 2011 (Cattaneo *et al.* 2011)

6.2 BRIC economies have yet to reap the full potential of the Internet

According to the OECD, high-growth BRIC economies have yet to reap the full potential of the Internet, with it making an average contribution of approximately 3% percent in India, China, Brazil and Russia. Similarly, the McKinsey Global Institute estimated that the contribution of the Internet to GDP is substantial in China and India (2.6% and 3.2%, respectively), but less than that in the front-runners (Pélissier du Rausas *et al.*, 2011).⁶⁵

As to the sources of the contribution of the Internet to a country's GDP the McKinsey study suggests that in developed economies, a large portion comes from private consumption. In contrast, the majority of the contribution to GDP in China and India comes from foreign trade, with net foreign trade making up 39% and 47% of the Internet's contribution to GDP, respectively. Indeed, India accounts for two thirds of all IT services imports into developed countries from developing countries (Pélissier du Rausas *et al.*, 2011). In the future, this picture might of course change as the structure of these economies shifts towards Internet-enabled services.

⁶⁴ The other company is Reed Elsevier, which according to our definition is not part of the European Internet industry.

⁶⁵ The contribution of the Internet to GDP is estimated in Sweden at 6.3 %, in the UK at 5.4 %, in South Korea at 4.6 %, in Japan at 4.0 % and in the USA at 3.8 %.

All of this suggests that stimulus programmes for the Internet in India and China might tend to have a more pronounced effect through the vector of foreign trade than similar stimulus programmes in the EU, the US, or Japan. Indeed, existing programmes in the Indian city of Bangalore (which accounts for more than one third of Indian IT services exports) have focused on ensuring access to capital, access to skilled university graduates, and complementary measures such as favourable tax rates and subsidised rates for electricity, all with an eye to facilitating exports (*ibid*).

6.3 **Internet-related investments have generated more productivity growth in the US than in Europe**

In its analysis of the economic impacts of the Single Digital Market, Copenhagen Economics (2010) argues there are three reasons why returns from ICT in Europe are lower than in the US: differences in the provision of infrastructure; inappropriate regulation in Member States; and fragmented markets between Member States.

The literature suggests that the different costs and returns to investment in Internet-related innovation are the most plausible explanation for differences in Internet-related effects across countries.

Several studies suggest that ICT investment, production and use have generated less productivity growth in Europe than in the US. The US and Europe had similar levels of ICT investment in the early 1990s, but the US outpaced Europe during the 1990s and early 2000s. By 2007, ICT capital stock in the US was worth about 30% of its GDP, compared to approximately 20% in many European countries (Oxford Economics, 2011). This is attributed in part to stagnating productivity in Europe's ICT-using sectors (Van Ark 2003; Van Reenen *et al.*, 2008). Van Ark *et al.* (2008) empirically showed that this productivity gap between the US and Europe is due to differences in the direct effects from investments in ICTs and changes in labour composition, largely caused by an increased demand for skilled workers.

To interpret these differences, it is necessary to distinguish the drivers of ICT adoption from their impacts. ICTs are generally seen as complementary to skilled labour, but a substitute for unskilled labour (Card and DiNardo, 2002). Therefore, economies with mature ICT-enabled markets and abundant supplies of e-skilled labour are more likely to see sustained productivity increases. Empirical evidence supports this. ICTs and skilled labour have increased together, but labour's share of value added has only sustained its increases in the US Financial and Business Services sector (Jorgenson *et al.*, 2010).

Other studies suggest that Europe's investment and regulatory climate does not foster innovation. This may have created barriers to the international competitiveness of the European Internet industry, including inflexibility and relatively high levels of regulation, fragmentation of labour and product markets, deficient venture capital markets, and lagging investment in organisational capital (Aho *et al.*, 2006; Cave *et al.*, 2008; Cave *et al.*, 2010).

A recent BCG report (Dean and Zwillenberg, 2011) explains differences across countries according to some of the enablers of Internet-related growth: infrastructure (how well built is the infrastructure and how available is access?); expenditure (how much money is spent

on online retail and advertising?); and engagement (how actively are business, governments and consumers embracing the Internet?). While a number of European countries are doing relatively well in these rankings, for example Denmark, the Netherlands, Luxembourg, Sweden and UK, it is the performance of the EU across the board that is lagging behind international players such as the US, Japan and South Korea.

However, an important aspect of the European Internet industry's global competitiveness is determined by its role in international trade. WTO statistics, show that the EU is a very strong actor in international trade of Internet-related goods and services.⁶⁶ This includes not only intra-EU trade, but also and in particular trade with countries outside the EU 27.⁶⁷

For example, the EU is by far the biggest exporter of computer and information services in the world, at more than US \$100 bn per year. Slightly under 60% of this amount is export between European Member States, the rest is exported to countries outside the EU 27. The EU is followed by India with approximately \$30 bn per year (see Table 6-2).

The EU also leads the world in imports of computer and information services. Indeed, the European Union imports a respective service volume of more than US \$50 bn, of which slightly under one third are imports from outside EU27 countries. The US accounts for a significantly lower import volume (just above US \$19 bn). All other major importers, like Japan, China, Brazil, Canada and India, have substantially lower computer and information services import volumes (each country far less than US \$5 bn).⁶⁸ In the Office and Telecom equipment segment, the EU follows China as the biggest exporter in the world, with the vast majority of exports to other EU countries.

⁶⁶ We focus here on the two segments "computer and information services" and "office and telecom equipment."

⁶⁷ Of course the WTO statistics are not entirely consistent with our demarcation of the Internet industry segments. Yet, we believe that the two segments provide reasonable approximations at least to parts of the Internet industry. The WTO statistic also comprises import and export entries regarding "telecommunications services". We have, however, decided not to use this specific statistic as it is to a large degree addressing telephony based services, i.e. services that are by definition not Internet related. See United Nations *et al.*, (2002 p.40).

⁶⁸ For a more detailed analysis of the ICT markets of Brazil, China and India see Simon (2011).

Table 6-2. Leading exporters and importers of 1) office and telecom equipment; and 2) computer and information services, 2010

<i>Billion dollars</i>	1. Office and telecom equipment*		2. Computer and information services**	
	Export	Import	Export	Import
China	449	278	9.256	2.965
European Union (27)	364	516	107.226	52.132
extra-EU (27) exports	101	253	46.736	18.556
Hong Kong	173	182	-	-
domestic exports/ retained imports	2	11	-	-
re-exports	171	-	-	-
United States	135	285	13.830	19.032
Korea, Republic of	97	48	-	-
Japan	93	82	-	3.575
India	-	-	33.807***	2.531

Source: WTO (2011)

Notes: *The computer and information services category particularly includes "database services and related computer services to access and manipulate data provided by database servers" (*ibid* p. 47). **Only top-10 exporters and importers are included. Countries with an "-" are not in the top-10. *** 2009 data.

6.4 Potential effects of a programme similar to FI PPP on the economies of the USA and Japan

Whatever Europe does regarding the Future Internet will not occur in a global vacuum. Other advanced economies are undertaking their own FI initiatives.

Three main effects must be considered, (1) the direct impact on the domestic economy of the country or region which implements the programme; (2) the effect on exports, and (3) the effect on imports.

A programme such as FI PPP potentially strengthens the economy within the region where it is implemented, as explained in Chapter 5. Notably, it can serve to increase real GDP. If an initiative equivalent to FI PPP were implemented in the US or Japan, however, it might have a significantly different effect than its counterpart in Europe for a variety of reasons, not least because industry and private households in countries like the US and Japan tend to take up ICT innovation more rapidly.

In addition, a programme such as FI PPP affects foreign trade in two different ways:

- Exports from the country or region which implements the programme tend to increase because of improved competitiveness across all sectors, which is negative for the GDP of other countries.
- Imports into the country or region which implements the programme also tend to increase because of higher production in relevant sectors, which is positive for the GDP of other countries with relevant exports.

The net effect of changes in foreign trade on GDP in the country or region which implements the programme depends on the relative strength of the two drivers.

The macroeconomic analysis in Chapter 1 showed that the PPP might contribute to enhancing Europe's real GDP, and enhance Europe's ability to compete internationally. The same tools can be used to estimate the effects that an equivalent stimulus applied to productivity, investment and consumption would have on the US or Japanese economy.

Figure 6-1 illustrates the estimated impact on real GDP in the US, Japan or the EU if a PPP-equivalent initiative were to be implemented there, based on the same macroeconomic analysis that was described in Chapter 5, and taking trade effects into account.

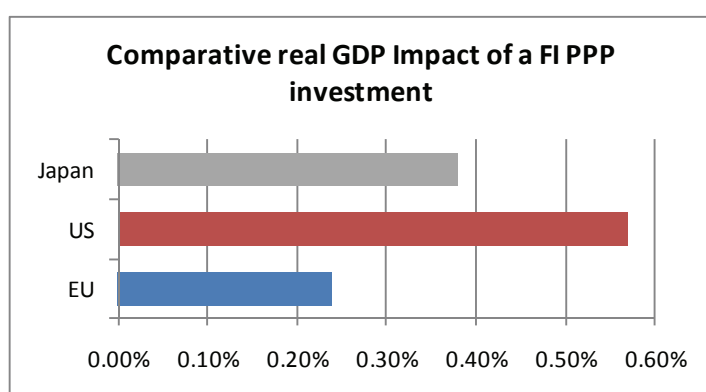


Figure 6-1. Real GDP impact in Japan, US and EU at peak in 2020 of FI PPP equivalent programmes

Source: WIK-Consult and GWS

This shows that a stimulus proportionately similar to FI PPP in the US or in Japan would have larger multiplier effects on real GDP than the equivalent stimulus in the EU. This probably reflects Europe's relatively more fragmented and rigid markets, as well as barriers to innovation and to the adoption and diffusion of ICT-related goods and services, both of which have been long-standing European concerns. The results are consistent with other analyses suggesting that Europe is less able to convert R&D to productive ICT innovation (Aho *et al.*, 2006; Cave *et al.*, 2008a).

Table 6-3 expands on Figure 6-1, showing the effect that an FI PPP equivalent implemented in only one of the three regions would have on real GDP in the other two. In each case, the largest effect is on the country or region implementing the programme (as shown in the figures on the diagonal, which are highlighted in *italics*), but there are also spillover effects to the other regions through trade effects.

Table 6-3. Real GDP impact in Japan, US and EU showing the effect on foreign trade

FI PPP equivalent	Effect on real GDP		
	In the EU-27	In the USA	In Japan
In the EU-27	0.244	0.01	0.003
In the USA	0.021	0.573	0.047
In Japan	0	0	0.382

That an FI PPP equivalent in Japan would lead to a negligible effect on real GDP in the EU and the US reflects the current realities of exports and imports of relevant goods to and from Japan.⁶⁹

6.5 In sum: global competitiveness of the EU Internet industry

While the Internet contribution to GDP in a number of EU countries is among the international frontrunners, the EU as a whole lags behind its international counterparts in the US and Japan.

In particular, the European Internet industry does not have many global players. Taking market capitalization as a benchmark, the most important market players within the European Internet industry that have a European home market are Internet-related telecommunication providers. In the software and computer services and technology hardware and equipment segments, the large majority of significant players have their home market outside Europe.

The differences in Internet-related effects in Europe vis-à-vis other parts of the world are down to a number of crucial factors, including the stagnating productivity of Europe's ICT-using sectors, market inflexibility, relatively high levels of regulation, fragmentation of labour and product markets, deficient venture capital markets, lagging investment in organisational capital, and an investment and regulatory climate that does not foster innovation.

That said, the EU has a substantial export surplus of internet-related goods and services. Indeed, if we focus on the one hand on "computer and information services" and on the other hand on "office and telecom equipment" the situation is as follows.⁷⁰ As to computer and information services the EU is the largest exporter in the world. India and China also have a substantial export surplus vis-à-vis the rest of the world. Net importers of computer

⁶⁹ In addition to the relative impacts in the US and Japan, it would be preferable to understand those in emerging economies such as China, India, and Brazil. However, the data availability for these countries does not allow for a macro-economic assessment using the GINFORS model.

⁷⁰ In 2010 the size of the trade in computer and information *services* is still significantly lower than the size of the trade in office and telecom *equipment*.

and information services include the US and Japan. For office and telecom equipment, the EU, the US and Hong Kong are net importers whereas China and Japan are both net exporters. India is among neither the top 15 exporters of office and telecom equipment in the world, nor the top 15 importers.

Our empirical estimates suggest that, if the US or Japan had the same proportionate stimulus as FI PPP, the multiplier effects on real GDP would be higher in these countries than in the EU. Yet, this is not a normative result which necessarily is valid forever. Investment in FI PPP and its successor might have greater positive effects if Europe had a more dynamic economy than it has. Political and business decisions might therefore contribute to ameliorate this situation. The extent to which the stakeholders in the European Internet industry are able to address the challenges will determine whether the potential can be realised.

There are particular sectors/areas where EU could still have realistic prospects of gaining competitiveness (e.g. use cases). The B2B market, for example, has been under-emphasised and there may be considerable unexploited potential in this market. However, opportunities need to be considered from both macro- and micro-economic perspectives. The potential for productivity improvements is huge, but the extent to which players can address challenges will determine whether the potential can be realised (this is discussed in the barriers section).

Europe dominates the IP used to start some parts of the Internet value chain (e.g. high-tech devices used to create smart infrastructures, photovoltaics, etc.) and is one of the biggest consumers at the end of the chain (especially for such innovative pilots), but captures disproportionately small amounts of value from its investments. Addressing skills gaps, including retention of highly-skilled labour, will be critical to capturing more value.

Strengthening Europe's market position also calls for reflection on government interventions associated with austerity and those that might provide the needed stimulus.

CHAPTER 7 **Barriers to the competitiveness of the European Internet industry**

The benefits of Future Internet development are potentially limited by barriers to Europe's competitiveness. We use Michael Porter's⁷¹ definition of "external" competitiveness in terms of, for example, productivity, which "allows a nation to support high wages, a strong currency, and attractive returns to capital—and with them a high standard of living." (Porter *et al.*, 2006). This perspective is reflected in the annual European Competitiveness Report (European Commission 2011d), which acknowledges that:

"A competitive economy (...) raises living standards sustainably and provides access to jobs for people who want to work. At the roots of competitiveness are the institutional and microeconomic policy arrangements that create conditions under which businesses can emerge and thrive, and individual creativity and effort are rewarded."

To put this into context, it is important to note that Porter's perspective focuses on the productivity of a region as a means to an end. To reach that end, it is necessary for firms operating in that region to be competitive—to employ resources (including human and knowledge capital) and to achieve and defend a profitable market position (in terms of share and margins) at home and abroad. The resulting economic returns, in the form of profits and reasonable wages, must then be "embedded" in the region; this is where policy comes in.

The process is not linear or simple, and policies that enhance productivity do not automatically promote competitiveness. In globalised sectors, and particularly the Internet economy,⁷² firms can: increase profits (though the exercise of market power) at the expense of reduced economic surplus; use global input markets to bid down input costs (including wages); and export profits away from the areas whose resources were used to generate them.

This chapter identifies barriers to competitiveness based on the analysis in previous chapters and a literature review.⁷³ For each barrier, we examine its relationship to the

⁷¹ Porter's "paradigms" regarding competitiveness include the "five forces of competitive position", the "five-fold classification of industries" and the "diamond" list of competitive factors. See: Porter (1980; 1985a; 1985b).

⁷² Where physical limitations on the mobility of inputs and outputs may be almost non-existent.

⁷³ There is a well-established body of literature on barriers to the competitiveness of the European ICT industry, of which the European Internet industry is a subset (for example: Aho *et al.*, 2006; Indepen 2006;

Future Internet PPP and identify the key actions needed to reduce the adverse impacts of the barriers. A detailed description of each of the barriers, including its nature, economic and/or societal costs, and the extent of the barrier in different scenarios, is provided in Appendix A, which is published as a separate document.⁷⁴

The vast majority of barriers analysed are particularly relevant for SMEs and start-ups, which are highlighted in this chapter. We recognise that both types of company drive the dynamics for innovation, hold the key to job creation, and are generally considered as engines for economic growth. While the barriers may impact on these two groups differently in practice, the underlying analysis is essentially the same. We also differentiate between the established, “traditional” incumbents and new(er) arrivals. This is reflected in the detailed analysis published in Appendix A.

Neither the recognition of these barriers nor the need for collective action are unique to the Future Internet area; the same barriers are also addressed by other policy actions and initiatives already underway or in preparation. For reasons of space and focus, we do not analyse them in detail in this report. However, we do discuss, at the end of the Chapter, the relation between the actions discussed here and those other initiatives, and of the overarching role of the different major stakeholders.

We group the barriers to competitiveness into three areas:

- Inadequate access to inputs of sufficient quantity and quality;
- Obstacles to innovation;
- Barriers to effective market competition and cooperation.

The three categories are broken down into more specific barriers (see Table 7-1) Taken together, these barriers can interfere with the mechanisms by which the Future Internet and activities conducted over it contribute to the productivity of the European Economy and progress towards meeting its societal challenges.

Jorgenson and Vu 2007; Cave *et al.*, 2008). These barriers typically fall under the headings of (1) market fragmentation, (2) regulatory barriers that raise costs, slow competitive responses and inhibit cross-border services and (3) insufficient risk capital for start-ups. A recent study (Copenhagen Economics 2010) finds three broad categories of barriers regarding the Digital Single Market (DSM): (1) fragmentation of the EU legal system, meaning that suppliers have to adapt their business models to different Member States; (2) differences in culture, meaning that suppliers have to offer differentiated products and services to meet a wider variety of preferences and demands; and (3) lack of consumer protection and more generally trust, meaning that suppliers have to try even harder to do business on the Internet.

⁷⁴ Appendix A: Barriers to the competitiveness of the European Internet industry. Available online at: www.fi3p.eu

Table 7-1. Summary of barriers and their importance in the three scenarios

Barrier	Description
Access to inputs	
Insufficient trained labour	Insufficient supply of relevant competencies, knowledge and experience for work and digital life; R&D personnel
Insufficient flexibility of labour	Regional imbalances in the labour market, impediments to migration
Insufficient access to financial capital	Amount, format of risk capital and business development support for SMEs/start-ups; lack of capital for investments in ultra-high broadband network infrastructure
Obstacles to innovation	
Insufficient R&D investment	Ability and incentive to invest in R&D
Limitations regarding the size of a company and its home market	Ability of SMEs/start-ups to locate external partners, merge activities; size of, vested interests in the home market
Impediments to cooperation between the Internet industry and other industries	Structural barriers (e.g. incumbents seeking to preserve rents, slow entry); policy-based barriers (e.g. sector-specific regulations); different corporate cultures
Infringements of Intellectual Property Rights	Diversity in and lack of effective protection of knowledge capital
Effective market competition and cooperation	
Economic barriers	
Protectionism	National/regional exclusionary practices
Incumbent dominance	Regional, layer (telco, IT, platform, business service) monoliths
Entry, interoperability barriers	Includes technology, standardisation, business model, contractual barriers
Demand side barriers	Lock-in, attitudes to new technology, trust
Cultural barriers	Language, resistance to social/business model change
Legal barriers	
Licensing etc.	Licensing, authorisation, registration (<i>ex ante</i> regulation)
Privacy, security	Privacy, data protection, security (internal and external)
IPR	Copyrights, industrial property, alternatives
Standards	Legal participation, co-regulation, openness, interoperability, speed
Financial regulation	Access to capital, globalisation, machine trading

The following sections present the individual barriers and key actions towards overcoming them, their implementation and likely impact. We also describe the relationship of each barrier with the Future Internet PPP—how the barrier may affect the success of the PPP, how the PPP itself is likely to affect the barrier, and the potential effects and impacts of these barriers if the PPP were not in place. In order to substantiate the analysis, we examine the barriers in an indicative number of use case sectors represented in Phase 1 of the Future Internet PPP (food and agriculture, environment, energy, and transport and logistics), as well as the FI-WARE project developing the core technology foundation.

As noted above, the barriers may be removed in other ways, or may resist removal by policy action; some of the barriers (e.g. access to suitable skills and capital or innovation-friendliness) have resisted solution for a long time. Our analysis of the Internet Economy and the FI PPP actions suggests, however, that pursuing these actions in conjunction with the deployment of the FI PPP outputs may: improve uptake of e.g. the generic enablers; increase the effectiveness of the policy actions; and encourage financiers, workers, collaborators and other third-parties to help in addressing the barriers, by demonstrating that Europe has done ‘all it can’ to demonstrate continuing commitment to removal of these barriers and to ensuring that their removal will advance shared policy objectives.

7.1 **Insufficient access to inputs**

Input availability issues concern the amount, quality, location and flexibility of a range of inputs. Because these inputs are used in combination, the issues are related; for instance, shortfalls in human capital may be partially overcome by substituting financial capital (e.g. by licensing intellectual property or hiring in skilled labour from outside the EU). Similarly, locational imbalances between job opportunities, skilled labour and financial capital can be addressed by relocating jobs (by firm mobility or tele-working) or labour mobility (moving the workers to the jobs); the capacity to do this will depend in turn on the adequacy of high-speed communications connections linking the firm, its workers and (in some cases) its customers.

Another overarching consideration concerns the origin of input demands. In this section, we adopt a requirements-led or (end-user) demand pull approach—how can the inputs needed to deliver productivity-enhancing services best be made available?⁷⁵

7.1.1 **Insufficient quantity of trained labour**

The future development of new applications, services and custom tailored solutions in the European Internet industry requires skilled workers with specific competencies, knowledge and experience. The analysis in Chapter 2 suggests that appropriate eSkills, notably ICT business innovation skills to address vertical markets and domain-specific business needs, are especially critical for the European Internet software and IT services industry.

The supply of knowledge and skills is already addressed by a range of initiatives aligned with existing Information Society policy, for example Action 57 of the DAE, which prioritises digital literacy and competences for the European Social Fund. The recent draft

⁷⁵ A converse approach is based on a generalised skills audit—how can the available inputs best be used to create and satisfy end-user preferences?

ESF Regulation (European Commission 2011b) specifically emphasises investment in education, skills and lifelong learning. This is potentially reinforced by the economic recession, which reduces the opportunity cost of pursuing further education and, in many countries, increases public commitment to formal and informal skills acquisition and to improved job-matching policies. Against this backdrop, further actions may include some or all of those listed in Table 7-2.

Table 7-2. Potential actions to address this barrier

Actions	
1	<p>Changes to formal education</p> <p>At School level, support the further development of pupils' and teachers' basic skills and qualifications relevant for the Internet industry. Meet information requirements and increase pupil interest by reinforcing transferable and work-related aspects of education-related ICT skills training and the extent to which training builds on and contributes to societal use of such skills. Specific measures such as internships, hands-on development and training schemes and active mentoring could be put in place through cooperation between education institutions and individual firms.</p> <p>At University level, the objective is to build expertise/skills combining ICT knowledge and domain (sector) specific knowledge. As with schools, an emphasis on computer programming and the use of innovative or advanced ICT capabilities (e.g. delivered over the cloud) in project work and internships would be beneficial, improving the employability of a group (indeed, a generation) currently facing a particularly difficult transition to productive working life. In a mid- and longer term perspective, this might also serve as an instrument to overcome "stovepipe" thinking and organisation across the different sectors of the economy.</p> <p>Intended economic and societal impacts: improved employability and productivity; greater engagement with work; closer integration between ICT skills and other knowledge domains</p> <p>Implementation requirements: revision of curriculum, assessment methods; upgrading teacher skills/partnership with industry</p> <p>Actors: European Commission and Member States</p>
2	<p>Stimulate participation of under-represented groups:</p> <ul style="list-style-type: none"> • Female labour force participation: Action 60 of the DAE focuses on increasing the participation of women in the ICT workforce. We underline the importance of developing and implementing targeted approaches to increase the participation of women in education and employment in areas relevant for the Internet industry (enabling them to meet family and job requirements in parallel). Indeed, advanced Internet services that enable women to combine work and family life in innovative ways will in turn strengthen their incentives to acquire, exploit and extend their skills, and will drive the refinement of work-life balancing applications that can ultimately benefit other groups (e.g. ageing workers) as well. • The ageing workforce: it is well-recognised that the demographic shift is making an extension of working life both inevitable (on economic grounds) and desirable (on welfare and societal grounds). The need to control retirement costs in the face of increasing life-spans and the fiscal weakness of public and private pension and healthcare arrangements are pushing up mandatory retirement ages, but many elderly people likewise find themselves involuntarily unemployed⁷⁶, or employed in jobs that do not make the best use of their skills and experience or provide satisfactory working conditions⁷⁷. The participation of older people in the labour force can be enhanced by initiatives that improve the skills and qualifications of older employees, which could meet general market demands for skilled and experienced workers, and also improve the quality and cost-effectiveness of services specifically demanded by this increasing proportion of the European population. More generally, there is scope for supporting businesses and community activities to foster use of assistive and other ICT-supported technologies, to make use of the skills and knowledge possessed by these workers and to facilitate the process of gradual retirement. • Persons with disabilities: Action 65 of the DAE draws attention to the productivity and inclusion costs of the restricted employment prospects of individuals with disabilities, which persist despite the lack of

⁷⁶ Increasing the mandatory retirement age in Austria increased employment by 7% for men and 10% for women, but increased the unemployment rate by 10% for men and 11% for women (Staubli and Zweimuller 2011).

⁷⁷ The recession has had two effects: a reduction in labour demand (particularly for higher-paid older workers, and a reduction in asset values (and hence the value of retirement provision). The net effect is a reduction in demand relative to supply, so jobs are more likely to be low-paid or part-time. Arpaia *et al.*, 2009 and Disney *et al.*, 2011)

	<p>correlation between many disabilities and productivity in Internet sector jobs and the development of a range of assistive technologies. This problem can be overcome by targeted programmes to deploy these technologies (e.g. via employer subsidies), both to overcome the initial investment hurdle and to break down psychological and social barriers on both sides.</p> <ul style="list-style-type: none"> • <i>Younger workers</i>: people entering the job market face particularly challenging conditions, and may need the flexibility to change jobs by acquiring new skills, or by repurposing their existing skills to fit locally available employment opportunities. This flexibility can be enhanced by initiatives to strengthen on-going post-formal learning, regulatory and benefit measures to protect workers seeking retraining, and support for the transition costs of firms seeking to change job configurations, skill mix and/or service delivery models to fit local labour supply. Initiatives supporting the human capital conversion costs of business change can be undertaken on a regional as well as an individual firm basis. <p>Intended economic and societal impacts: Increased labour market flexibility, productivity and employment levels; reduced social costs of unemployment and underemployment; reduced burdens associated with an ageing society.</p> <p>Implementation requirements: targeted support programmes aimed at vulnerable groups; public e-services to increase employability, reduce costs of combining work with family life and facilitate part-time employment.</p> <p>Actors: European Commission and Member States, employers</p>
3	<p><i>International benchmarking</i></p> <p>If European competitiveness on a global front is to be reinforced through skills availability, or if developments elsewhere are to be effectively adapted to the European context, it is necessary to have reliable, useful and detailed information about skill movements and productivity⁷⁸. This should not be based solely on counting personnel with specific credentials; productivity, especially in the Internet-based economy, is the result of applying a broad range of skills through flexible job configurations, organisational forms and business models. Therefore, efforts should be made to monitor these elements and to track the career paths of skilled and unskilled workers over time, across countries and through different jobs.</p> <p>Intended economic and societal impacts: better targeted and more efficient labour policies; greater mobility and labour productivity; higher levels of employment; reduced cultural backlash to economic migration.</p> <p>Implementation requirements: expansion of longitudinal surveys of workers and employers, international collaboration to develop consistent indicators.</p> <p>Actors: European Commission, national statistical offices.</p>
4	<p><i>Immigration policy</i></p> <p>The brain drain issue cuts both ways; Europe is an important source of education and skills acquisition for students from around the world, including many countries that are, or soon will be, potent global rivals. It certainly does not follow that Europe should refuse to provide such training or restrict immigration of skilled workers across the board; rather, it should follow the example of other advanced economies by ensuring that its immigration policies optimise the benefits of migration to all parties concerned. This includes facilitating the inward migration of skilled workers and providing opportunities for those educated here to seek employment after graduation.</p> <p>The EU Blue Card system is a step in the right direction (See: Council of the European Union 2009). It is too soon to assess its effectiveness, but it is evident that the alternative may involve the offshoring of skilled jobs rather than their reallocation to European nationals, especially for jobs in the global Internet economy.</p> <p>The education of foreign students is an important element of European higher education from both a financial and a substantive point of view. Moreover, with the increasing mobility of highly-skilled workers, Europe needs to provide the conditions they find most attractive (including flexible markets, access to capital, etc. for instance via the European Research Council for the scientific domain). Another solution is to transform the brain drain into brain "circulation" by systematically reinforcing both inward and outward migration (as has been successfully accomplished within the EU by the Marie Curie programme, for example [cf. Action 6]).</p> <p>Intended economic and societal impacts: Greater labour mobility and productivity; some risk of job displacement; more sustainable public education system; reduced levels of illegal economic migration.</p> <p>Implementation requirements: Changes to immigration law, improved funding for R&D and innovation, support for mobility of innovators as well as researchers (extension of existing EC programmes).</p> <p>Actors: European Commission, European Parliament and Member States</p>

⁷⁸ The need for better data has been noted by many researchers; particularly relevant here is the discussion in the OECD International Migration Outlook 2011.

Relationship to the Future Internet PPP

It is assumed that the organisations involved in the current set of projects comprising the Future Internet PPP have the skills needed for successful implementation of the project plans. Any shortfalls are expected to be met by the recruitment of additional partners via Open Calls, for which notably the FI-WARE Project (developing the Core Platform) has reserved a substantial budget.

While training has been an important element of traditional Integrated Projects within the EU Research Framework programme since FP6, this does not apply to the PPP projects. This raises a general question as to the dependence of the envisaged impacts of the PPP on the availability of specialist ICT skills (e.g. software engineering and business process design and management) beyond the organisations participating in the programme. Moreover, to benefit fully from novel business models enabled by the technological outcomes of the PPP, business innovation skills must be readily available and easy to acquire and deploy. Some use case projects straddle multiple industrial sectors; rolling out their results therefore requires a combination of knowledge and know-how across industrial sectors and ICT disciplines as well as deep domain expertise. Insofar as FI PPP results are meant to scale up and lead to extensive uptake, the labour market might struggle to fill the skills pools for ICT and, in particular, for smart application areas, especially in view of the relatively ambitious timeframe during which the PPP seeks to close the gap between research and implementation in the market (three to five years from project commencement).

Conversely, however, the Future Internet PPP provides a unique opportunity for the European Internet industry as a whole to focus attention on concrete actions to foster and cultivate both additional and new skills in key and high value application contexts.

7.1.2 Insufficient flexibility of labour

Even if adequate skills exist, firms in the European Internet industry may not be able to hire the workers they need at the right locations. Geographical asymmetries of labour demand (in particular by specialised SMEs, which tend to be localised) within the Internet industry and other sectors will in all likelihood increase. This is a particular problem where local labour demand exceeds supply, but where it is difficult to match human capital with new or regionally-diverse skill needs, as will inevitably happen with SME-based (hence localised) business model and service innovation that characterises the Tipping Point scenario.

The objectives of the recent draft ESF Regulation (European Commission 2011b) include promoting employment and supporting labour mobility. Against this backdrop, actions to reduce the barrier may include some or all of those in Table 7-3.

Relationship to the Future Internet PPP

This barrier is linked to broad labour policy and access or availability of trained labour (Section 7.1.1). Future Internet development is likely to increase economic dependence on transferability and adaptability of skills. Some smart infrastructure usage areas are very localised (for example content, smart cities or safe cities) or subject to regional variations (e.g. logistics, farming, and environment). Recent external developments, for example “hyperlocal media” platforms to support creative industry clusters, take this localism even further, increasing the need for labour mobility to meet changing requirements as usage

areas develop. More generally, labour mobility provides an overall uplift to knowledge transfer, collaboration and networking across value chains, which in turn underpin the Future Internet PPP as a whole and are crucial for cohesion and integration at the programme level. Labour flexibility and mobility are also necessary for creating European scale markets for PPP results.

One interesting possibility is the potential at programme level of encouraging the development of centres of expertise for individual application areas and ICT competencies by strategic allocation of project funding across institutions and participating countries/regions. This could lead clusters that produce the right mix of (local) cooperation and (regional or European) competition to form, and even induce competition among Member States or regions to attract such clusters. Member States could cooperate in the framework of the Future Internet Forum to generate a diversified and world-class portfolio of clusters, a mix identified by Porter as an essential precursor to the development of services and business models capable of competing successfully in wider markets.

Table 7-3. Potential actions to address this barrier

Actions	
5	<p><i>Matching workers to jobs</i></p> <p>This comprises a series of related initiatives to resolve difficulties in finding suitable workers and/or jobs and in moving to take them up.</p> <p>Finding new workers or jobs: Support for programs and innovative services to improve the knowledge base of would-be migrants. Such programs might include language improvement, increasing familiarity with the legal, organisational, administrative conditions and requirements in the target country, brokerage facilities to match workers with jobs on a wider geographic basis, facilitating accommodation and exchanges, etc.</p> <p>Moving to new jobs: Suitable initiatives to ensure that those moving for employment or working for foreign employers have both familiar processes and sources of information and equivalent rights and responsibilities⁷⁹. This can be complemented by financial measures to facilitate migration for work, where the focus might, for example, be on funding removal costs and other costs to develop the skills needed to work across borders, providing appropriate tax relief to workers and employers, or facilitating access to private funding through loan guarantees.</p> <p>Intended economic and societal impacts: enhanced labour mobility, productivity and employment levels; higher job security and quality; potential for enhanced European citizenship.</p> <p>Implementation requirements: language training, platforms for public information provision, changes in employment law, extension of public labour brokerage programmes, financial support or tax relief for relocation.</p> <p>Actors: European Commission, Member States, Employers</p>
6	<p><i>Facilitating job and/or skill mobility</i></p> <ul style="list-style-type: none"> • Extension of internships: Internships and similar initiatives can be extended to individuals moving from one sector to another, and can be explicitly targeted at supporting e-internships, whereby individuals would not move until they—and their employers—were convinced of the quality of the resulting job match. However, implementing this approach must be carefully tuned to overall labour market conditions. • In the research domain, the highly-successful Marie Curie Actions, which increase the attractiveness of research to young people by supporting the mobility of young researchers (including those from outside Europe), merit further promotion and possible extension in the ICT area, especially in relation to specialised disciplines required for the rollout of FI PPP and possibly even (perhaps through a parallel programme) an extension from scientific research to less formalised forms of innovation. This would have the additional benefit of tending to facilitate business model and service innovations that were pan-European by design. <p>Intended economic and societal impacts: higher skill levels, more secure employment, greater employment and productivity; enhanced effectiveness of regional development and recovery; improved SME access to skills; better match between skills and jobs.</p>

⁷⁹ This does not apply to non-EU workers, of course.

Implementation requirements: funding (wage subsidy) and regulatory changes to support cross-border internships; targeted educational interim and post-graduation job placements; extension of researcher mobility programmes to innovators.
Actors: European Commission, Member States, Employers

7.1.3 Insufficient access to financial capital

Access to venture and expansion capital have played crucial roles throughout the development of the Internet. There is no reason to believe that this dependence will weaken in the future. Two issues are especially relevant: lack of capital for SMEs and start-ups in the Future Internet-based web ecosystem; and lack of capital to create and maintain (ultra-high-speed) broadband network infrastructures.

In the case of ultra-fast broadband infrastructure, a wide range of European and national initiatives support broadband deployment and improving investment conditions. Examples include:

- Planned actions regarding very fast Internet within the frame of the DAE, in particular actions 45 -48;
- The evidence base for new initiatives provided by a multitude of studies identifying overall costs, the main cost drivers, barriers to investment, advantages of cooperation, etc.;
- Regulatory research and actions regarding NGA networks, open access etc.,
- New financial instruments from the EIB; and
- A range of national public, private and public-private initiatives aimed at creating or extending fibre infrastructures.

There is a general tension between preventing financial entities from making uneconomic investments and achieving financing for risky but genuinely promising ventures. Action 7 concerns the dual nature of the capital shortfall barrier. Actions 8-10 address ultra-fast broadband infrastructure investments.

Relationship to the Future Internet PPP

The Future Internet PPP envisages a strong role for SMEs across the initiative, from involvement in technology development to participation in large-scale trial offerings of services and applications, thereby filling a key niche in the Future Internet ecosystems targeted by the initiative (European Commission 2011e). The financial barrier facing SMEs therefore potentially jeopardises the scale and scope of SME involvement in the PPP, given that SMEs must themselves finance 25% of the eligible costs for participation.

Conversely, PPP participation potentially provides SMEs with a head start in gaining a foothold in promising areas of the Future Internet ecosystem, thus improving their chances for accessing financial capital. In this respect, we believe that the ability of the PPP projects to deliver, in a timely fashion, industrial grade technologies and close-to-market solutions with robust and operational prototypes of demonstrated effectiveness is absolutely critical for increasing the attractiveness of SMEs to would-be investors further downstream.

Phase 3 of the Future Internet PPP—the largest in terms of available funding (€130M)—is intended to involve large constituencies of developers in exploiting the generic and specific enablers developed and delivered under the previous phases; many are expected to be

SMEs and/or start-ups. The programme therefore constitutes a valuable source of finance for enabling aspiring SME software and service developers across Europe to develop novel tools and experiment with (new) business models in potentially the brightest segments of the Internet markets (see Section 2.3), at least where access to finance did not prevent their participation in the programme in the first place.

It goes without saying that the success of the Future Internet PPP depends upon the continuous development and rollout of advanced broadband infrastructures in Europe, even if the initiative does not directly contribute to the building of those infrastructures (partnership with the owners and operators of existing infrastructure is envisaged instead for capacity building and infrastructure support). In so far as the focus is on integrating existing infrastructures to support large-scale trials of the application of Core Platform technologies in a variety of industrial sectors, the PPP would serve as a stimulant to further infrastructure investments for prospective growth in usage as well as new patterns and modes of usage.

Table 7-4. Potential actions to address this barrier

Actions	
7	<p><i>Matching investments in service innovation and infrastructure</i> Given the complementarity between SMEs and innovative new services on one side, and high-quality, ubiquitous and high speed infrastructure providers and networks on the other, there is a potential for diversifying risks by supporting balanced portfolios combining both types of investment. Such combined investments could qualify both for public risk capital participation and for purchase by institutional investors whose rules would otherwise prevent investment in the component (SME or infrastructure) assets.</p> <p>Intended economic and societal impacts: Greater alignment of infrastructure with economic development clusters, reduction in price/service barriers to SMEs; greater access to risk capital for SMEs, start-ups and infrastructure expansion.</p> <p>Implementation requirements: reconfiguration of existing financial support, relaxation of (public and institutional investor) rules limiting risky investments in cases of balanced investment.</p> <p>Actors: European public financial institutions, Member States, Private sector</p>
8	<p><i>Funding and regulatory measures to improve capital availability and structure</i> These measures aim to enhance the availability and terms of venture and other capital for SME and start-ups, restructuring, adoption of future Internet services and expansion, and for start-ups relying on or offering advanced Internet services⁸⁰. Specific actions include public participation in underwriting debt capital, loan guarantees or dedicated new instruments.⁸¹ Public value can be enhanced and market distortion avoided by active creation of balanced investment portfolios and targeting support to new competitors with existing firms. Private funding can be improved by</p>

⁸⁰ This is particularly relevant to the European Internet industry, as research shows that start-ups are differentially more likely to introduce innovations compared to existing firms, while the reverse is true for manufacturing (Criscuolo *et al.*, 2012).

⁸¹ We acknowledge the potential competition policy pitfalls involved in public participation; such vehicles would have to be carefully structured to comply with the spirit as well as the letter of State Aid rules. The well-known problems of debt financing can at least be partially offset by for example low-coupon bonds (which minimise the threat of insolvency), offering only long-term finance and pro-active support for enhanced information disclosure to reduce information asymmetry problems.

	<p>regulatory incentives for more interactive, longer-term and risk-tolerant investments e.g. favourable tax treatment for private equity in targeted areas, partial reversal of differential tax shields on debt, a tax on asset sales inversely proportional to the length of time an asset is held⁸² (to prolong investments), or regulatory support (including monitoring and enforcement) for collateralised derivatives and synthetic indices tied to specific Future Internet services.⁸³</p> <p>Intended economic and societal impacts: reduced cost of finance to SMEs and start-ups, more rapid innovation and diffusion of new services, higher levels of competition, faster and more sustainable growth in the Internet economy.</p> <p>Implementation requirements: Changes to the implementation of existing public funding programmes, possible modification of Financial Regulations, tax codes, linkage between ICT, development programmes and financial regulation.</p> <p>Actors: European public, private financial institutions, Member States, Private sector.</p>
9	<p><i>Directly reinforcing universal or near-universal high and ultra-high broadband coverage</i></p> <p>The DAE calls for Member States to “(D)evelop and make operational national broadband plans by 2012 that meet the coverage and speed and take-up targets defined in Europe 2020 using public financing in line with EU competition and State aid rules...”. Against this backdrop, Member States should assess the costs and benefits of universal coverage of high and ultra-high broadband infrastructure, respectively, given the existing network infrastructure in their respective countries. Assessing the costs and comparing them to current and likely future benefits to society as a whole and to infrastructure providers will allow policymakers to assess the case for financial support. Member States should consider direct financial support at least for those areas that are unprofitable for a private investor if the shortfall in revenues is justified by societal benefits and/or as an interim measure where the future commercial potential warrants.⁸⁴ The business case for using such direct support to meet the partial coverage target for ultra-high-speed broadband can be strengthened by aligning it with recovery plans for regional economic reclamation, or by shifting from a grant or loan modality to equity participation in which the infrastructure would be (partially, at least) publicly owned⁸⁵ but private-sector operated. To implement this, Member States should identify those regions within their country in which ultra-high broadband infrastructure deployment is unlikely to be profitable under pure market conditions due to deficient commercial returns or capital market imperfections, and they should calculate the respective overall deficit.⁸⁶ This could be compensated by a regulation-based (internal subsidy or fund-based) subsidy to identified infrastructure supplier(s) or a “pay or play” system, perhaps implemented by a periodic competitive tendering of the right to operate and the obligation to maintain the infrastructure.</p> <p>Intended economic and societal impacts: increased coverage of fast and ultra-high-speed</p>

⁸² As a general policy, this would improve the stability of financial markets by discouraging the more destructive forms of e.g. machine trading and would be better targeted than a flat ‘Tobin tax’ levied on all financial trades, which would tend to lock in unprofitable as well as profitable investments.

⁸³ Such special purpose vehicles could also address the lack of capital for infrastructures closely tied to such services (e.g. ‘data centre derivatives’).

⁸⁴ The extreme case would be if the State steps in and finances the nationwide network infrastructure (as in Australia where the State deploys the infrastructure and owns it at least for a couple of years).

⁸⁵ Thus providing an additional safeguard against foreclosure or departure from ‘net neutrality’.

⁸⁶ Such an approach is implemented in Finland, for example. The (non-) profitability of a region with given population density, topographical conditions, existing network infrastructures etc. can be estimated on the basis of potential revenues and bottom-up deployment costs on the basis of geo-information of buildings, streets, etc..

	<p>broadband, regional advanced-service clusters, increased e-inclusion.</p> <p>Implementation requirements: regional economic analysis of ARPU, potential economic development, change (possible extension of) in universal service regulation, possible infrastructure ownership (reverse PFI), adjustment to State aid rules.</p> <p>Actors: Member States, Private sector.</p>
10	<p><i>Leveraging and restructuring existing public broadband funding</i></p> <p>The recent Connecting Europe Facility has reserved more than €9bn for broadband deployment and Europe-wide digital services. Depending on the costs of deploying infrastructure to currently non-profitable areas, it may be advisable to increase the financial capacity of EU broadband deployment⁸⁷ funds or develop alternative financial vehicles to increase the leverage of available funding.⁸⁸ The EU, national and regional high-speed broadband funds involve varying conditions and practices. The funding schemes could potentially be harmonised. We propose extending Action 43 of the DAE, which aims at reinforcing and rationalising high-speed broadband funding via EU instruments (e.g. ERDF, ERDP, EAFRD, TEN, CIP), to include the Member States and thereby increase coherence and incentive compatibility, and decrease transaction costs, administrative burdens and delay in financing broadband deployment initiatives.</p> <p>Intended economic and societal impacts: more rapid, uniform and joined-up deployment of high-speed broadband networks, greater linkage to complementary EU and Member State initiatives to produce faster, more robust and more evenly-dispersed economic growth.</p> <p>Implementation requirements: As with DAE Action 43, to include an EC/Member State (MS) initiative to agree framework, co-funding and collaborative deployment arrangements.</p> <p>Actors: European Commission, Member States.</p>

7.2 Obstacles to innovation

Innovation is growing in importance for the European economy in general and the Internet industry in particular, and its focus is likely to shift away⁸⁹ from hard technology and infrastructures. This is not simply a matter of spending more on R&D; rather, it reflects a clash of business cultures between the technical parts of the Internet economy (including the ICT and telecommunications industries), which are significantly and rapidly affected by technological innovations on one side, and the service industries served by those technical capabilities on the other.

Innovation in business and service industries proceeds by fits and starts, in a series of niche hotspots and waves of diffusion. Therefore, ICT innovation does not automatically lead to business and service innovation. The FI PPP is designed to balance technology push and application pull; both ends are involved, and their interaction is planned and fundamental. However, the dynamics of this interaction are subject to the same business laws as the market itself; it is difficult to design and develop a supporting technology in the same time-frame as the experience-led definition of use case requirements, especially when the imperatives of implementing and testing the technology pre-empt user control over use

⁸⁷ U.S. Department of Commerce (2012) notes that providing the infrastructure needed to be competitive “will require both additional support by the government and an appropriate policy framework to enable the private sector to build on the government’s support.” Local or regional public-private partnerships can minimise risks via a continuing government stake in the infrastructures and utility regulation or government infrastructure ownership combined with a competitively-assigned private licence to operate the infrastructure.

⁸⁸ Some elements of Action 10 are likely to raise State aid issues. Beyond this legal point, the involvement of public financial support and regulatory changes in boosting the prospects for private sector entities may raise further competition and related issues. As a pragmatic matter, it may be necessary to modify State Aid rules to ensure that they reflect the public good character of suitably regulated broadband infrastructures.

⁸⁹ This may not hold across the board; Europe’s lead in advanced materials and component design is likely to persist, but much of the resulting manufacturing will continue to take place outside the borders of the EU.

cases. In the market, this tension plays out in business turbulence and technological overshoot. The actions explored in this section are designed to help stabilise the linkage between the FI PPP core platform and use case dynamics.

7.2.1 Insufficient investment in innovation

The analysis of the European Internet industry in Chapter 2 points to a fundamental shift in the competitive arena from cost and price to quality (for differentiation) and innovation (for transformation). Value creation in the Internet market is rapidly advancing “up the stack” towards end users and service- and application-based innovation. One potential key consequence is a need to reallocate investment from technology R&D towards new layers of the Internet economy and towards collaborative and notably user-led innovation.

This barrier is not unique to the Internet setting; it has received sustained policy attention at least since the Hampton Court summit and is currently an active focal area of the Innovation Union, the Digital Agenda for Europe and many other initiatives. Particularly important is the Horizon 2020 programme; its holistic approach to the innovation life-cycle should increase the perceived rewards to well thought-out, innovative risk-taking. Additional actions may include improved tax incentives at national level.

Table 7-5. Potential actions to address this barrier

Actions	
11	<p><i>Improved tax incentives (at national level)</i></p> <p>These are illustrated by recent activities in two countries. The US Department of Commerce (2012) calls for “a tax credit for private-sector R&D to give companies appropriate and well-designed incentives to boost innovation above the baseline level that would have been reached absent these incentives”. The UK is about to introduce a “Patent Box” clause to reduce corporation tax on profits generated from UK national patents (see: Dowling 2010). Such direct and indirect R&D investment support could be provided on an overtly countercyclical and pro-competitive basis, e.g. through use of offsets, and extended (if practicable) to cover the full gamut of investment-supported innovative activities rather than R&D in the narrow sense.</p> <p>Intended economic and societal impacts: Increased private-sector innovation investment, faster IP formation, greater innovation-led competition and economic recovery.</p> <p>Implementation requirements: Changes to national tax codes.</p> <p>Actors: Member States</p>

Relationship to the Future Internet PPP

The Future Internet PPP links R&D (in network and communication infrastructures, devices, software, service and media technologies) to experimentation and validation in real application contexts. It builds on results from previous European projects and technologies made available by participating organisations. It is thus an important component of the strategy to rebalance technology-push and application-pull forces, with potentially high impacts.

The success of the PPP therefore depends on how effectively it balances the set of technologies and applications and energises a positively engaged set of participants who can then seed further extension and exploitation throughout the European Internet Industry. It also relies on the additional measures considered here that are aimed at enhancing the readiness of the industry to adopt the fruits of the PPP, engage with the stakeholders and contribute their own innovations, especially in the business and services sectors. This readiness depends on further investments and experiments in promising technological and application areas by incumbents and newcomers alike, including user organisations in

vertical industry segments, who can be engaged through involvement in the early stage of the research lifecycle.

7.2.2 Limitations regarding the size of a company and its home market

This barrier relates to the extent to which the appropriate European Internet industry partners find each other. Even if they fit together, the question remains whether they have the right incentives and internal capabilities to combine previously separate businesses efficiently, integrate innovation and enable technology transfer. If not, can they coordinate effectively on a temporary basis? Do the expected transaction costs favour setting up such an integrated business or flexible network? Limitations to this type of external growth are particularly relevant for would-be partners from different EU countries.

Many aspects of this barrier are already being addressed, not least by the FI PPP itself. Additional actions are listed below.

Relationship to the Future Internet PPP

The Future Internet PPP directly addresses this barrier by mobilising stakeholders across Europe and emphasising large-scale, pan-European trials.

As already mentioned, the PPP aims to produce viable results in the medium term. Organisations and projects involved in the PPP are meant to pro-actively collaborate, manage their dependencies and synchronise their activities under common and coordination structures. Horizontal business models of (re-) usable results cutting across usage areas and national markets are among the expected outcomes of the PPP.

In other words, the Future Internet PPP seeks to mitigate the effects of this barrier by facilitating the scalability and applicability of project results (economies of scale and of scope), thereby overcoming the fragmentation that arises from limitations in company size and home markets.

Table 7-6. Potential actions to address this barrier

Actions	
12	<p><i>Provide key functions as infrastructure</i> Address the tension between scale economies and the need to retain agility by stimulating cloud development or using regulation to ensure that sources of strong scale economies are made available to others on a fair, reasonable and non-discriminatory (FRAND) basis.</p> <p>Intended economic and societal impacts: lower entry, upgrading and exit costs for innovative firms, more efficient pricing and higher productivity in domestic and global service sectors. Implementation requirements: Procurement, standardisation and regulation to stimulate cloud development; extended neutrality and access regulation. Actors: Member States, Private Sector</p>
13	<p><i>Modify merger rules and policy</i> The aim is to facilitate M&A that attain critical mass but do not threaten the competitive health of the relevant market. This entails a careful analysis of the global scope of the market and the degree to which concentration in the home market can be linked to effective competition in the world market.</p> <p>Intended economic and societal impacts: more rapid structural adjustments to realise economies of scale and create effective countervailing competition to established incumbents. Implementation requirements: Analysis of competition, size and coordination issues, determination of suitable market definition and power tests and modification of merger guidelines (may require legislative changes). Actors: European Commission, European Parliament, Member States</p>
14	<p><i>Implement a suitable legal status for SMEs and networked enterprises</i> The usual legal form for SMEs is a limited liability company (details vary across Member States). A</p>

	<p>unique European legal status— that cuts or simplifies bureaucratic requirements—might facilitate cross-border M&As by decreasing the transaction costs for partners from different countries. This could be extended to provide a specific legal status and regulatory rules for forming networked enterprises, particularly on a temporary basis.</p> <p>Intended economic and societal impacts: Reduced administrative burdens and delays, greater prevalence of cross border enterprises.</p> <p>Implementation requirements: A European Enterprise Act to parallel the European Companies Act. Rules would have to establish the basis for evaluating competition concerns; govern the allocation of IPR and market access; establish conditions for participation in public tenders; and make provisions for assignment of responsibility, enterprise reporting and effective and proportionate collective compliance with rules applying to single enterprises. It may also be necessary to assist, constrain or participate in novel financing vehicles for such entities.</p> <p>Actors: European Parliament, European Commission</p>
15	<p><i>Target public procurement</i> Demand-side instruments⁹⁰ can be used to provide critical mass in specified markets, while managing the risk of market distortion through a combination of pre-competitive procurement, and multiple-source (and possibly multiple-client collaborative sourcing) procurement mechanisms.</p> <p>Intended economic and societal impacts: more cost-effective support for public service use cases, improved sustainability of novel services in private and mixed markets, greater alignment between public and private solutions, accelerated innovation.</p> <p>Implementation requirements: Possible reinterpretation or redrafting of procurement rules to permit: inclusion of economic and industrial objectives in selection criteria; use of novel forms of bidding and more flexible contract forms (to permit e.g. multiple sourcing, IPR options, etc.).</p> <p>Actors: European Parliament, Member States</p>

7.2.3 Impediments to the cooperation of the Internet industry with other industries

In order to internalise the full potential of future Internet based services, applications and solutions, cooperation between the European Internet industry and entities from other economic sectors is vital. This echoes the analysis in Section 7.2 of the relationship between technological and business/service innovation; the home sectors of the use cases may be slow and selective in taking up the benefits of the emerging technologies, and in feeding back relevant lessons from their experience.

Relevant actions already in place include the full range of DAE actions under Pillar 5 (from 50 to 56). Potential additional actions are included in Table 7-7.

Table 7-7. Potential actions to address this barrier

Actions	
16	<p><i>Extend support for establishing appropriate industry clusters</i> Action 53 of the DAE strengthens financial support for joint ICT research infrastructures and innovation clusters, which enable multidisciplinary collaboration. In view of this, we recommend extending existing cluster programmes to provide infrastructural and business development support for the formation of diversified <i>filière</i> local and virtual value networks that cross sectoral lines.</p> <p>Intended economic and societal impacts: Enhanced local cluster development, improved sustainability of local labour markets and economic productivity, increases in service and business model diversity.</p> <p>Implementation requirements: Re-examination of selection rules and implementation mechanisms for cluster formation to encourage a balanced mix of complementary enterprises and to permit virtual clusters. Establishment of public-private technology exchanges to facilitate the rapid diffusion of ideas among firms. Integration of co-location initiatives with regional development strategies.</p> <p>Actors: European Commission, Member States</p>

⁹⁰ See Wilkinson *et al.* (2005). Multiple-sourcing allows multiple firms (or groups of firms) to divide the contracted volume of goods or services, and maintains competitive pressure by periodic reallocation of this volume based on performance to date. This aids scale by spreading the experience needed to serve private markets across a wider supply base. Pooled procurement allows public customers to aggregate demand, benefiting from economies of scale and enhanced bargaining power.

Relationship to the Future Internet PPP

The barrier to cross-sector collaboration is recognised in the structural design and implementation of the Future Internet PPP. The programme was devised to bring together the demand/pull and supply/technology push. A fundamental element of the programme is the active involvement of prospective users, contributing requirements to the FI-WARE core platform and providing use cases and scenarios for large-scale trials. “User driven innovation” has been a guiding principle for programme implementation.

To date, the Future Internet PPP has mobilised many major actors in the European Internet Industry as well as eight major application sectors. The programme requires significant cooperation, collaboration and coordination between them, through a broad range of horizontal actions, including (*inter alia*) dissemination, intellectual property rights, use of generic tools (e.g. for requirements collection), deliverables scheduling and impact creation.

The success of the PPP ultimately depends upon broad uptake of FI-WARE core technologies, notably the generic enablers, in the build-up and build-out of “smart infrastructures” in a wide array of application sectors. The present PPP is thus a unique vehicle for strengthening cooperation between the Internet industry and other industries, which is a major criterion of success for the entire initiative. However, as with the innovation barrier, success also depends on developments in those other industries and on continuous two-way linkages between the Internet industry and other industries.

7.3 Barriers to effective market competition and cooperation

This section focuses on barriers to the Digital Single Market that prevent the European Internet industry from fully exploiting potential economies of scale and scope. At best, these barriers prevent European companies from enjoying specific advantages relative to companies based outside Europe, weakening their ability to compete in international markets from a robust and consolidated European home base. They undermine the ability of incumbents to rapidly move into promising new business areas and reduce the likelihood that new entrants can achieve sustainable market entry.

Relationship to the Future Internet PPP

The Future Internet PPP initiative is framed under the Digital Agenda for Europe, so removing these barriers is important for the general success of the PPP beyond its scientific excellence and technology achievements.

The expected creation of European-scale markets for PPP results depends upon the proper operation of an integrated single market. Conversely, the Future Internet PPP is expected to produce a “comprehensive approach towards regulatory and policy issues such as interoperability, openness, standards, data security and privacy within the context of the Future Internet complex and ‘smart’ usage scenarios” (European Commission 2011e). This activity is coordinated at programme level by the facilitation and support project CONCORD, which is made up of various boards and groups of PPP project representatives and/or external parties (as appropriate), who discuss and reach agreement on a broad range of non-technological issues. The work of CONCORD includes

“developing guidelines related to standardisation, legal and policy frameworks, SME and user involvement and cross-project collaboration” (*ibid*).

The Future Internet PPP can facilitate the harmonisation of positions on barriers to market competition and cooperation among the stakeholders, even if it cannot directly remove those barriers.

It could be argued that the European scale and scope of PPP results and their exploitation and implementation by market actors within and beyond the PPP should significantly affect the efficient and effective functioning of the Internet market. The generic, open FI-WARE Platform is a vital key to the whole system, and not only in technical terms. Given timely development, successful large scale trials, smooth rollout and broad adoption across a variety of usage areas, the comprehensive and integral set of FI-WARE technologies and tools would significantly lower barriers to market entry facing software and service developers, stimulate third party and user-driven innovation (closing the circle between technology-push and demand-pull), and generally foster a more dynamic, open and experimental culture in enabling business-level innovations.

The barriers described in general terms below will vary across specific application markets. The Future Internet technologies will be embedded in infrastructures and applications; the competitiveness and prospects of the European Internet industry are ultimately entwined with the competitiveness and prospects of the sectors to which it contributes.

7.3.1 **Economic barriers**

Market competition is one of the main drivers of efficiency and innovation throughout the economy, and especially for the Internet industry. However, it is vulnerable to a wide range of risks, including: network effects; asymmetries of information between users and suppliers; concentrations of market power along the value chain; protectionism; technical and operational barriers to entry and interoperability; and consumer or supplier lock-in. These risks therefore constitute a barrier to competitiveness as defined above.

The economic barriers can be addressed by a mixture of competition and consumer oriented policy and should be pursued at a pan-European level to avoid protectionism and inefficient barriers to competition. Specific actions may include a portfolio of initiatives aimed at enhancing and preserving openness (see Table 7-8).

Table 7-8. Potential actions to address this barrier

Actions	
17	<p><i>Preserve and extend the openness of the Digital Single Market</i> This includes neutrality regulations, selective adoption of public utility regulation for bottlenecks in the Internet value chain, and measures to enhance customer mobility.</p> <ul style="list-style-type: none"> • <i>Net neutrality rules:</i> Commissioner Kroes has noted (Meyer 2011) that net neutrality legislation at this point would be premature. To move ahead, we should identify neutrality related challenges and establish an appropriate concept of neutrality for Europe; benchmark net neutrality rules outside Europe; and monitor net neutrality related practice in Europe. • <i>Market-opening measures:</i> Utility regulation of specific Future Internet services and support for open standards can be used. This would complement the support for interoperability and standards development embodied in DAE Pillar 2. Specifically targeted support for Future Internet service development and marketing (using the integrated approach laid out under Horizon 2020), will also be important. • Innovation depends on the development of generic (and especially infrastructural or use case-specific) and essential services as the foundation for adding value in more specific offerings. The aim here is to prevent foreclosure or attempts to protect existing market power, and this might be achieved by focusing on technologies that rival those currently dominating the market, or by channelling support to potential rival firms. This is likely to be more effective than regulations designed to force dominant firms to share service and other infrastructures with rivals on advantageous terms, at least in the long run, where market discipline is likely to prove more effective than formal regulation. • <i>Increasing customer mobility:</i> Entry barriers to the use of advanced services can be lowered through cloud-like initiatives that share common, scalable facilities, are charged on a per-use basis and are provided by a competitive field of application and functionality service providers. Consumer protection regulation will need to be adapted to the technological, contractual and locational peculiarities of Future Internet services. <p>Intended economic and societal impacts: enhanced economic and welfare benefits from the Digital Single Market extending throughout the European economy; enhanced domestic competitiveness for European firms; greater protection of consumer interests; possible increase in churn.</p> <p>Implementation requirements: modification of net neutrality rules; possibly the creation of new regulatory bodies or an extension of the NRA remit; development of new standards (and standards bodies).</p> <p>Actors: European Commission, Member States, Private Sector</p>

7.3.2 Cultural barriers

Cultural differences between customers and suppliers in Europe might be relevant for the Internet industry, potentially impeding the efficient development of Internet ventures by artificially reducing or fragmenting the market. These include language differences, differences in aptitude and attitude (e.g. towards risk-taking) and psycho-social cultural differences across Member States.

Table 7-9. Potential actions to address this barrier

Actions	
18	<p><i>Improve linguistic equivalence in cross-border services</i></p> <p>To some degree, existing consumer and Single Market rules attempt to address the language issue. Empirical evidence suggests, however, that compliance is low. A suitable action therefore might focus on improving linguistic equivalence in offering cross-border services, provided there is evidence that the costs of compliance (which are substantial) justify potentially modest benefits. This could be accomplished by requiring multilingual web content and by providing support to language intermediaries offering certified translation as a service to Internet Users.</p> <p>Intended economic and societal impacts: Increased scope for comparing offers, leading initially to greater competition and eventually to increased cross-border e-commerce and incentives for producing pan-European content and services. The emergence of linguistic intermediaries that can extend the reach of both commercial and public services. In the long run, enhanced cohesion and inclusion.</p> <p>Implementation requirements: Support (through existing and Horizon 2020 programmes) for suitable application development linked to Future Internet PPP generic enablers; assessment of changes in the e-Commerce and Services Directives to enforce multilingual offers.</p> <p>Actors: European Commission, Member States, Private Sector</p>

7.3.3 Legal barriers

From the literature and our analysis of the Internet industry we can identify a number of different legal barriers related to national differences regarding:

- Licensing, authorisation, registration;
- The legal treatment of privacy/ data protection, security, etc.;
- Standards and Intellectual Property Rights; and
- Financial regulation.

Any policy intervention must balance user protection, return on investment and technology development. Overall, the legal barriers are well-understood and in principle are being addressed through governmental action both by the European Commission and the Member States. Indeed, several are addressed by the DAE, in particular by actions specified under Pillar 1 and 2. However, the legal issues have persisted for some time, and there is still room for national implementations, so their resolution cannot be taken for granted.

Table 7-10. Potential actions to address this barrier

Actions	
19	<p><i>Defragmenting the consumer and business legal environment</i></p> <p>On the consumer side, this involves a common framework and harmonised rules, monitoring and enforcement in such areas as data protection, service delivery, warranties, quality of service contracts, dispute resolution, data location and information recovery. On the business side, areas in need of harmonisation include (in addition to those listed for consumers) cross border retail, VAT, recycling rules and special measures such as copyright levies for blank media—especially important is uniform treatment of on-line and off-line commerce.</p> <p>Intended economic and societal impacts: greater overall economic efficiency, increased cross-border trade and business development, enhanced consumer welfare and more effective and proportionate protection of fundamental rights.</p> <p>Implementation requirements: Reconciliation of European Directives and Regulations applying to consumer interests, especially as regards new forms of service contract and relationship; harmonisation of business regulation; verification of compliance with Better Regulation principles.</p> <p>Actors: European Commission, Member States</p>
20	<p><i>Assessment of an appropriate certification approach</i></p> <p>Certification provides an additional light-touch and/or self-regulatory instrument for data protection as well as other areas of consumer protection (at a minimum). It may be particularly important in relation to use cases where trust is important, for example in ensuring quality of service by the network and the quality, reliability, transparency, etc. of services provided over the network. Such arrangements may involve co-regulation, as in the Safe Harbour Agreement used to provide equivalent protection for EU citizens' personal data transferred to compliant US firms. However experience shows that such arrangements need a high degree of monitoring and transparency, they may suffer from corruption and may serve as market exclusion devices. Certification needs to be established on a Europe-wide, neutral and reliable basis. Its actual implementation might e.g. be based on an official quality seal or labelling scheme, and may perhaps benefit from combining a legally-enforced minimum standard with additional certification and/or disclosure of information about performance above the minimum level.</p> <p>Intended economic and societal impacts: reduction of regulatory burdens, improved effectiveness of consumer protection, greater integration of quality of service into market forces; in the medium term, improved focus of consumer choice on certified characteristics and resulting stimulus to further improvement.</p> <p>Implementation requirements: Multi-stakeholder workshop to establish areas and participation for certification; potential legal and regulatory changes to transfer power to certification bodies, establish government participation; impact assessment, particularly as regards monitoring and enforcement.</p> <p>Actors: European Commission, Private Sector</p>

7.4 Relating the barriers to indicative use case sectors and FI-WARE

To substantiate the above, we have analysed the barriers to the competitiveness of the European Internet industry with reference to how the industry may contribute to the development of several other industrial sectors. These indicative sectors—food and agriculture, environment, energy, transport and logistics—are among those addressed by the use case projects in Phase 1 of the Future Internet PPP⁹¹. We have also included the health sector, in view of its share of the European economy. To complete the picture, we have applied the analysis with reference to the objectives and activities of the FI-WARE project, which is building the technology foundation for the Future Internet. Table 7-11 identifies the main barriers for the sectors examined. Some barriers (esp. labour inflexibility, licensing and financial regulation) are not noticeably more acute in these sectors, although they may be important in the EU Internet Economy as a whole.

⁹¹ Respectively, SmartAgriFood (food and agriculture), ENVIROFI (environment), FINSNEY (energy) and FINEST (transport and logistics).

Table 7-11. Summary of main barriers in indicative use case sectors and FI-WARE

Barrier	Description	Agri-Food	Environ-ment	Energy	Transport & Logistic	Health	FI-WARE
Access to inputs							
Insufficient trained labour	Insufficient supply of relevant competencies, knowledge and experiences for work and digital life; R&D personnel	X			X		
Insufficient flexibility of labour	Regional imbalances on the labour market, impediments to migration						
Insufficient access to financial capital	Amount, format of risk capital and business development support for SMEs/start-ups; lack of capital for investments in ultra-high broadband network infrastructure	X	X	X	X	X	X
Obstacles to innovation							
Insufficient investment in innovation	Ability and incentive to invest in R&D	X	X	X	X	X	X
Limitations regarding the size of a company and its home market	Ability of SMEs/start-ups to locate external partners, merge activities; size of, vested interests in the home market	X	X		X	X	X
Impediments to cooperation between the Internet industry and other industries	Structural barriers (e.g. incumbents seeking to preserve rents, slow entry); policy-based barriers (e.g. sector-specific regulations); different corporate cultures	X	X	X	X	X	X
Effective market competition and cooperation							
Economic barriers							
Protectionism	National/regional exclusionary practices	X		X		X	X
Incumbent dominance	Regional, layer (telco, IT, platform, business service) monoliths			X	X	X	X
Entry, interoperability barriers	Includes technology, standardisation, business model, contractual barriers	X	X	X	X	X	X
Demand side barriers	Lock-in, attitudes to new technology, trust	X	X	X	X	X	X
Cultural barriers	Language, resistance to social/business model change	X		X	X		
Legal barriers							
Licensing etc.	Licensing, authorisation, registration (<i>ex ante</i> regulation)						
Privacy, security	Privacy, data protection, security (internal and external)		X	X		X	
IPR	Copyrights, industrial property, alternatives		X				X
Standards	Legal participation, co-regulation, openness, interoperability, speed			X			X
Financial regulation	Access to capital, globalisation, machine trading						

Our analysis suggests that the main barriers in the indicative sectors are:

- Insufficient access to financial capital;
- Insufficient investment in innovation;
- Limitations regarding the size of a company and its home market;
- Impediments regarding the cooperation of the Internet industry with other industries;
- Economic barriers regarding entry and interoperability; and
- Demand-side barriers, notably lock-in, attitudes to new technology and trust.

All the industries as represented by the use case sectors seek to reinforce sector competitiveness by boosting application and use of Future Internet ICTs as a whole system, spanning the value chain. The general view is that the efficiency, performance and sustainability of the sector can be radically enhanced by using advanced sector-specific systems that are tightly integrated with advanced Internet-based networks and services.

The main barriers to meeting sector objectives through exploitation and use of Future Internet technologies are obstacles to innovation. The sub-systems targeted by the sectors to push efficiency and drive change typically involve a huge number of SMEs, as (potential) application and service adopters in various segments of the value chain. The SMEs span multiple segments of the European as well as regional and local economies, and supply networks of diverse size, scale, scope and complexity. Innovation in principle may be obtained in wide-ranging areas in each of the sectors.

The key challenge is the aptitude, readiness and ability of these diverse SMEs to invest in innovative solutions. There is also a need for SMEs to collaborate ever more closely with partners in existing as well as new business networks, in order to achieve the envisaged transparency and interoperability of data and knowledge. The business incentive for doing so may not be compelling. Investments in service- and application-based R&D might be limited by risk aversion among stakeholders and the financial sector. Specifically, innovative SMEs also find it hard to manage risks by diversification, and may be vulnerable to unfriendly acquisition.

Large-scale experimentation, validation and implementation of the solutions is dependent upon coordinated structures that galvanise stakeholders to merge activities and forego vested interests in home markets. This is not only relevant for production and sourcing within sectors, but also to promote more seamless and effective linking of such activities to those in neighbouring areas. High fragmentation of these sectors in many parts of Europe, and the existing European and national policies in regulating them, presents obstacles to genuine stakeholder cooperation, across industry as much as geographic borders. Even for those sectors with high ICT penetration and ICT R&D investment, stakeholders typically have no tradition of sustained, coordinated dialogue with actors from the Internet industry, especially those in the newer web ecosystem. eSkills are not pervasive among the personnel in sector segments that are most in need of change if they are to boost productivity and growth.

In terms of economic barriers, current practices, business model and contractual barriers help preserve the status quo, and may prevent large-scale adoption of promising solutions. Entrenched attitudes are not generally consistent with the culture of dynamic open supply

chains, and the demands they place on new working practices, that the Future Internet would foster. Resistance to change is evident from established players.

Downstream, while consumers would welcome better quality and safety at lower prices arising from sector improvement, the benefits that the Future Internet may bring to make this happen in the high street and at home need broad awareness and convincing demonstration. Additional demand side barriers relate to consumers' attitude to and acceptance of new technology, and difficulties end-users may have in understanding and managing security, privacy, quality of service and other aspects of increasingly complex Future Internet services.

7.5 Self-organised coordination

It is both unrealistic and inappropriate to attempt a grand synthesis of all actions, stakeholders and objectives. The Future Internet is sufficiently complex, and the critical uncertainties sufficiently important, that this may be ineffective or even counterproductive. To make progress, a looser form of coordination might be preferred.

In the first place, none of the barriers falls entirely within the remit of any single competent authority. Moreover, many of the most important and effective aspects of Internet development and governance (Cave *et al.*, 2008b) have arisen from self-organised multistakeholder engagement; by comparison, previous grand strategies in the Internet domain have not had enjoyed the same success.

Part of the difficulty is that a grand strategy requires agreement on a common set of objectives, methods, indicators of success and assumptions – usually well in advance due in part to the delays inherent in such formalised processes. Inevitably, as work progresses, the stakeholders will respond to their own evolving interests and knowledge, depart from the original understanding and – perhaps more importantly – cease to engage with the overall process on a continuing and serious basis.

Of necessity, the current FI PPP community includes a small and selective sample of the (potential) key players in the Future Internet and of those communities expected to benefit from and/or exploit its outputs. This may become more problematic as the initiative moves towards widespread deployment and uptake. At the same time, it is premature to draw up a list of who should be in and who should be out – or even a specification of what 'in' or 'out' might mean.

Inclusion must go beyond the traditional bounds of the Internet economy; the strongest and most sustainable economic benefits of exploiting Internet technologies (as with ICT technologies in general) come from diffusion to other sectors. Diffusion to other services sectors faces some corporate culture hurdles. But these are less problematic than the differences between services and manufacturing. Under current economic conditions, European manufacturing is continuing to contract even as services (which in some sectors begin to recover; thus, it is particularly important to encourage the application of Future Internet technologies in (non-ICT) manufacturing sectors.

Taken together, these factors argue for a flexible and open framework. This should be based on open collection and exchange of information, flexible governance arrangements

and clear principles. European institutions have a particular role to oversee important elements of common structure binding the Digital Single Market that underpin European regional competitiveness. But they should also provide leadership by opening up new areas of separate—or even coordinated—activity where progress is retarded by coordination problems.

Chapter 7 discusses various barriers to the competitiveness of the European Internet industry organised into three meta-layers. It also identifies 20 actions for reducing the adverse impacts of the barriers and four main groups of actors for taking the actions (European Commission, Member States, European Parliament and the private sector).

This chapter sets out our policy recommendations, based on the above analysis. These recommendations correspond to seven high-priority actions selected from those identified in Chapter 7. The prioritisation was based on a range of considerations, including feedback from experts in the field and complementarity to/alignment with the expected outputs from the FI PPP and its potential successor. The guiding principle is the critical importance of the Future Internet to innovation. Europe's competitiveness rests on productivity; defending this in the global economy requires continual improvement, which means innovation in products, services, markets and business models. The Internet is increasingly central to all of these; the FI PPP in particular provides a set of generic enablers of innovation and interoperation—and thus of collective as well as competitive innovation.

The PPP also emphasises the centrality of SMEs and new start-ups as vectors of innovation, productivity and competitiveness. As noted in Chapter 7, these small firms play a variety of vital roles; in general, a network of small service-orientated firms offers specific advantages in meeting the specialised needs of their clients and in forming strategic partnerships with them. Moreover, market competition tends to be associated with low market concentration; in other words, a multitude of small firms are more likely to respond to market forces than to attempt to shape them, and therefore to produce more resilient and egalitarian divisions of surplus between their workers, their owners and their customers. As regards innovation, small firms may have smaller exit costs; a successful innovation ecosystem requires failure as well as success to incite and select the most productive ideas and to reallocate capital accordingly. More generally, successful innovations—at least for services—tend to be associated with start-ups rather than incumbent firms.

In these recommendations we focus on actions that are not widely recommended elsewhere, except where the development of the Future Internet offers new opportunities to make progress. Below, for each recommendation we indicate how –and by whom– implementation might be achieved and reference the barrier to competitiveness addressed. Details of the actions can be found in Chapter 7 and in the separate Appendix A, under the corresponding action items.

Engaging Europe's youngest and oldest citizens in Future Internet-based industries can transform a drain on public and private finance into a unique competitive strength.

The age structures of European populations are changing and many are ageing. At the same time, citizens at both ends of the working age distribution are underemployed. The young tend to have better ICT skills, but high and persistent unemployment rates threaten to create a “lost generation” that threatens European competitiveness, cohesiveness and sustainability. In parallel, many older workers find themselves involuntarily unemployed or employed in jobs that do not make the best use of their skills and experience or provide satisfactory working conditions. Suitable measures are needed to facilitate the employment of both groups, and to stimulate the emergence of new businesses that can uniquely benefit from the combination of skills, experience and ambitions they offer. Present measures aim at increasing the employment of young people (mostly in existing jobs) and in increasing e-participation among the elderly.

We recommend that national and EU policymakers act together with existing employers to join up these measures, and that Member States take steps to facilitate the emergence of new forms of employment by using a portion of the resources devoted to economic recovery to support start-ups on an initially non-commercial basis. This will be no more expensive than current employment policies, but potentially more productive in the medium term and an indirect stimulus to other start-ups, and to the acquisition of e-life skills among those approaching traditional retirement age. This recommendation (Action 2) will improve access to skilled labour.

New assets and financial partnership models are needed to support the transformation of Europe into a leading competitive player in the emerging, Internet- and service-based global economy.

Under current arrangements and economic conditions, Europe's financial sector is not only failing to adequately finance start-ups and innovative business models and services, but is also equally failing to produce stable growth in other ways. Moreover, the structure of prevalent current financing vehicles creates incentives that discourage collaboration, long-run success and “sharing.”

We recommend support in the form of regulatory clarity from the EU and Member States, and risk capital participation by public bodies and the financial sector earmarked specifically for such Future Internet enterprises. On the risk capital side, this might take the form of new financial assets (offered by private sector financial institutions and purchased by public as well as private investors) adapted to the needs of companies whose metric for success may derive from market share, third-party monetisation of value creation or licensing/re-use of intellectual property, and who may have to move rapidly in order to realise and sustain these advantages. This recommendation (Action 8) will improve access to suitable (and suitably structured) financial capital, and also reinforce intra-industry collaborative networking.

National and European infrastructure initiatives must be “joined up” to produce effective complementarity and to encourage pro-innovation and pro-competition investment and growth by all sizes of firm and all sectors of the European Internet economy.

Europe's communications (and computing) infrastructures are growing, but gaps in coverage and inequalities in speed, quality of service and affordability are restricting access and producing uneven growth across sectors, regions and business sizes. Because the

growth “hot spots” include the most keenly contested areas of the global economy, this concentration threatens to undermine competitiveness. In this sense, a high-quality, affordable and dense infrastructure is a trans-European public good.

We recommend that the European Commission’s Connecting Europe Facility (CEF) be actively used to join up existing regional, national and European infrastructure measures and to ensure—through funding conditionality and regulatory changes at Member State level where necessary—that the resulting networks remain open, affordable and of uniformly high capability, security, etc. This is particularly timely because such measures may be threatened by public austerity programmes, at least in some countries. The CEF creates opportunities at European level that can reinforce such initiatives and ensure their balanced progress. Various new models are available, especially when orientated to how the infrastructures are used (e.g. private, enterprise, community clouds; use of shared data centres to justify fibre investment, etc.). This recommendation (Action 10) will improve access to capital for investing in and maintaining Europe’s communications infrastructure.

Europe’s global rivals in the Internet economy are finding tax incentives a useful way to encourage R&D and other forms of innovation.

Europe’s international competitiveness relies on a vigorous, diverse and resilient domestic economic environment. Fiscal measures to strengthen innovation incentives are necessary to compensate for restricted access to capital, especially for new firms, services and business models. Such measures are currently being pursued by Europe’s main global rivals, and the initiative, once lost, cannot easily be regained during the next phase of the global business cycle.

We recommend that Member States implement favourable tax treatment for R&D, for new forms of partnership and for revenues to early-stage offerings (e.g. via deferrals) that can provide far more cost-effective medium-term stimuli than untargeted austerity or subsidy measures. However, to prevent costly and destabilising tax competition, it is vital that such measures be harmonised or at least balanced at the European level. This recommendation (Action 11) would provide a specific stimulus to innovation, especially of the sort best-placed to exploit the Future Internet PPP’s generic enablers.

Europe’s competitiveness may hinge on near-universal access to advanced communications and computing services as well as to high-speed broadband.

Small firms, start-ups and enterprises in remote regions continue to face barriers to entry, not just in terms of Internet access, but also in terms of increasingly necessary computing (storage, processing) and service (for example identity, security, privacy, or data curation) resources. Moreover, even where such resources are available to small, new and remote firms, they tend to come with a degree of lock-in that reduces the returns to service users and the economy as a whole, or with selective blocking or degradation of such services. As the Future Internet economy develops, access on reasonable terms will become increasingly necessary for even minimal success. Thus European competitiveness depends on near-universal access to such resources for basic software-based services and service platforms that power business applications across value chains, beyond advanced communication networks.

We urge Member States and established users of such services to adopt further measures (e.g. targeted procurement) to stimulate technological and business models that improve

availability (e.g. cloud development), reduce lock-in (e.g. open standards for essential software-based services for businesses), and provide support for a multitude of alternative more ad-hoc and potentially faster approaches to facility interoperability.

We further recommend that Member States consider regulation (e.g. utility or enhanced competition regulation) to ensure that such sources of strong scale economies are made available to all economic stakeholders on a fair, reasonable and non-discriminatory (FRAND) basis under commercially viable terms and condition. Specifically, utility regulation of specific Future Internet services and support for open standards may be considered to ensure an open market for third party innovation of basic software-based services, across service platforms. This recommendation (Actions 12 and 17) will reduce barriers to entry, competition and innovation based on enterprise size and incumbency and home market access.

Dynamic and diverse Future Internet businesses need new forms of legal identity.

Both small businesses and new forms of economic activity (for example “virtual” networked enterprises) are unduly burdened by legal rules designed to address the characteristics and needs of larger and more permanent unitary firms. Failure to provide suitable legal and regulatory support will distort European Internet Industry development towards outmoded forms of organisation, unduly advantage incumbents and, in a worst-case scenario, drive European business and service model innovators to more hospitable regimes abroad.

We recommend that the EC initiate and the European Parliament enact a European Enterprise Act to complement the European Companies Act in providing SMEs with a unique European legal status that cuts or simplifies bureaucratic requirements and thereby facilitates cross-border mergers and acquisitions by decreasing the transaction costs for partners from different countries. This could be extended to provide a specific legal status and regulatory rules for forming networked enterprises, particularly on a temporary basis. This recommendation (Action 14) would also act to reduce competitiveness barriers based on company size and incumbency and home market characteristics.

To succeed in the global Internet Economy, Europe's Digital Single Market needs internal defragmentation in legal and regulatory terms.

The founding principles of the Single Market include the recognition that competitiveness abroad requires a healthy balance of competition and cooperation at home. The current crisis has inhibited progress in recent years towards greater economic integration, threatening a return to protectionism. This fragmentation complicates cross-border potential as well as actual competition for consumers and producers alike.

We recommend that the EC initiate and Member States pursue the creation and implementation of a common framework and harmonised rules, and ensure monitoring and enforcement across a range of areas affecting the European Internet industry and the Internet economy. Uniform treatment for on-line and off-line commerce should be part of the picture. This recommendation (Action 19) will serve to remove legal barriers to effective market competition and cooperation

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