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NEW ICT SECTORS: PLATFORMS FOR EUROPEAN GROWTH?

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Highlights

- Europe's failure to specialise in new ICT sectors and firms is likely to hold back Europe's post-crisis recovery. Europe lacks in particular leading platform providers, who are capturing most of the value in the new ICT ecosystem.
- In-depth analysis of some specific new emerging ICT sectors shows that the problem in Europe appears not to be so much in the generation of new ideas, but rather in bringing ideas successfully to market. Among the barriers are the lack of a single digital market, fragmented intellectual property regimes, lack of an entrepreneurial culture, limited access to risk capital and an absence of ICT clusters.
- The EU policy framework, particularly the *Innovation Union* and *Digital Agenda* EU 2020 Flagships, could better leverage the growth power for Europe of new ICT markets. The emphasis should move beyond providing support for infrastructure and research, to funding programmes for pre-commercial projects. But perhaps most important is dealing with the fragmentation in European digital markets.

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IT IS WELL UNDERSTOOD that information and communications technology sectors are and will continue to be major contributors to innovation and growth (see for example Grajak, 2012). It is equally well understood that compared to the United States, Europe has a less efficient ICT growth model: the EU's economy specialises less in ICT sectors, ICT contributes less to growth in the EU, and the EU is lagging in terms of private expenditure on research and development into ICT goods and services. Because of the prominence of ICT R&D investment in overall R&D investment, this ICT investment 'gap' accounts for a substantial part of the difference between EU and US total R&D investment (O'Mahoney & van Ark, 2003; Moncada *et al*, 2009; IPTS PREDICT, 2010; European Commission, 2011).

Firm-level analysis suggests that the EU's ICT innovation and growth deficit might reflect constraints on the growth of new ICT sectors and ICT firms in the EU compared to the US. The EU ICT sector fails to focus on the new ICT sub-sectors and firms which have the greatest potential for ICT-based growth, most notably internet and software. Europe lacks young leading innovators (yollies) in these areas, which could compete with US corporations such as Google, Apple, Amazon and Qualcomm (Veugelers and Cincera, 2010).

Europe's failure to specialise in new ICT sectors and firms is likely to hold back Europe's post-crisis recovery. The ICT sub-sectors in which there were the greatest pre-crisis growth opportunities (internet, software) experienced only a minor reduction in growth rates, whereas others (computer services, telecom equipment) are struggling to return to their pre-crisis growth levels (European Commission, 2011). These global market trends can be related to specific companies. For example, the rapid development of the internet platform industry has been underpinned by Amazon and Google, which are based in the US, while the EU does not host comparably performing internet firms. Similarly, the growth in demand for smart phones and tablets is satisfied mostly by US-based Apple and Korean Samsung, whereas the European firms from this sub-sector, such as Nokia, report relatively lower performance in terms of revenue and R&D expenditure.

The implications of this European ICT growth deficit are daunting for policymakers, who have set out very ambitious knowledge-based growth aspirations. The Europe 2020 strategy calls for smart, sustainable and inclusive growth in Europe. This strategy tries to capitalise on the growth-enhancing effects of innovation and ICT through its *Innovation Union* and *Digital Agenda for Europe* flagship initiatives. Will these initiatives enable firms in the new ICT sectors with the greatest growth potential to turn into world-leading yollies and drive forward Europe's post-crisis growth agenda?

This Policy Contribution analyses specific emerging ICT sectors, examines in more detail the evidence for the ability of firms in Europe to enter and grow into leading innovators in these sectors, and draws out the implications for the EU's digital policy agenda. The analysis shows that Europe's weakness is not so much in the generation of new ideas, but is further down the commercialisation path. When attempting to bring ideas to market, EU firms face the lack of a single digital market,

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fragmented intellectual property regimes, lack of access to risk capital and strong ICT clusters with pooled labour markets, and too few advanced early (public) users and complementary industries.

THE CHANGING ICT LANDSCAPE

It has become standard to describe the ICT sector as an 'ecosystem' (Fransman, 2010). This term stresses the importance of the links between the various ICT actors. When looking at the supply side of the ICT ecosystem, three types of actors can be distinguished:

- Layer I: Network element providers (eg Cisco, Samsung, Alcatel, Ericson, Nokia)
- Layer II: Network operators (fixed and mobile) (eg BT, Deutsche Telekom, Vodafone)
- Layer III: Platform, content, application providers (eg Google, Apple, YouTube)

Together with the final users, they make up the ICT ecosystem market. In the new ICT ecosystem (ie post-internet), users are gaining presence on the supply side of the system by co-creating with suppliers (von Hippel, 2010).

In contrast to the old ICT ecosystem (ie pre-internet), which could be described as a closed innovation system with the most important links being between network operators and network suppliers (Layers I and II), the new ICT ecosystem is more open. The focus has shifted to the interaction between platform, content and application providers (Layer III).

Platform competition

Within Layer III, platform providers are in a unique position, being intermediaries between businesses that want to sell and consumers who want to spend money. Increasingly, competition and cooperation in the new ICT ecosystem take place between and within platforms.

A platform is a framework provided by platform owners to launch software. It is a system with well-defined access points and rules, on which other parties can build applications or services (Zhu and Iansiti, 2012).

Examples of platforms are operating systems such as Microsoft Windows, Unix, Linux and Google Chrome. In the mobile sector, there are Google's Android, Apple's iPhone, RIM's Blackberry, Nokia's Symbian and Samsung's Bada. Perhaps the best example of the power of a technology platform is Apple's iPhone. The iPhone platform and its eco-system have had a huge impact on the smartphone industry, moving the centre of this industry from the EU to the US.

Platforms are two-sided. Platform providers must get both consumers and developers of complementary applications on board in order to succeed. The value of the platform comes from its size. The more users, the larger the set of peers to connect to, and the more developers and equipment providers, the more features will be available on the network. Different business models for attracting consumers and suppliers will typically co-exist in the market (Rochet and Tirole, 2003). These models are mainly differentiated by which side of the market is charged the most by the platform provider: buyers, sellers or developers. For instance, video-game developers are charged relatively more through royalties and fixed fees for development kits, whereas for hand-held mobile devices, consumers are charged a larger portion through fees.

Whether application providers can capture value or not in the system will depend on their bargaining position inside the platform (*within*-platform competition) and the strength of the competition with other platforms (*between*-platform competition). In any case, platform providers are usually in the driver's seat.

In the case of between-platform competition, platform providers decide whether or not to develop their platform so that it is compatible with others (*open* or *closed* model). When there is compatibility, there is more competition for developers, which have a better bargaining position. As a consequence, access prices are lower for compatible than for incompatible platforms, and therefore market entry for developers is presumably easier. With more developers entering the market, the total size of the market and the total value creation will be higher for compatible platforms. This explains

policymakers' preference for compatibility. Nevertheless, despite this market size advantage, platform providers may shun open platforms, as this offers the prospect of greater market dominance (albeit in a smaller overall market). Free market forces could thus lead to incompatible platforms (Casadesus and Ruiz, 2009).

Compatibility and within- and between-platform competition are therefore important determinants of the (potential) total value creation in these markets. They are also important for determining which part of the ecosystem captures most of this value, and the incentives for platform providers, developers, equipment providers, telecom providers or customers to invest in innovation.

Competition in the new ICT eco-system

Most of the competition in the new ICT eco-system is competition between platforms 'for the market' rather than 'in the market'.

Having large scale is an advantage in new platform-based ICT sectors. The benefits mostly emerge from network effects operating on the two sides of the market: a large user base and a large base of applications and equipment. These two-sided network effects create a major barrier to entry for new entrants, and a strong advantage for established incumbents.

Nevertheless, as technology changes rapidly, incumbent advantages may also be quickly depreciated. New entrants offering radical innovations can quickly surpass existing entry barriers. This feature of new ICT sectors constantly challenges incumbent positions.

The relationship between new firms and incumbents is often seen as one of competition, where the start-up innovation, spurring the Schumpeterian 'gale of creative destruction' destroys the existing sources of market power. However, industry studies suggest a more nuanced relationship (Gans *et al*, 2002). As well as creative destruction, through which start-up innovations earn their rents through product market entry and competition with more established firms, there is also ample evidence of cooperation between start-up innovators and more established firms through licensing, strategic alliances or outright acquisition. When the 'old' technologies of the incumbent firms are challenged by new technological developments introduced by new players, incumbents can either respond positively by developing their own innovations and competing with the new entrants, or can buy up these new entrants and possibly develop further their innovations once they have been acquired.

EUROPE'S POSITION IN THE CHANGING ICT LANDSCAPE

For our analysis, we are particularly interested in whether (and how) European firms can create value in the new ICT eco-system and whether (and how) they can appropriate rents from this value creation to sustain their innovation-based growth and job creation.

More specifically we want to see how well Europe is doing in producing major world-leading *innovators* (*yollies*) in the sectors with the greatest ICT-based growth potential: Layer III. To characterise the EU's contribution to innovation in the ICT ecosystem, we use the IPTS (Institute for Prospective Technological Studies) scoreboard data on the world's largest R&D spenders[1]. The following tables detail the number of world-leading innovators (ie scoreboard firms) in ICT, split up by region, age group and layer.

A first important observation from Table 1, is the strong position of the US in ICT R&D in general: 52 percent of the world-leading innovators in ICT come from the US, versus 17 percent from the EU. In addition, when compared to the EU, far more of the US-based ICT world-leading innovators are 'young' (71 percent) and their R&D intensity is on average higher.

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1. See http://iri.jrc.ec.europa.eu/research/scoreboard_2008.htm.

Table 1: World-leading innovators by region, total ICT cluster

		ICT total
World	No. leading innovators	344
	% young	62%
	RDI	6.1%
EU	Share of leading innovators	17%
	% young	54%
	RDI	5.3%
United States	Share of leading innovators	52%
	% young	71%
	RDI	8.7%

Source: On the basis of IPTS Scoreboard (European Commission, 2008). Note: Leading innovators are firms present in the IPTS Scoreboard, ie among the 1000 biggest R&D spenders in Europe or the 1000 biggest spenders outside Europe. RDI (R&D intensity) is calculated as R&D expenditure as a percentage of net sales) of leading innovators. 'Young' means created after 1975.

with 70 percent of its firms being old leading innovators. When comparing within layers, EU firms are not less R&D intensive. In fact, they are typically more R&D intensive. The overall lower EU ICT R&D intensity is due to the greater weight of the older, less R&D-intensive Layer II, compared to the US. The EU is most specialised in Layer II, in contrast to the US, as shown in Table 3.

Table 4 on the next page looks at the individual segments within each layer. In Layer I, the most R&D intensive sector is semiconductors; it also has the greatest share of young firms among leading innovators. The EU is under-represented in this segment, with only eight world-leading innovators. Telecom equipment is the next most R&D-intensive segment in this layer; Europe's

Table 2: World leading innovators by region, by layer (%)

		Layer I	Layer II	Layer III
World	Share of ICT total	73	6	22
	% young	56	30	22
	RDI	9.6	1.6	14.1
EU	Share of region's ICT total	58	18	25
	% young	52	20	86
	RDI	11.9	1.5	15.4
United States	Share of region's ICT total	71	1	28
	% young	64	0	88
	RDI	8.8	0.8	13.7

Source: On the basis of IPTS Scoreboard (European Commission, 2008).

Table 3: Technology specialisation by layer

	EU RTA	US RTA
Total ICT	0.66	1.28
Layer I	0.61	1.19
Layer II	1.65	0.20
Layer III	0.46	2.14

Source: On the basis of IPTS Scoreboard for the year 2007. Note: RTA (relative technology advantage) is calculated as the share of the region in total sectorial R&D relative to the share of the region in overall R&D. An RTA value higher than 1 reflects that the region is technology specialised in these sectors.

Table 2 separates the ICT world-leading innovators into layers. The most R&D intensive layer is Layer III (internet and software). The least R&D intensive layer is Layer II (telecom operators). This holds both in Europe and the US. Layer III has not only the highest R&D intensity, it is also the 'youngest' layer with 88 percent of its world-leading innovators founded after 1975; this is the case in both Europe and US. Layer II is the 'oldest' layer, world leading innovators in this segment are markedly 'older' than their US counterparts. In Layer III, we observe that both the internet and software sectors are highly R&D intensive. Although Europe has far fewer world-leading innovators in software, their relative share in Europe's ICT ecosystem is similar to the share of comparable firms in the US, and so is their age profile. Internet is the sector in Layer III where there is the greatest difference with the US. The EU has no world-leading innovators in this sector, while the US has seven out of the nine world total.

With the power in the post-internet ICT ecosystem shifting to platform, content and application providers, these numbers clearly show how poorly positioned the EU is. Europe's strong position is in the layer of telecom services, which is the 'oldest' and least R&D-intensive layer. In the platform, content and application providers layer, the EU is

Table 4: World-leading innovators by region, individual segments within each layer (%)

		Layer I				Layer II	Layer III	
		Telecom equipment	Semi conductors	Computer equipment	Electronic equipment	Telecom Operators	Internet	Software
World	Share of ICT total	12	27	16	19	6	3	19
	% young	64	71	64	26	30	100	86
	RDI	12.5	14.5	4.5	4.9	1.6	10.9	15.1
EU	Share of region's ICT total	12	14	12	19	18	0	24
	% young	28	75	57	45	20	0	86
	RDI	13.0	16.9	3.9	6.1	1.5	0	15.5
US	Share of region's ICT total	13	33	15	10	1	4	24
	% young	74	73	60	29	0	100	86
	RDI	12.7	17.0	5.0	5.4	0.8	10.9	14.8

Source: On the basis of IPTS Scoreboard for the year 2007.

weakly present. Europe's struggling R&D position in the ICT eco-system is therefore clearly related to the sectoral and age composition of its firms, and its failure to create new ICT firms and redirect towards new ICT sectors.

With fewer European companies operating in the sectors from which most new value creation originates, the question is if they will be able to capture value from the new and follow-up generations of innovation or as providers of applications and equipment to the platforms of leading firms. This will depend on the contestability and the compatibility of the platforms.

BARRIERS TO THE DEVELOPMENT OF NEW ICT SECTORS IN EUROPE: EVIDENCE FROM FLY

Why is it that Europe has failed to redirect its innovation performance towards new ICT growth sectors, which offer the greatest opportunities for growth? Which forces most impede the development of firms in new ICT sectors? And how systemic is this lack of readjustment capacity in the EU, meaning it is likely to be repeated in future? To answer these questions we provide an in-depth analysis of some specific new emerging ICT technologies and sectors.

The FLY cases

For a selection of in-depth studies, we draw on the FLY report[2], which covers the following ICT sectors:

- Web 2.0
- Online and mobile gaming software
- Automotive embedded software
- Displays: OLEDs (organic light-emitting diodes) and e-paper
- RFID (radio frequency identification): item-level tagging and public transportation
- Semiconductor design
- Robotics: applications to safety and adoption by SMEs

Each of the cases is an example of a new advance in ICT technology that creates potential for new markets, although the sectors studied differ in their degree of 'newness' and potential for value creation (for Europe). Web 2.0 in particular offers the greatest potential for new value creation. It also has the potential to be highly disruptive, not only for content providers such as media companies, but also for enterprise software and web 1.0 platform and application providers[3]. The question for Europe is if it can capture any of the value offered by web 2.0 (through the producer and/or the user side). This is a particularly sensitive question in view of the limited number of world-leading platform providers that Europe has. For the *mobile 2.0* part of web 2.0, Europe has been playing a key role in the development of global mobile communication second and third generation technology standards and beyond. Europe could leverage its stronger early position in mobile technologies to capture value in mobile 2.0 segments. However, its position in mobile technology runs through equipment suppliers, infrastructure providers and operators. In the mobile 2.0 era, these firms are less pivotal because power has shifted towards platform providers. For *enterprise 2.0* (web 2.0 for

2. The selection of the sectors was done by the European Commission's Institute for Prospective Technological Studies (IPTS) for the project *Further lessons from ICT innovative industries*, known as FLY, which was carried out by Bruegel. The FLY project expanded on the sector discussions from the IPTS COMPLETE project (http://is.jrc.ec.europa.eu/pages/ISG/COMPLETE.html). This Policy Contribution summarises the main insights. The interested reader is referred to the full report for more detailed insights (Veugelers, van Pottelsberghe and Véron, 2012).

3. A web 2.0 site allows users to interact and collaborate. Users co-create content in a virtual community, in contrast to Web 1.0 websites, where users are limited to the passive viewing of content that was created for them.

commercial firms), the potential impact (value added) has been slow to develop and the EU is lagging both on the supply and the demand sides. Digital ecosystems – whether at home for mobile devices, entertainment systems and home appliances, or in business where mobile devices are combined with virtualised and cloud computing – are meshed and brought together through platforms and software applications such as Google's Android, Microsoft's Embedded CE or Samsung's AllShare. The outlines of this landscape of digital convergence are still emerging.

Platforms and standards in the FLY cases

Standards and platforms are concerns in many of the new ICT markets considered. Web 2.0, video games and automotive embedded systems are the clearest cases. Some examples are listed below. Semiconductor IP, robotics, the RFID segment and the e-paper market also have potential for generating one or more technology platforms.

Examples of platforms or potential platforms:

- Video games: Sony PlayStation platforms, Microsoft X-Box, Apple iPhone, Android Smartphones
- Web 2.0: Google Maps, Facebook, Twitter, Skype, LinkedIn
- Automotive Embedded Systems: AUTOSAR, GENIVI

A dominant (*de facto* or regulated) standard has so far not emerged in any of these sectors. The web 2.0 segment has plenty of platforms and is likely to have many others in the future. In fact, the web 2.0 segment is a nice illustration of the dynamics of ICT platforms and ecosystems. It has seen several changes in technology platforms because innovation can destroy or relegate previously leading platforms to a secondary position over a short period of time. A good example of this is how Facebook has totally eclipsed MySpace.

Analysing the social costs and benefits from standards and platforms for the FLY cases yields a mixed picture. The lack of technical standards does not help to reduce the high level of uncertainty that pertains in the early-stage of development of markets. This high level of uncertainty impedes access to finance, markets and suppliers. Establishing standards would thus help market development. However, given the high level of uncertainty about what the best standards would be, a premature picking of the standard can impede the development of new higher quality standards and their follow-up innovations. The problems of lock-in and settling on the wrong standards can be substantial, as path-dependencies in these network markets are particularly strong. Standardisation will also make entry by lower-cost producers easier and the consequent commoditisation will shift value away from first movers.

As mentioned, with the exception of the AUTOSAR consortium in the Automotive Embedded Software market, standards are typically developed *de facto* through a bottom-up approach. Competition in the market for customers and developers determines which standards and platforms are successful. Therefore the ability to obtain a dominant position or greater market penetration is what in the end will determine which framework becomes a *de facto* standard.

Major players aim for platform leadership to capture value, building around them a network of suppliers, developers and users. In none of the FLY cases, particularly in the early-stage ones, has a dominant leader so far been established, although an oligopoly of major players is emerging. US companies are particularly well represented in this set of potential leaders, while European firms are poorly placed. The AUTOSAR consortium is an exception because the European firms involved in it are in a stronger position compared to other emerging platforms in this market. Nevertheless, in the infotainment segment of automotive embedded software, there is a US-led battle

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between Genivi, Meego and Android, which remains far from being settled.

Competing standards and platforms differ in how interoperable they are. Platforms range from being perfectly open to closed systems. In many FLY cases, platforms differentiated on compatibility are competing on the market for dominance. Without government intervention, market forces will thus determine how open the *de facto* standard will be, which may not be the socially preferred degree of openness.

As Europe lacks players that can become dominant standard holders, it has a strong incentive to push for open and compatible models, as these will be more beneficial for both European customers and European firms developing applications within the platforms, increasing their bargaining power relative to platform providers.

Contestability of the FLY markets

The two-sided network effects mentioned previously create a significant barrier to entry for new entrants and give a strong advantage to incumbents in web 2.0, video games and automotive embedded software.

Nevertheless, as technology changes rapidly, incumbent advantages can also be quickly reduced. When talking about rapidly changing technologies, it is sometimes difficult to delineate a sector, and hence define what its entry barriers are and which are the incumbents. Entry barriers to new ICT segments are usually low, but once niches or new markets have been created and occupied, entry barriers can quickly be raised because of network effects.

Technological changes, most often introduced by new players, challenge and replace the 'old' technologies. Examples include the supplanting of video console hardware producers by the (no console-based) online and mobile videogames, LCD by OLEDs, or players within the traditional publishing industry by the introduction of E-paper. New players not only challenge 'old' technologies, but also first-movers. For instance, web 2.0 has also constituted a threat for some web 1.0 internet companies. Often, staff from existing platforms, knowing in detail the strengths and weaknesses of the platforms, leave to set up new businesses with follow-on innovations, or build new competing business. This 'churning' is particularly common in Silicon Valley.

This contestability feature of new ICT markets challenges incumbent positions, incentivising incumbents to carry out cutting-edge innovation in order to defend their positions, and to actually compete as if they were inhabiting a very competitive market despite strong network effects.

Mergers and acquisitions and alliances are a common business practice in the new ICT ecosystem, particularly the takeover of small young start-ups by large incumbents. This is true for every FLY sector. It is particularly emphasised for semiconductor IP blocks[4]. Most successful innovations typically come from new start-up companies, particularly the more radical type of innovations. But as these start-ups face problems accessing finance for their growth investments and as firms need complex combinations of different tools to provide 'solutions' and given the importance of complementary assets such as a well established reputation or brand recognition, the most prevalent growth path for successful start-ups in semiconductors is acquisition by one of the incumbents. Small firms are either acquired by one of the large incumbents when successful, or go out of business. Occasionally they rise independently to become a world leading innovator. Examples of European start-ups acquired by the US leading players can be found in the FLY sectors, Skype being a well-known example.

Access to markets

An oft-cited weakness of innovation in Europe is its poor capability to commercialise technological innovations. This commercialisation deficiency also holds in the FLY sectors. Most FLY studies identify a major problem for firms in Europe to create commercial value from their new technologies, to access early lead customers willing to take the high risk of first adoption, to mass customise and successfully brand their innovations.

The lack of a large integrated digital market in

4. For a nice description of the role of mergers and acquisitions in the electronic design automation (EDA) industry, see Henkel, Ronde and Wagner (2010). The EDA industry is a subsegment of the semiconductor industry, providing tools that support the automated design of integrated circuits.

Europe is an impediment for commercialisation identified in all FLY studies; this contrasts with the US. In particular, language borders hinder the development of some sectors in Europe, such as web 2.0 or the E-paper industry. At the same time, Europe's cultural differences could also be an opportunity to differentiate and create niches, conditional on being able to reach critical scale in these niches.

Beyond the lack of a large integrated digital market, there are other specific market barriers impeding commercialisation. The lack of sufficiently sophisticated SMEs in Europe, which lack the skills needed to effectively absorb new ICT technologies, is a major impediment to the adoption of new applications. This problem is present in business-to-business markets such as item-level tagging (RFID), and web 2.0 (European enterprise 2.0 is taking off slowly).

Geographic proximity between firms in the ecosystem may provide a considerable advantage when it comes to building ICT eco-systems, bringing together infrastructure, skills, finance and professional support. Various local clusters are observed in ICT markets, the most notable being Silicon Valley in the US. But ICT clusters prevail also in Europe. One recent example is London's Silicon Roundabout, where a mix of private incubators, external investment from large ICT companies (such as Cisco, Intel, Google, Vodafone and Samsung), academic institutions (such as Imperial College London and University College London) and government policy support a bustling start-up scene. When firms are based close together they intensify their interactions, both cooperatively and competitively. This point is remarkably important for online and mobile video games and web 2.0. Local clusters are also identified as important for improving links with customers. This is especially the case for lead customers in the business-to-business commerce of web 2.0 technologies, semiconductor IP blocks and automotive embedded software.

Science, research and skills links

For players in new emerging technologies, which are often built on insights from frontier research (or are even spin-offs from public research), a well-functioning interface between the science system and the corporate sector is particularly important.

In all of the FLY cases, R&D and innovation capacity was identified as important for market success. There is however no evidence in these cases that Europe's public R&D infrastructure would be inadequate, compared to the US. The conclusion that more public R&D would be needed in order to enhance European competitiveness in ICT is therefore questionable, particularly for web 2.0 technologies. The problems for market development are typically identified elsewhere.

Nonetheless, access to knowledge is important, particularly when defined more specifically as not only access to science and basic R&D but as access to "skills to bring ideas to market". From this perspective, Europe has some deficiencies to tackle. First, there are skill gaps in some specific areas (eg in infotainment software for automotive embedded software, software project management, etc). Second and more generally across all FLY cases, there is evidence that Europe lacks entrepreneurial skills to move new research results into start-up business development.

Innovation partnerships in the form of large R&D consortia, such as the Framework Programme projects funded by the European Commission, may have helped to create momentum for developments in established technologies and industry, but have not been found to be particularly helpful for small-scale and young innovators in new emerging ICT sectors.

Public-private links

The importance for new ICT markets of a smooth interface between the public sector and private

'Innovation partnerships in the form of large R&D consortia may have helped to create momentum for developments in established technologies and industry, but have not been particularly helpful for small-scale and young innovators in new emerging ICT sectors.'

sector innovators is demonstrated through the long-standing and continued importance of the US federal government as an early user (see Box 1).

Public procurement is also identified in some of the FLY sectors as perhaps the most important instrument for European policy to support the development of new ICT markets. The role of innovative procurement is particularly important for RFID (eg in public transportation scheduling). For web 2.0 technologies, public procurement (for e-government) is also considered to have the potential to kick-start markets.

The fragmentation of the EU public sector is, in all of these cases, identified as a significant barrier to the development of a compact procurement policy at an integrated European scale.

Access to finance

Financial constraints – both external and internal – are a major barrier to the development and growth of new innovation-based ICT markets. The private venture capital market is best equipped to fund projects, especially for highly innovative and radical growth projects with high levels of technical and commercial uncertainty.

Much higher volumes of venture capital go into financing IT ventures in the US than in Europe. The difference arises because there is a higher number of realised deals in the US, but deals in the US are also typically larger, supporting the growth stage of IT ventures, when scaling up to world market leadership. This pattern holds for all ICT sub-sectors, and constitutes a clear indicator of the lower maturity of the EU venture capital market for ICT investment, particularly at the growth stage.

Access to public funding (subsidies) was viewed as a critical constraint in none of the FLY studies. Funding of R&D projects by public authorities is only identified as an important though not critical constraint for public transportation (RFID). The process of public funding allocation is often seen as too slow when compared to the speed of evolution in ICT markets.

Intellectual property issues

If intellectual property regimes are not clear, open or affordable, the development of ICT markets will be hampered. This is particularly the case for young firms, which need clear IP regimes in their search for partners to develop, finance, produce, market and distribute their breakthrough ideas.

Trademark laws are perceived to be working well both in Europe and the US for FLY sectors. The same is true for chips masks protection when relevant for the industry (as in RFID, robotics or semiconductors)[5]. For the other IP policy tools, the EU's position compared to the US is less robust.

There is a fundamental difference between the US and the EU patent systems on the patentability of sensitive subject matter, which is relevant to the IT

BOX 1: Public procurement for US ICT market development

In many new ICT sectors, US public institutions, through public procurement, have been crucial early users (Mowery, 2008). Federal agencies – and especially the Department of Defense – provided large-scale, stable funding. A big, stable demand through government procurement creates a demand long before a commercial market is possible. Stability creates trust, which enables significant private investment. Rather than direct its R&D and procurement funding to incumbents, the US military has been willing to award substantial procurement contracts to new firms, such as Texas Instruments, which had recently entered the semiconductor industry but had little or no history of supplying the military. Inclusion of new small players in major contracts helped to create a more diverse development and production ecosystem. The US military's willingness to purchase from untried suppliers was accompanied by conditions that mandated substantial technology transfer among US semiconductor firms. To reduce the risk that a system designed around a particular integrated circuit would be delayed by production problems or by the exit of a supplier, the military required its suppliers to develop a 'second source' for the product – that is, a domestic producer that could manufacture an electronically and functionally identical product. To comply with second-source requirements, firms had to exchange designs and share sufficient process knowledge to ensure that the component produced by a second source was identical to the original product. Mandatory pre-commercial information exchange and mandated weak IP resulted in rapid learning and platform development.

5. Chips masks protection tools protect the design and manufacture of specific chips. These rights protect the broad architecture of the chip, and its core technology and components.

industry for its software and business methods. In the US patent system, these subject matters are patentable, and are indeed frequently patented. The EU, however, has the ill-defined concept of computer-implemented innovations, which are a patentable subject matter (including software codes) provided they are associated with a well defined technology. Article 52 of the European Patent Convention applies European patents only to software that is part of a technological improvement. Thus, in contrast to the US, the EU does not provide strong patent protection for software development that leads to innovative business methods, new games or new online tools.

With respect to copyrights, the US fully recognises and implements the 'fair use' exception which allows a much smoother process for innovators to test new ideas across the internet.

A third major difference between the EU and the US is the fragmentation of the IP system. That Europe lacks a single patent is well known, though finally progress has been made. But beyond this, there is a need for a coherent EU approach to digital rights, copyright and data privacy policies. In these areas, EU countries have different regulatory approaches, leading to the perception of a fragmented system. This fragmented system reduces substantially the perceived market reach of innovations. Digital rights includes the regulation of platforms (IP pool practices), privacy protection and database protection. Another major difference between the EU and US systems is that in Europe the consumer is much more protected, but differently in different countries, creating a highly fragmented environment for firms.

Data privacy laws are more stringent in EU countries than in the US, where the soft regulatory environment is sometimes taken as a competitive advantage for new ICT services. It should be noted however that the *ex-ante* looser position in the US is accompanied by a tougher *ex-post* litigation climate.

Overall, there is vast room for IP policy improvement in Europe, particularly towards the homogenisation of IP policy tools in different countries, which is still far from being achieved. Despite its significant weaknesses on privacy protection and the quality of examination at the US Patent and Trademark Office, the US is integrated and much more open towards new technologies and soft protection mechanisms.

IMPLICATIONS FOR EU INNOVATION POLICY DESIGN

A good understanding the characteristics of the new ICT ecosystem, particularly inter- and intra-platform competition, is important for policymaking. But policymakers, including competition policy authorities, should also appreciate the dynamics of the ICT ecosystem which is highly non-linear, with high velocity, systemic interdependencies and path dependencies, fluid boundaries, and actors entering, specialising, constantly innovating, exiting and refocusing. Although there is some evidence and analysis emerging on the development of new ICT markets, there are still too many unknowns about whether and which government interventions are effective for supporting the development of new ICT markets[6].

With a highly complex area to address and limited evidence about which policy instruments are best to use, designing an appropriate EU policy for new ICT markets is bound to be a challenging endeavour. Nevertheless, the insights from the analysis of the FLY cases can be used to evaluate if the current EU policy framework, particularly the Innovation Union and Digital Agenda EU 2020 Flagships, is on the right track to deal with the major roadblocks impeding ICT-based growth.

The FLY analysis has shown that the problems appear not to be so much in the generation of new ideas, but rather further down the commercialisation path and in bringing ideas successfully to world markets. Obstacles include the lack of a single digital market, fragmented IP, lack of an entrepreneurial culture, poor access to risk capital and strong ICT clusters with pooled labour markets, the limited role of advanced early (public) users, and the lack of complementary industries. Do the EU2020 Flagships address these major roadblocks?

Strengthening the research base through Framework Programmes remains an important component of the Innovation Union Flagship, and

6. For analysis of government instruments in new ICT markets in the US, see Mowery and Langlois (1996), Fabrizio and Mowery (2007) and Mowery (2009).

also, in particular, for ICT in the Digital Agenda Flagship. But it is fortunately no longer the exclusive focus of EU ICT policymaking. This is an important and much needed shift because the critical deficiencies do not lie in the public R&D infrastructure. Policy attention, both in the Innovation Union and the Digital Agenda flagships, has shifted not only to supporting the generation of ideas, but also to helping to get ideas to market and to capturing the growth dividend from them.

The EU 2020 Flagships have moved beyond providing public funds for R&D to put more emphasis on developing the framework conditions for market development. The *Innovation Union* stresses the access to private finance, the single market and stimulating partnerships. The *Digital Agenda* focuses on the digital single market, interoperability and open standards and availability of (broadband) infrastructure. Also the *Industrial Policy* flagship stresses the building of framework conditions for fostering the EU's competitiveness. Its focus on industrial capacity strengths for capturing value is unfortunate, as it underestimates the potential of service providers to be in the pilot seat for capturing value in many new ICT sectors.

The emphasis on general framework conditions – improving access to finance, access to skills, access to markets and strengthening partnerships – is laudable. What still needs to be closely monitored is if the implementation of these policy ambitions through concrete policy measures will be effective. Will a general framework condition policy agenda be sufficient to mobilise the growth potential of new ICT sectors? Will a general policy be effective to address the specific barriers for development of new highly R&D intensive ICT sectors and firms? We concentrate here on suggestions for improving intervention at the EU level to leverage the growth potential of these particular ICT segments. These suggestions are by no means an exhaustive list.

Combatting fragmentation in European **digital markets**, particularly fragmentation caused by uncoordinated national regulations of relevance for new ICT sectors, cannot be high enough on the policy agenda. This includes not only product or service **market regulations**. The fragmentation in **IP rights** within Europe should also be tackled. Having made progress on the EU-wide patent system, policymakers' attention should also be directed towards an integrated EU approach to digital rights, copyright and data privacy policies. And without jeopardising quality standards, the European Patent Office's examinations should be much more open towards new technologies and soft protection mechanisms.

Standards and regulations, by overcoming market uncertainties, can help early-stage innovations to come to market sooner. Nonetheless they may also carry a risk of becoming trapped too early, precluding the emergence of new and better technology breakthroughs. When and which regulatory or standards interventions policymakers choose to use should be carefully evaluated ex-ante, based on their longer-term impact on the development of new markets. If and when governments intervene in standards and regulations, they should be designed with a technology-neutral and open perspective, which will allow new future innovators to continue to compete. These should also be designed in a coordinated fashioned with a global perspective, enabling firms to build first-mover advantage and leadership in world markets.

In line with the successes of US **public procurement** in ICT markets, the EU should make greater use of public procurement for nurturing early-stage innovations, at least in those sectors in which the public sector can act as a pivotal lead user. For new ICT markets, there are ample examples where the public sector can have an important early user role: e-government, e-health and e-education for the web 2.0 market, or public transport for RFID. Using public procurement as an instrument for supporting the development of new ICT markets is not about picking and protecting winners. Procurement policies should be designed not to replace private markets but to help develop them, stimulating the diffusion of innovations. Policies should encourage entry and growth of new firms, nurture potential competition and the development of complementary actors. When done at an EU integrated or at least coordinated scale, risks and resources can be pooled across a larger public market. Removing the fragmentation in the European public procurement markets

should therefore be high on the policy agenda.

To effectively address Europe's thin **risk capital** market, government intervention should address any market failure along the 'funding escalator', covering the whole cycle and not only the very early stage of shaping ideas, and testing and prototyping them. In particular government intervention should address the early commercialisation and larger-scale deployment of innovative projects. The EU has already in place a number of instruments and initiatives (eg Framework Programme and Competitiveness and Innovation Programme funding, loans by the European Investment Bank's Risk Sharing Finance Facility). In addition new EU initiatives should complement existing EU instruments along the funding escalator, particularly to bridge the gap from the idea to the world market. A programme similar to the US Small Business Innovation Research programme for funding pre-commercial projects should be established. See Veugelers (2009) for a detailed discussion of this.

To improve the availability of **specialised ICT skills**, the European higher education sector should be given the autonomy, finance and proper incentives to develop new specialised degree programmes that are sufficiently flexible, timely and responsive to new trends.

Any of the suggested policy interventions should not be seen in isolation, but part of a policy mix. This is important because the problems Europe has in building innovation capacity in new ICT markets are systemic. A prioritisation of policies would ignore this systemic nature.

At this stage of the analysis, with still too many unknowns about whether and which interventions are effective for new ICT markets, policymakers should engage in **prospective analysis and close monitoring of emerging technologies and markets**, to evaluate whether the right mix of general and specific policy instruments is present and adapt or drop interventions when this is not fulfilled.

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