European Commission

ICT research and innovation in a globalised world

A contribution for thinking strategically the role of international cooperation in EU ICT research and innovation

ISTAG

Working Group on International Cooperation

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1. Why strengthen the International Cooperation? Reasons, objectives & expected mutual benefits of International Cooperation on ICT for EU

A central objective of the Europe 2020 Innovation Union flagship is to improving the work with international partners. The strategy calls for a continuation of the EU's policy to provide open access to its R&D programmes, while ensuring comparable conditions abroad. This implies that the EU and its Member States treat scientific cooperation with third countries as an issue of common concern and develop common approaches to increase the level of international cooperation, while protecting common European interests at the same time.

The Digital Agenda for Europe, the EU's strategic policy for the ICT domain, seeks to maintain Europe's competitive edge, among others, through an increased focus on ICT research and innovation. International cooperation in ICT research and development shall support this goal, aiming at attracting the best minds to cooperate with Europe, and helping to establish important partnerships for the future.

However, in the current programme phase of the 7th European Research Framework Programme (FP7), International Cooperation (InCo) in Science, Technology and Innovation (STI), particularly in ICT research, has not reached an adequate and satisfying level. Though being promoted and supported in various work programmes, participants in FP7-projects have often developed a much broader relationship with international partners in alternative ways, e.g. through direct contacts and collaboration than through InCo activities of the EU. Therefore, ISTAG, the European Commission's advisory group on European ICT research, has been asked to work on a set of recommendations how to address this challenge in an adequate way and how to improve international cooperation in STI with the EU. Moreover, ISTAG has been asked to identify concrete cooperation opportunities both in terms of technological areas as well as regions to cooperate with. Lastly, this report should also serve to set the InCo RTD priorities for the 2013 ICT FP7 Work Programme.

It must be mentioned at this point that the report covers only the most relevant countries and technologies that show the biggest potential for cooperation in STI with the EU. However, in certain sections reference is also made to other regions and ICT-related topics (e.g. Green IT, Smart Grids or Robotics).

For the proper identification of such priorities specific contexts and conditions need to be taken into account:

- ***The particular context in which the ICT FP7 WP 2013 will be prepared***
  - the need to deliver on earlier commitments and ensure continuity
  - the need to bridge from the current research framework programme (FP7), which will end in 2013, to the successor programme Horizon 2020
  - the need for close collaboration and coordination between the ISTAG Working Group on International Cooperation with the ISTAG Working Group on the 2013 ICT FP7 Work Programme

- ***Specific information related to International Cooperation in ICT research and development***
  - intelligence about cooperation possibilities with strategic third countries
  - consideration of the results of recent calls for proposals with an InCo component
  - relevant technological developments in the EU and in third countries
  - experience with and views on InCo by the ICT European Technology Platforms (ETPs)
  - socio-economic and geopolitical evolutions
  - current political EU priorities in general, and in external relations in particular

Taking these issues into account, this report will address and focus on the following three main aspects:

First, it will be discussed how a strategic and sustainable approach on international cooperation in ICT-research shall look like. The given history shows that a simple tactical oriented approach will not lead to a sufficient level of international cooperation.

Secondly, it will be discussed which technological areas shall be of specific interest for international cooperation activities. In this context, a particular emphasis is put on European ICT-platforms and how these could be leveraged when cooperating with international partners.

Thirdly, it will be discussed how to cluster the activities with respect to regions and countries. It is obvious that the international partners from different regions are in different stages of maturity and levels of development. Therefore, a "one-fits-all" strategy won't be adequate and cannot be applied. In this section, emphasis shall also be put on the issue of "competition versus cooperation".

Finally, a list of recommendations will be provided that should ensure a more strategic and sustainable approach on international cooperation in ICT research with the EU.

In order to get a common understanding for the strategic thinking which is guiding and driving the authors of this report, a summary of the reasons, objectives and expected mutual benefits of International Cooperation in ICT-research is provided in the following. The underlying question in this regard is: "Why should the EU improve international cooperation in the field of R&D with other technology- and R&D-intensive countries?"

International cooperation in science, technology and innovation (STI) presents a number of opportunities and challenges for both those who collaborate and work together in such activities as well as the wider public and economy that benefit from its results and outcomes. In the following section reasons and objectives are presented that shall explain why the EU shall strengthen its activities in the field of international cooperation in ICT-research and why ISTAG supports it. As a conclusion, the guiding principles for a future EU policy on this issue shall be: strategic thinking, proactive action and synergetic outcomes.

Strengthen competitiveness and tackle global societal challenges

International cooperation in STI is an adequate instrument for strengthening the competitiveness of European companies. It gives them access to excellence in third countries and facilitates access to new markets at the same time. In this context, the focus should be on developing industrial partnerships and on creating a level playing field between the EU and its partners.

In addition, international cooperation in STI can help to respond more rapidly and effectively to global societal challenges by providing an infrastructure that enables to work more efficiently on joint solutions. ICT is of major importance in this context due to its enabling and catalytic character.

Respond to the global character of ICT-technology and the market

The ICT-sector is one of the most international and globalized markets world-wide. Main technologies and services are provided on a global-scale, particularly when having a closer look on developments in the web-based field. The basis for economic success of many ICT-technologies is to operate internationally. Examples in this regard are online search engines, mobile communication technologies, social media platforms, and enterprise wide applications. Therefore, the EU should flank these developments with a policy that supports cooperation especially on standards, IPR, regulations, public procurement and open markets.

In this context, international cooperation in the field of ICT research supports the global character of this technology. It allows for the tracking of future trends at an early stage before they reach the market. Cooperation further is enabling researchers and developers to get access to existing pre-products and supplying components on the international markets thereby supporting the acceleration of own development processes. Lastly, international cooperation in ICT research is helping to assess the level of technology development outside the EU and how this might apply to the European ICT-platform strategy.

Exploit growth and innovation potential

Despite the size of the EU internal ICT-market, its level of output, growth creation and innovation potential is limited to a certain degree, requiring from European ICT-players to further reach out to international markets. In a long-term perspective, it is necessary for European ICT companies to face competition outside the EU to stay competitive, to enter new markets and to keep pace with developments taking place elsewhere. International cooperation is addressing these issues. It can be seen as a mean to secure the leading role of European ICT-companies by fostering knowledge and information exchange thereby enabling them to get a deeper insight on markets, technologies and relevant players outside the EU.

React on ICT research & development trends outside the EU

Reluctance and inactivity in terms of reacting on new global technology trends led to a situation in Europe that certain R&D activities are nowadays carried out outside rather than within the EU. With a view on ICT, special attention must be put in this context on social web technologies, online applications, cloud computing as well as virtualization technologies. European companies missed the chance to shape new developments, now being in the difficult situation to be forced to catch-up. Through international cooperation this trend can be eased and countered. It enables European researchers to get access to new technologies, embedded systems and related components. That way they are able to keep touch with new trends while getting at the same time the possibility to contribute to new ideas and work on complementary technology and supporting services.

Learning from ICT-innovation strategies from outside of EU

A range of ICT-technologies and inventions have their origin in Europe, though the further development of the technology and its final market entrance is taking place elsewhere. A prominent example in this context is the MP3-Player, originating from Germany but further developed and produced in Asia. Through international cooperation lessons could be learnt from why certain non-EU-countries are more successful in creating innovation from inventions. Specific areas of interest for the EU in this regard should be: access to venture capital, the role of public procurement, as well as support public-private cooperation models. As a result, the EU could learn from successful examples in third countries and adapt its own policy accordingly.

Support European ICT-companies to internationalize (especially SMEs)

An effective measure for companies to protect themselves from a severe impact of economic crises is to diversify their sales markets. A German study is proving this assumption, analysing the strategies of different ICT-companies on how to cope with the financial and economic crisis in 2009. As a result, ICT companies operating on a global level were more successful to come through the crisis than companies with a more limited market basis. One of the reasons is that countries and regions got differently hit by the crisis. While the US and EU suffered heavily from the economic downturn, markets like Brazil, South Africa, India and China were less affected. For that reason, ICT-companies, that were present on these markets, were able to react more flexible on the new situation than less internationalized ones.

As a result, the EU should further support European companies in their efforts to internationalize to make them less vulnerable in future crisis situations. The aim must be to

develop a coherent European approach which simplifies processes of establishing contacts and co-operations, as well as offers possibilities to collaborate in joint programmes and frameworks. A special focus in the development of this policy has to be put on SMEs for whom internationalization is connected with particular economic and competitive risks.

Support development and catch-up processes in less-developed countries

International cooperation in STI is an instrument to support development processes in less-developed countries. It helps them to build up scientific competences and to strengthen their academic and technological basis. Emphasis in this context shall be put on specific economic and social challenges like food and energy security, bio-diversity, poverty-reduction and health. As such, STI-cooperation supports EU External Policies to develop strategic external partnerships with certain regions and countries.

Create mutual benefit

In order to be successful, a core requirement for international cooperation in STI is to guarantee mutual benefits for all participating partners. Each participant has to profit from its engagement into such activities. Therefore, ways of cooperation need to be developed in a joint exercise involving representatives from the EU, the partner countries and regions as well as from the industry and research community in order to develop an effective, functional and sustainable framework for cooperation.

2. Strategic Approach of International Cooperation on ICT for EU - Areas & Instruments

2.1 Strategic Thinking behind International Cooperation

The EU's policy in the field of international cooperation in science, technology and innovation (STI) is subject to certain strategic considerations. This section analyses certain thoughts and recommends how to strengthen the EU's approach.

In general, from a geographic point of view, the EU differentiates between three groups of countries:

- industrialised countries (mature markets) and emerging economies (e.g. BRIC)
- enlargement and neighbourhood countries
- developing countries

For each group different priorities as well as drivers for collaboration in STI applies. The proposed concept for coming programmes should focus on a more specific and strategic agenda for international cooperation in STI, based on geographic thoughts or thematic considerations. In this context, it is of major importance to assess, why certain regions, countries or companies are of particular interest or importance in terms of potential or know-how for the EU. In order to be able to make these kinds of decisions, it is necessary to make considerable effort in information and intelligence gathering and to conduct strategic assessments of potential partners. The outcomes of such targeted country evaluations shall constitute an important input to the broader discussion, taking place e.g. in joint S&T committees. Aspects to be considered in a country analysis shall include, amongst others:

- the current and prospective STI capacity of the target country
- possible synergies between target country's and European capacities
- the current and prospective economic performance of the target country
- the market situation in the target country
- interests of potential partners in the target country
- interests of European partners
- added value of EU actions on already existing actions at the national level
- added value of EU actions on already existing actions that directly involve stakeholders
- prospects of finding the right balance in terms of mutual benefit (including reciprocity)
- IPR-related issues, pre-competitive standards and the risk of strengthening competitors
- potential mechanisms/instruments for action

In this context, the policy dialogue with third countries merits modification. In future, the discussion should not be limited to science and technology topics but also take other EU priorities into consideration and put emphasis on mutual benefits and the avoidance of fragmentation. The aim should be to use international cooperation in research activities for the promotion of progress on framework conditions for innovation (e.g. IPR, standards, regulations) and strengthening competitiveness (e.g. facilitate access to markets). In addition, international cooperation in STI must be put into connection with the EU's external policy, due to its significant contribution to development and catch-up processes in less-developed countries (also known as "science diplomacy").

The policy dialogue itself should take place in a more flexible way. A more open approach should be applied which pays greater attention on the actual capacities and innovation potential of the partner countries/regions. The effectiveness of more formal ways of cooperation like association

or S&T agreements are seen with some scepticism as they often involve an important negotiation burden and the final result often lacks the necessary flexibility. Instead, ad-hoc STI groups for cooperation are seen as an adequate mean for cooperation. At the same time, direct collaboration in policy terms with strategic partners with a large capacity in STI should be considered. The definition of a common research agenda with certain industrialised countries and the BRIC states should be accelerated, including concrete actions at programme level (e.g. coordinated calls, twinning, and participation in JTIs) and a strengthening of links between research and economic cooperation. A similar approach should be applied with associated countries to the EU (pre-accession countries, EEA/EFTA-members as well as EU neighbourhood countries) that have close STI and economic links to the EU and a good track record in the current FP7 programme. For non-EU-members direct collaboration with the EU is of great importance, since it is an indication to them that they are treated as equals, thereby contributing to developing a feeling of mutual trust.

In order to pay attention to different levels of development a customized approach in STI cooperation needs to be applied. Important is that EU-support is given to third countries according to their economic strength. At the same time, the EU should take into account and reflect in its work programmes the economic and market potential certain countries (BRICs) have for the EU and develop targeted joint programmes.

In general, instruments that are envisaged in the new EU research framework programme "Horizon 2020" for international cooperation in STI will include: collaborative research projects, frontier research, mobility grants and infrastructures, large scale projects (EIT-KIC, European Innovation Partnerships, and PPPs) as well as joint programmes with 3rd countries.

2.2 Intellectually Property Rights (IPR) and International Cooperation

Recently a discussion on a 'Europe centric IP policy' was triggered by one of the recommendations in the KET report (KET - Key Enabling Technologies). It is clear that in view of International Cooperation between the EU and third countries this recommendation and the European IP policy in general should be addressed.

Due to the exploding cost of research in advanced ICT technologies (both hardware and software), global partnerships are established to tackle the more general/fundamental issues. As such, research is becoming a global activity and can no longer be done in an isolated environment. For that reason it is vital that Europe builds up win-win research partnerships with non-European countries.

BusinessEurope stated very clearly: "The EU must aim at creating growth and jobs within Europe by strengthening the competitiveness of its enterprises and realizing their full innovation potential also through the promotion of a globally competitive IP policy; however this must be implemented in the right way, ensuring that the EU remains an open economy in a globalizing world and continues to advocate free trade.

Stipulating that IP from EU-funded projects needs to first be exploited within the EU is incompatible with the way European companies operating in a global environment are organized and do business. These provisions would discourage the participation of a large fraction of global enterprises in Horizon 2020 and limit opportunities for EU based companies to co-innovate with other partners."

In a recent press release the EUROTECH Group within EARTO stated that optimal protection of European interests should preclude the grant of exclusive licenses to non-European entities, while fully encouraging productive engagement with leading global players through active knowledge partnerships.

Europe should set up collaboration with non-European partners in an effort to share not only resources but also the results and aiming at win-win partnerships in existing and new markets. Such open innovation scheme should allow for an efficient protection of background IP of the partners, but also sharing of new foreground IP.

2.3 Standardization & Technology Overview

The use of standards to enable and ensure interoperability of networks and systems, especially in the field of ICT, is today a well known and established mechanism. Globally accepted standards is an essential tool in creating the basis for mass market and hence world market access for our industry. In combination with the widely accepted principle of FRAND1 licensing policies for handling of intellectual property rights it has become an important component for sharing the cost related to the developing of new technologies, which is of key importance in stimulating further investments into R&D. Investments needed to maintain and further strengthening European competitiveness in the globalised economy.

In the past, standards were more related to technical standards and more specifically directly related to product standards, targeting specific infrastructure or an application. This has today changed and we are evolving more towards process and production oriented standards covering a broad range of subjects, not being limited to one area or usage. Standards will to a larger extent only address part of a system rather than the entire system, still continuing to play a crucial role in supporting interoperability of existing and new networks and systems and its usage and implementation within other sectors of our society.

In the globalised economy, where ICT today is being identified as a key enabling technology, we need to ensure that a European standardization system is supporting our Europe 2020 Strategy for smart, sustainable and inclusive growth where globally harmonized standards must keep pace with ever faster product development cycles. In addition being the basis to a proper functioning of the single market and enabler for more innovation and social inclusion.

2.4 Instruments

Regional and Country Specific Opportunities

Open European R&D support programmes for external partners are a key requirement for allowing international cooperation in STI with the EU. Thereby third countries and regions get the opportunity to join promising European projects, and the possibility to bring in their respective potential and know-how. However, differences in development levels call for a customized approach in order to be able to respond to the individual situation in certain countries and regions (e.g. exclusive access to certain programmes for less-developed regions). Also, certain competition issues like IPR, state aid or unfair protection of domestic markets need to be considered when developing an effective international research cooperation policy. Therefore, it is of major importance that framework programmes are developed that address the before mentioned issues, and are equipped with adequate tools and instruments.

Despite the general notion that all R&D programmes shall be open for international cooperation, consultations with international delegations have revealed that certain instruments are regarded as most favourable and best suiting for the support of international research cooperation with the EU. These are:

- **Collaborative Research**

  Collaborative research is regarded as a favourable instrument for supporting international research cooperation because of its flexible nature. The range of tools includes:

[1] FRAND – licensing of the patents that form the basis of the standard under fair, reasonable and non discriminatory terms

- targeted calls and topics that require and/or encourage external participation from third countries; including the promotion of matching funds
- coordinated calls with a common research agenda; including joint calls (with common funding) or parallel synchronised calls (with aligned funding)
- coordinated calls with complementary research agendas and reciprocal funding agreements
- contribution to organisations that manage joint international research programmes in specific areas

- **Coordination and Support Actions**

  In terms of Coordination and Support Actions the EU contributes to international research cooperation through calls that concentrate on twinning existing projects or through the support of certain coordination and joint actions in the Member States (ERA-net, ERA-net+).

- **Joint test beds, pilots, innovation calls**

  With a view on supporting innovation activities, instruments include joint test beds in other markets (South Korea, Australia), joint pilots on strategic themes (e.g. Future Internet) as well as joint innovation calls with user communities focusing on target markets (e.g. Healthcare or Smart Grids).

In the following paragraph, ISTAG recommends additional actions that are regarded as most promising for the support of international cooperation in STI. They shall be included into the list of actions of the upcoming 2013 ICT FP7 Work Programme as well as the EU's future research framework programme "Horizon 2020".

2.4.1 Simplifying Joint Calls

Joint calls between EU member states and international partners have proven in the past to be an adequate tool to build up international cooperation partnerships and to achieve real benefits from the joint exercise. However, it is necessary to work on further simplification of the instrument to make international cooperation easier to come into place.

A major bottleneck in this regard is the length of the whole programme development, application and implementation process. At present, it takes about 2 years to develop an EU research work programme. Additional 1 ¼ years are needed to implement such a programme (opening of a call for proposals, application, evaluation and approval of project proposals) before a project can finally start. This time horizon does not match with the actual research to market cycle of the ICT-industry. For example, an iPhone generation has a time horizon of one year. Taking this market and innovation situation in the ICT-industry into account much faster processes are needed to support R&D at the EU-level.

Therefore ISTAG recommends speeding up the whole R&D funding process in the EU. It is necessary that EU support programmes reflect the innovation cycle in the ICT-sector. This includes fast procedures for the development and implementation of work programmes that shall not exceed 9 months from call opening until the final approval of a project. In this context, a "short cut-procedure" should be developed to enable ICT companies to gain real added-value from taking part in EU research projects. In addition, the attractiveness of international cooperation projects must be increased, e.g. by favouring proposals that contain partners from third countries. As a last point, ISTAG calls for regular data gathering and reporting on international cooperation activities in the field of STI at the EU-level (e.g. informing on the participation rate and acceptance quota).

In this context, with a view on ICT, ISTAG further recommends to develop targeted R&D co-operations on strategic ICT topics with third countries (Taiwan, South Korea) and to strengthen the cooperation with specific regional organizations (APEC, ASEAN, Mercosur etc.).

2.4.2 Deploying EU ICT Technology in external labs

In some countries like South-Korea or Taiwan large technical laboratories (labs) were set up in the last years, larger in size compared to their counterparts in the EU. International cooperation could address this development and create synergies at the same time. While EU-based companies are given access to these labs and the right to deploy their technologies in them, partner countries will benefit from knowledge transfer and exchange with European researchers. In addition, it supports a further exchange between market participants and technology experts and can be used as show-rooms for European technologies and external markets.

2.4.3 Open European ICT platforms for ICT-applications from outside the EU

A new instrument for International cooperation in STI could be the development of strategic alliances which bring together European and third countries' specific strengths in certain technology fields. While the EU is particularly strong in ICT-platforms for enterprise software or in the field of internet of services, countries like Taiwan or Korea are strong in ICT-applications. By combining these conditions, and opening European ICT-platforms for ICT-applications from outside the EU, European ICT will be leveraged, and could be implemented as standard in the partner countries. In addition, innovation can be created through the further development of the ICT-platforms through the exchange with external ICT-researchers and experts.

3. Technological Areas of Cooperation – European ICT Platforms

3.1 Future Internet

Scope

ICT is today an enabler to numerous other key areas at the heart of European strategy for economic growth and well-being. The overall global market for ICT and related communication is enormous and Internet has today become a vital part to our daily life and development of our societies; not only as an enabling infrastructure, but even more so as a key driver for our future change. Pace is increasing as ICT and communication becomes an integral part of almost anything we do and as a result - traffic demand is doubling every year together with an increased mixture in traffic, all placing enormously high requirements on the behind systems – We have moved from society of human communication only, into a world of Internet of Things – where machine-to-machine communication will be a large part of future communication.

The need for new developments and use of the Internet bring opportunities for Europe to exploit, not only in terms of new technical architectures but also in the domain of services and applications. There will be need for new architectures enabling flexibility in new services introduction and deployment whilst supporting in hiding technical complexity and interoperability. Technical areas such as flexibility, scalability, efficiency and robustness together with autonomous and self-organising operation, ubiquitous connectivity and services will be key in future operation providing seamless service for the user, being human or machines.

Main Actors

Main actors in the research field are Europe's large ICT industries and academia organisations, who together carry out both the identification and definition of strategic research areas as well being main drivers within established programs and projects. Through established global forums (e.g. Wireless World Research Forum, WWRF) results and views are exchanged, involving stakeholders from all regions in the world to align not only results achieved but also the way forward.

Even though ICT being a key enabler into almost all sectors of our society, ICT research and innovation programs are today in Europe still to a large extent not integrated as part of cross-sector programs and there is a need for increased interaction between developer and user of technology. Member States could here play a more active role into facilitating early research and innovation programs and the take-up of new technologies in order to stimulate development and growth in targeted sectors.

On-going Activities

Future Internet has been a European focus area for several years, both at European level and Member States level. On-going activities are mainly part of the European Commission pre-competitive research oriented programs (FP7) and cover a broad area of different technical challenges. In addition, the European Technology Platforms (ETP), holding some 1.000 stakeholders, assist in providing strategic views in terms of a European strategic research agenda, also aligned at a global level.

However, there is an increased need for increased technology transfer from research into innovation and market take-up. For this reason, recent activities have been launched to address the innovation phase and trialling of new technologies and concepts for future markets segments. Serving the idea of innovation and market take-up the use of Private-Public-Partnerships (PPP), looks promising, but need a more thorough shaping than of what is today present.

Benefits of International Collaboration

ICT today is an area where globalization is more visible and present than in perhaps any other area. It is therefore essential that research and development are undertaken with a global perspective, still building on regional and national strengths aligning initiatives into harmonized contributions. Europe has through its EU-wide collaborative research programs a long tradition in pre-competitive research programs, which has played crucial role into establishing technical position for several technical standards, today implemented and used globally. International collaboration not only provides insights into the technical developments worldwide, but also enables to bring key strengths into line with global perspectives and to prepare for new potential markets.

Thus the EU should continue to invest into programs devoted for ICT Future Internet, communication technologies and infrastructure architectures in order to support Europe's industry (particularly SMEs) and academia for a continued strong position in global markets. Programs should provide for large flexibility over time in terms of content and execution as well as enabling international collaboration. This approach should also include also a stronger alignment of existing instruments for concerted efforts.

3.2 Cyber Security

Scope

Over the last decade, all major entities worldwide, including EU and US institutions, have introduced cyber security policies to protect all aspect of cyberspace. The International Telecommunication Union (ITU) defines cyber security as the collection of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies that can be used to protect the cyber environment and organization and user's assets. Organization and user's assets include connected computing devices, personnel, infrastructure, applications, services, telecommunications systems, and the totality of transmitted and/or stored information in the cyber environment. Cyber security strives to ensure the attainment and maintenance of the security properties of the organization and user's assets against relevant security risks in the cyber environment, without degrading the user's experience when using web and ICT networks. The aforementioned definition spans cyber security to a very broad horizon, broader than technology solutions can offer. Therefore a comprehensive approach in R&D is required, including contributions from governance, organisational, legal, operational and educational domains.

The UK Parliamentary Office of Science and Technology[2] defines cyber security as referring to the defences against electronic attacks launched via computer systems. They go on to identify a spectrum of possible attacks from small-scale e-mail scams through to major attacks on critical infrastructure (either the information infrastructure or physical infrastructure), attempts at data theft and espionage. In the UK, cyber security has been identified as one of the top four priorities for national security. The government emphasis is on large-scale attacks and this is a common theme throughout the world – the US Department of Homeland Security (DHS) is running a Cyber Security R&D Centre since March 2004 focussing on these issues.

[2] http://www.parliament.uk/documents/post/postpn389_cyber-security-in-the-UK.pdf

Categorization and impact of Cyber threats

Many commentators categorise cyber-attacks into four main kinds[3]:

- Against individuals and business (cyber crime)
    - Cyber crime which is mainly targeted at individuals or companies with a motive of financial gain
    - Cyber espionage which is mainly targeted at companies and governments with a motive of data/information theft.

- Against states (cyber warfare)
    - Cyber terrorism which is more difficult and controversial to define.
    - Cyber warfare which involves military operations conducted in cyber space.

This initial segmentation of cyber-attacks can be further complemented by the impact on information, the degree of the disruption of services and networks and the motivation of the attackers[4]. Nevertheless and regardless their focus cyber-attacks have considerable negative impact on the performance of business, administration and citizen's everyday life and therefore the availability, integrity, authenticity and confidentiality of cyberspace has turned into a central challenge for the states, business and society both at EU and international level.

Governments are mainly focussed on the last three of these. The DHS published a roadmap for cyber security research at the end of 2009[5] which identified 11 hard problems:

- Scalable trustworthy systems (including system architectures and requisite development methodology)
- Enterprise-level metrics (including measures of overall system trustworthiness)
- System evaluation life cycle (including approaches for sufficient assurance)
- Combatting insider threats
- Combatting malware and botnets
- Global-scale identity management
- Survivability of time-critical systems
- Situational understanding and attack attribution
- Provenance (relating to information, systems, and hardware)
- Privacy-aware security
- Usable security

We are still at an early stage of addressing these problems and some of them are featured in the remaining calls for the ICT work programme in FP7.

Main Actors

EU governments have an important role to play in this area and their responsibilities are largely discharged through CERTs (Computer Emergency Response Teams) who have responsibility for protection and education and raising awareness. Europe's main partner in cyber-security is the United States. For this an EU-US Working Group on cyber security and cybercrime has been established, and the first joined EU-US cyber-defense exercise has taken place in November 4th 2011. NATO is also one key of the key actors in cyber-security domain. Recently, at 2010 Lisbon Summit NATO identified cyber-attacks as one of the main threats against Alliance members and in June 2011 issued the NATO's Policy on Cyber Defense.

[3] Cyber Probing: The Politicisation of Virtual Attack, Defence Academy of the United Kingdom, 978-1-905962-89-1, September 2010

[4] EOS White Paper on Cyber Security, September 2010 (available at http://www.eos-eu.com)

[5] http://www.cyber.st.dhs.gov/docs/DHS-Cybersecurity-Roadmap.pdf

Outside Europe there are also significant actors with active cyber-security programs, either state or privately driven. Countries like Russia, Australia, China and other Asian Countries have influence in the cyberspace and their contribution and co-operation for establishing global cyber-security should be taken into account.

The industrial actors include companies that run large infrastructure (utilities, telecoms, mass transportation systems operators); companies that specialise in security and defence solutions and software providers.

The EU research community is also present in this area. Within FP7's security calls a lot of European Universities and Research centres have conducted research in topics related to cyber-security and protection of critical infrastructure, and from that participation have gained vital experience in cyber-security.

On-going Activities

The first European initiative to deal with cyber threats and specifically with Cyber-Crime is the Budapest Convention on Cyber-Crime. The treaty, issued in 2001 by the European Council is currently ratified by 30 countries (some non EU like USA), provides the first basis of cooperation.

In 2005, EU created the European Network and Information Security Agency (ENISA). ENISA is considered as a centre of excellence for the European Member States and European institutions in network and information security, giving advice and recommendations and acting as a switchboard of information for good practices. Moreover, the agency facilitates contacts between the European institutions, the Member States and private business and industry actors.

In 2009 EU issued the Digital Agenda 2010-2020[6]. One of the Pillars in this Agenda is Trust and Security which has thirteen actions for enhancing cyber-security, and therefore can be used as a guide for conducting R&D in EU level and internationally.

Benefits of International Collaboration

Cyber security is a global concern. The EU has already run joint exercises with the US and the UK recently held a major summit which was attended by delegates from 60 countries including China and Russia.

Since one of the main benefits of Cyberspace is that it is a global and open infrastructure, capable of spreading information, socioeconomic development, essential improvement in social and business life, its global and open nature is a key value. Therefore it is important to find security solutions that protects cyberspace from any malicious activity, within the framework of open, globally available, standards.

The cross-border nature of threats makes it essential to focus on strong international cooperation. Many measures will only be effective if they are aligned or implemented at an international level. Organizations like the EU (Digital Agenda for Europe and the Internal Security Strategy) and NATO (cyber defence policy) can form the basic reference point for developing such co-operations. The results from EU funded projects as well as the EU's research infrastructures can be utilized by the other countries in order to form a common cyber-security baseline. Joint calls with countries like Australia, USA, Japan, Russia, China and other Asian Countries can reinforce co-operation and produce concrete results in securing cyberspace.

[6] http://ec.europa.eu/information_society/newsroom/cf/pillar.cfm?pillar_id=45&pillar=Trust%20and%20Security

3.3 Micro-Electronics

Scope

The domain considered comprises both the More Moore (MM) and the More Than Moore (MTM) areas. MM refers to the dimensional and/or functional scaling of components on silicon chips used for microprocessors, memories, logic circuits, while MTM refers to the added functionality by combining other devices like MEMS, sensors, transducers. This domain contains the circuit and system design techniques, the device and process R&D and also the equipment and material development needed to make the 450 mm wafer transition happen. In extension, the domain may also contain the PV (Photovoltaic) area and the LED area as semiconductor materials are used in these fields.

Main Actors

The main actors are companies like Intel (processors), Samsung (memories), TSMC (wafer foundry), Texas Instruments (analog and mixed signal), Toshiba (memories), Qualcomm (wireless), Sandisk (flash memories),and many others like Renesas, Panasonic, Xilinx. Key players in Europe are STM, Infineon, and NXP. Intel has a big fab near Dublin; Global Foundries has a fab in Dresden. European equipment and material suppliers like ASML, ASMI, Aixtron, and Siltronic have an important market share. Other non-European key players are Applied Materials, LAM Research, KLA Tencor, TEL, Nikon, and many other suppliers of resists, gases, materials, metrology tools. European research centers like FhG, imec and LETI are amongst the best in the world.

On-going activities

Europe has several very active industry driven Eureka clusters like CATRENE, ITEA (more ICT services oriented), EURIPIDES (packaging) and ETPs like EPoSS (smart systems). The ENIAC and ARTEMIS JTIs were launched a few years ago and are fully operational. Challenge 3 ("Alternative Paths to Components and Systems") of the FP7 ICT-theme complements the developments undertaken in these two JTIs. It covers the topics: electronic and photonic components, integrated micro-/nano-systems, multicore computing systems, embedded systems and their monitoring & control and cooperating complex systems.

Benefits of International Collaboration

As R&D in the field of micro-electronics is becoming increasingly expensive, global alliances and consortia have been formed in order to share the cost, the efforts and the results of joint programs. In view of this, Europe should not stay aside but should establish partnerships with companies and countries outside Europe.

3.4. Wireless Sensor Networks

Wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants, at different locations.

Scope

The development of WSN was originally motivated by military applications such as battlefield surveillance. However, WSN has potential in many industrial and civilian application areas that include machine health monitoring, disaster management, environment monitoring, healthcare applications, home automation, aerospace and aviation, automotive and ambient assisted living.

WSN commercialisation has already started with applications such as automating meter readings in buildings, and manufacture and process control automation. Smart meters (collecting house meter readings wirelessly) is by far the biggest success of WSN (wherein ZigBee protocol is employed) and is seen as a starting point for home automation (wireless sensors automatically communicating with smart meter).

WSN will grow rapidly from $0.45 billion in 2011 to $2 billion in 2021.WSN business is set to become a multibillion dollar activity but only if there is major progress with standards, technology and device lifetime [1].

In spite of vast amount of research works there are open topics that will have to be addressed specific to the application sectors (mentioned above) for realizing the potential of WSN. Some of the important research areas include promising battery technologies for the next ten years, energy harvesting techniques (photovoltaic, thermoelectric, piezoelectric), real time target tracking sensor networks, green reliable and secure systems, sensor networks and social sensing, sensor- mobile platform integration.

Main Actors

Based on the current geographical spread of development and usage of WSN the main players in WSN are as shown in diagram 1 below[7]. The most important country by far is the USA, followed by Korea. Only Korea has a nationally coordinated program directed at the future of WSN. East Asia will become a more important territory for WSN in the years to come.

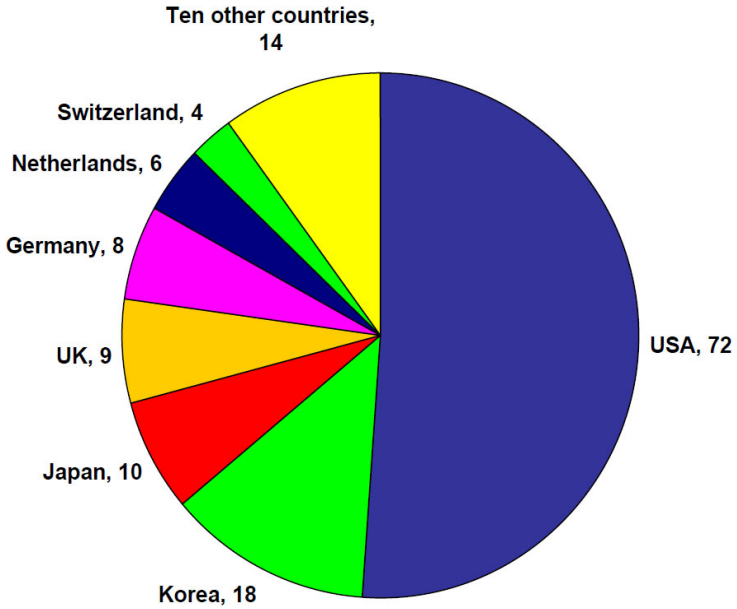


Diagram 1: Global and European Wireless Sensor Network (WSN) main players

The reason for USA to dominate the development and use of wireless sensor network are:

- Heavy funding while other countries invest far less. For example the CENS (Center for embedded networked Sensing) at UCLA alone has got 40 million dollar for the past 5 years of WSN work.
- Creating and funding start-ups is particularly easy in USA.
- US industries (like Microsoft, IBM) are particularly interested, as WSN is regarded as next wave of computing.
- US military spends more than all other military forces combined

[7] Wireless Sensor Networks 2011-2021, IDTechEx, Dr. Peter Harrop and Raghu Das.

The main actors in Europe are UK, Germany and Netherlands. Noticeably the WSN research and development activities in Europe is by far less compared to that of USA and also to a certain extent less than that of East Asia (Japan, Korea).

In general the WSN time to market is quick for governments than for the industries as the industries main priorities lie in rapid payback while the governments focuses towards better safety, security etc. The governments created the first main market for WSN in smart meter.

On-going Activities

The on-going WSN activities include EU research programmes, product development and research in companies, activities by research centers and R&D projects. Some of the important activities are mentioned as follows:

European Commision ICT work programme 2011/12 addresses using WSN technology as target outcome for the objectives "Low carbon multi-modal mobility and freight transport". This programme also addresses using WSN technology for "network monitoring and control" research area for the objective "EU-Brazil international cooperation".

European companies provide versatile solutions for asset tracking and RTLS (Real Time Location System) in the supply chain using network of smart objects (sensor devices with product information like history and origin). Ambient Systems, Netherland provides a cost-effective solution for real-time monitoring of temperatures (for food and pharma products), as well as security.

The "Living PlanIT" Project[8] focuses on making smarter cities by creating an ICT platform through aggregating existing and proven technologies that will be blended into real estate development. They plan to embed huge number of sensors in the "test-city" Portugal and are focusing on stadndardisation, open API, horizontal integration, lifetime and zero maintenance for embedded sensors.

Benefits of International Collaboration

As far as the WSN standards are concerned there is no standard that has emerged as a clear winner. This is because the industry is not gearing towards a more collaborative approach to allow many to win as they have their own proprietary wireless communications which in turn is putting off adoption. Besides customers don't want to buy proprietary solutions due to scalability issues, considering the fact that multivendor sensors will have to be interoperable. Also concerning scalability, no one has yet tested the performance of WSN with 100's to 1000's of sensor nodes.

Another problem is the lack of a total solution that delays adoption. Vendors are providing only hardware or software solutions and require complete solutions to be more successful. Additionally reducing the price and increasing node lifetime are keys to high volume applications.

An international collaboration (industrial partnership) can handle pitfalls like standard adaptation delays, lack of total solution, scalability issues, high costs. Collaborations with the main player USA and also with East Asian countries like Korea can be mutually beneficial and can facilitate access to new market, diversify sales make EU companies less vulnerable to crisis situations.

[8] http://living-planit.com/default.htm

3.5 Future Urban Mobility / e-Mobility

Scope

Future Urban Mobility is part of a larger mega-trend which is linked to growing urbanization world-wide and the emergence need of mega cities and large metropolitan regions:

- Throughout the 20th century, cities all over the world witnessed unprecedented expansion
- For the first time in history, more than half of the world's people now live in urban centers
- By 2050, the United Nations predicts that 7 of every 10 people will live in massive urban centers Cities are top players in their nations' economies.

China is one of the most striking examples of urbanization:

- China plans until 2025 to increase the city population up to 85% (today less than 50% / end of 2010)
- 100 new cities with more than 1 m inhabitants until 2025 6 new mega cities with more than 10 m inhabitants
- Doubling the cities with 1 m inhabitants up to more than 220 cities
- Merging the cities of Guangzhou and Shenzhen to one super mega city (over 40 m inhabitants)

Also Europe faces a strong trend of urbanization: In 2010 more than 71% of Europe's population lived in cities. Europe has a current urbanization degree of 72%, which will increase to 78% in 2030. In Germany, Belgium, Netherlands and Denmark this degree is >85%. Europe in general has about 120 Metropolitan Regions with more than 500.000 inhabitants.

Urbanization leads (among others) to high population density, more cars on the roads, overloaded transportation systems and high emission with impact on the environment. Urbanization processes in this context are therefore specifically concerned with crucial mobility questions. Among others they relate to issues like:

- reducing the number of individual cars and emissions in urban agglomerations
- developing and applying innovative multi modal integrated transport concepts that are efficient, secure, emission free and cheap and demonstrate an intelligent mix of individual and public means of transport
- solving the challenge of mobility and transportation in urban areas as one pre-condition for well-functioning urban processes

Possible solutions are new concepts of are integrated transportation systems like car sharing, new mobility chains, intelligent traffic management and information systems, mobility as a service, electro mobility (eCars), smart public transportation systems.

Internationally, there is a fast and strong tendency to develop electro mobility systems with electric vehicles, storage and loading systems on the technology side, as well as new business models and mobility concepts on the complementary side.

The automotive industry and in addition its large supply industry is one of the most important industrial sector for Europe. Of course, Europe is the cradle of automotive technology and industry, the place where the cars were invented, 125 years ago. If the new car is an eCar, Europe has to be on the top of this development. The danger is, that Europe loses its competitiveness in one of its core and future market.

Main Actors

Main actors on country level are China, Japan, USA, Canada, France and Germany. China is planning for 11 million eCars in 2020, USA and Germany are planning for one million, France and

Japan for two million, all until 2020. Drivers in Europe are mainly Governments in connection with local communities (city and logistic planning), R&D institutes and companies specialized on components of eMobility. Current new urban mobility concepts are more in the stage of test-beds, pilot projects or labs than real market approach. Thus, business cases for eMobility as part of larger new Urban Mobility concepts are still missing or in a development stage. Estimation of the total market size is about 470 billion Euro by 2020 and about 77 million eCars by 2020 worldwide.

From industry side, the main actors are OEMs which have eCars in their present portfolio and ready for the market: Mitsubishi, Opel/General Motors, Citroen, and Peugeot.

On-going Activities

EU-level: Green Cars Initiative – Toward Horizon 2020

The scope of the Green Cars Initiative is to contribute to a smarter, greener, integrated transport system, which is a major societal challenge for Europe. Transport is the largest sector in Europe, requesting a high R&D intensity. To gain visibility, achieve critical mass and obtain tangible results, the scope of the Green Cars Initiative has to concentrate on three dimensions in the road transport context: objectives, technology and process chain.

Here, the focus is on energy efficiency of alternative powertrains, including electrification, hybridization, as well as adaptation to renewable fuels. The other topics, namely safety infrastructures, pure internal combustion engines, fuels, hydrogen, lightweight and also urban mobility and logistics are topics in the scope of the normal Horizon 2020 calls.

Additional on-going activities in Europe today:

ERTRAC, the European Road Transport Research Advisory Council, has agreed to strengthen its cooperation with other technology platforms like EpoSS (ETP on Smart System Integration) to intensify their work on topics like electrification or Smart Grids.

Here the European Green Cars Initiative is in the planning phase to create a new association which fits the requirements for a contractual agreement for a PPP association. It is now in the phase of harmonizing these activities. Based on the ETP's roadmap, we have also begun to work out the multiannual roadmap as a basis for the annual roadmap for the Horizon 2020 programme.

National-level: individual national promotion activities to promote the development and deployment of electric cars:

- France / The Netherlands: Tax exemption and subsidies for electric cars
- Germany: national competition of Electric Car Model Regions (public funding: ~ €180m)

Benefits of International Collaboration

International collaboration in the areas of future urban and e-mobility enables European researchers and companies to participate in ground-breaking activities related to a variety of societal challenges (climate change, mobility, urbanization, growing populations).Through International Cooperation in STI these challenges can be early addressed in regions and countries that already face problems that are expected to reach Europe in the coming decades. These environments offer excellent conditions to test and pilot new concepts and technologies, e.g. innovative mobility solutions for mega-cities. Furthermore, international cooperation in future mobility technologies will enable European companies to benefit from development and catch-up processes in emerging markets that long for modern transport and mobility systems (like India and China).

3.6 ICT for Inclusion

Scope

ICT for inclusion / e-inclusion is a broad and diverse topic with links to a range of different application area. Topics include: digital literacy, skills, education as well as vulnerable societal groups like elderly, less-literate, disabled or low-income people. E-inclusion shall address these topics and enable the whole society for a digital take-up.

An additional promising area for ICT for Inclusion is e-Health. This includes the spectrum of telemedicine (also known as e-care) which focuses on the delivery of healthcare services through the use of ICT in a situation where the actors are not at the same location[9].

ICT technologies are used everywhere now and play an important role in the delivery of better and more efficient healthcare services. This is how Information and Communication Technologies (ICTs) are helping people, doctor(s), and pharmacist to take better care of patients' health.

When we talk about telemedicine we need to consider:

- Mobile Technologies
- Biosensors and other medical technologies
- Image and wireless video transmission enabling remote diagnosis

The results are: Mobile services in healthcare, from delivering the information people need to lead a healthy lifestyle, to making healthcare systems more efficient and responsive and to providing "at home" and mobile healthcare technologies

This is the technological view but the major issues are related to insurance policies, standards, liability.

Health informatics and telemedicine are among the key areas of innovation in the health and social services sector.

Mobile technologies enable new services, with the potential to dramatically improve the efficiency of health organisations' operations and healthcare delivery practices.

Prevention will have a key role in this future health care scenario. Biosensors and other new medical technologies reduce health care costs and facilitate do-it-yourself home care. Recent advances in image and wireless video transmission enable remote diagnosis such as those already being used, in pilot projects, in ambulances.

Mobile services can have a significant impact on all aspects of healthcare, from delivering the information people need to lead a healthy lifestyle, to making healthcare systems more efficient, proactive and responsive and to providing "at home" and mobile healthcare technologies.

Telemedicine is explicitly presented as a topic within Net! Work[10] and the Sensors and monitoing system for leaving bodies monitoring are presented in EpoSS Strategic Agenda[11].

Main Actors

Health care organisations, social services (for young, elderly, people with disabilities), local communities are the main responsible organisations. Policy makers and governments are also responsible for coherent policy, implementation and support of measures for helping people to

[9] http://ec.europa.eu/information_society/activities/health/policy/telemedicine/index_en.htm
[10] www.networks-etp.eu
[11] http://cordis.europa.eu/technology-platforms/eposs_en.html

be active, heath, integrated in the society and to keep the right balance between quality of medical/ social services and costs.

The industrial actors include large and small companies specialised in software and telecommunications providers, hardware providers (sensor networks, robots, data processing, computer interfaces), intelligent houses providers, etc.

On-going Activities

ICT for inclusion / e-inclusion features prominently in the Digital Agenda for Europe, adopted by the European Commission in May 2010. Pillar 6 (Enhancing digital literacy, skills and inclusion) of the Digital Agenda calls for a series of measures to promote take-up of digital technologies of vulnerable groups, such as elderly or less-literate people. An important part of the e-inclusion agenda is also to provide digital access to disabled people as well as to tackle demographic ageing with the help of ICT. As a result a better quality of life for the elderly, reduced costs for care as well as business opportunities in the "silver economy" can be expected. The European Commission is active in these areas and will further reinforce the Ambient Assisted Living (AAL) Joint Program to allow older people and persons with disabilities to live independently and be active in society.

Benefits of International Collaboration

The increasing aging population, the costs of healthcare and of social programmes for inclusion are strong motivation for Europe to continuously work in ICT for Inclusion topics.

In terms of ICT technologies for inclusion and global market Europe would have benefits in international Collaboration. There are some progresses in the area of intelligent houses in USA and also in robotics and personal monitoring (Japan, Korea).

3.7 Software (with a focus on: Enterprise Software)

Scope

The software market encompasses a larger number of software sub-sections as e.g. services (consulting and integration); enterprise software; games, music and media, Internet; data storage and management. Secondly, the European software market is divided in software vendors which produce and sell software products and solutions, and industries which develop their own software for internal use (embedded IT-Systems). For example, the German automotive supply and industrial technology company Bosch plans to expand from currently ca. 450 to a number of 1.000 software developers and IT-experts until 2015. Similar examples can be discovered in large banks as well as logistic and production companies in Europe.

Software as part of IT (Hardware, Telecommunications) has the function of being a cross-cutting or enabling technology which mainly drives innovation and productivity in industry as well as in public sectors like administration, government, health, transportation, energy, education and others. Estimates say, 80% of productivity gains are due to software based processes. This number makes clear that software is a strategic asset for the European industry. The traditional strong industrial sectors in Europe (machinery, automotive, chemicals, and pharmacy) are depending on software to gain productivity enhancing effects to stay competitive and innovative.

Apart from the industrial sector also for the service sector ICT solutions have become crucial for their business. Over the last decade, the service sector has become the biggest and fastest-growing business sector in the world, employing now most people worldwide. In order to safeguard this growth process, services need to become more widely and easily available and should yield higher productivity. A solution provides the vision for next-generation services

provided via the Internet, also known as the Internet of Services. In the Internet of Services, innovative technological developments drive the creation of new delivery channels for services and entirely new business models. The creation of these services is facilitated by an open platform and interface architecture, as provided by the Enterprise Service-Oriented Architecture (enterprise SOA). The Internet of Services takes the enterprise SOA approach to the next level by making services easy to implement, consume, and trade. In combination with Web 2.0 technologies, the Internet of Services is expected to improve service innovation. Additionally, by bringing events from the real world into the services realm, the Internet of Services will become a cornerstone for the Internet of the next generation (Web 3.0).

Analysis of the European Software Industry Competitiveness

The software industry in Europe is a dynamic economic sector, with fast growing number of revenue, jobs, number of enterprises, innovation turnout and an increasing importance of contribution to national GDPs (Germany 3%, Ireland 7%, UK 5%, and France 5% (OECD 2008).
However, compared to the US, the European Software-Industry is facing certain weaknesses:

- European Software companies are much smaller than US companies (example: in the German Software-Cluster are 11,000 software companies, more than the Silicon Valley, but except SAP no DAX 30 company. Many of them are hidden champions, and the fact of being "hidden" prevents these companies of reaching critical size, market presence, access to capital and human capital, internationalization. The path is to stay small or to be bought by US companies which have an aggressive merger and acquisition growth strategy.
- European Software companies seem weaker than US companies in a growth and go-to-market strategy, in marketing and communication, in setting standards to the markets, internationalization and up-scaling of products, the "industrialization of software production" (USA: one size fits all"), sometimes over-engineered. Many software products and solutions are tailor-made, highly specialized, market leader in market niches e.g. IT and software security, software for SMEs, virtual and augmented reality and more.
- In some software domains, Europe do not play an important role: search engines, social media platforms, operating systems
- Lack of access to growth and/or venture capital, and lack of access to the European public sector market, no pre-commercial procurement, no innovative public procurement policy.
- High productions (labor) costs which leads to an outsourcing (near and off-shoring) effect to low cost countries (Eastern Europe, Russia, India), which leads to a loss of working places as well as emerging new competition from these regions (India)

A strong point of the European ICT sector is the high engineering capacity of European Software firms which leads to a high level of technological and innovation potential, corresponding with the highly fragmented European industry sector in general. As a consequence, with a market share of 45%, Europe is world market leader in enterprise software.

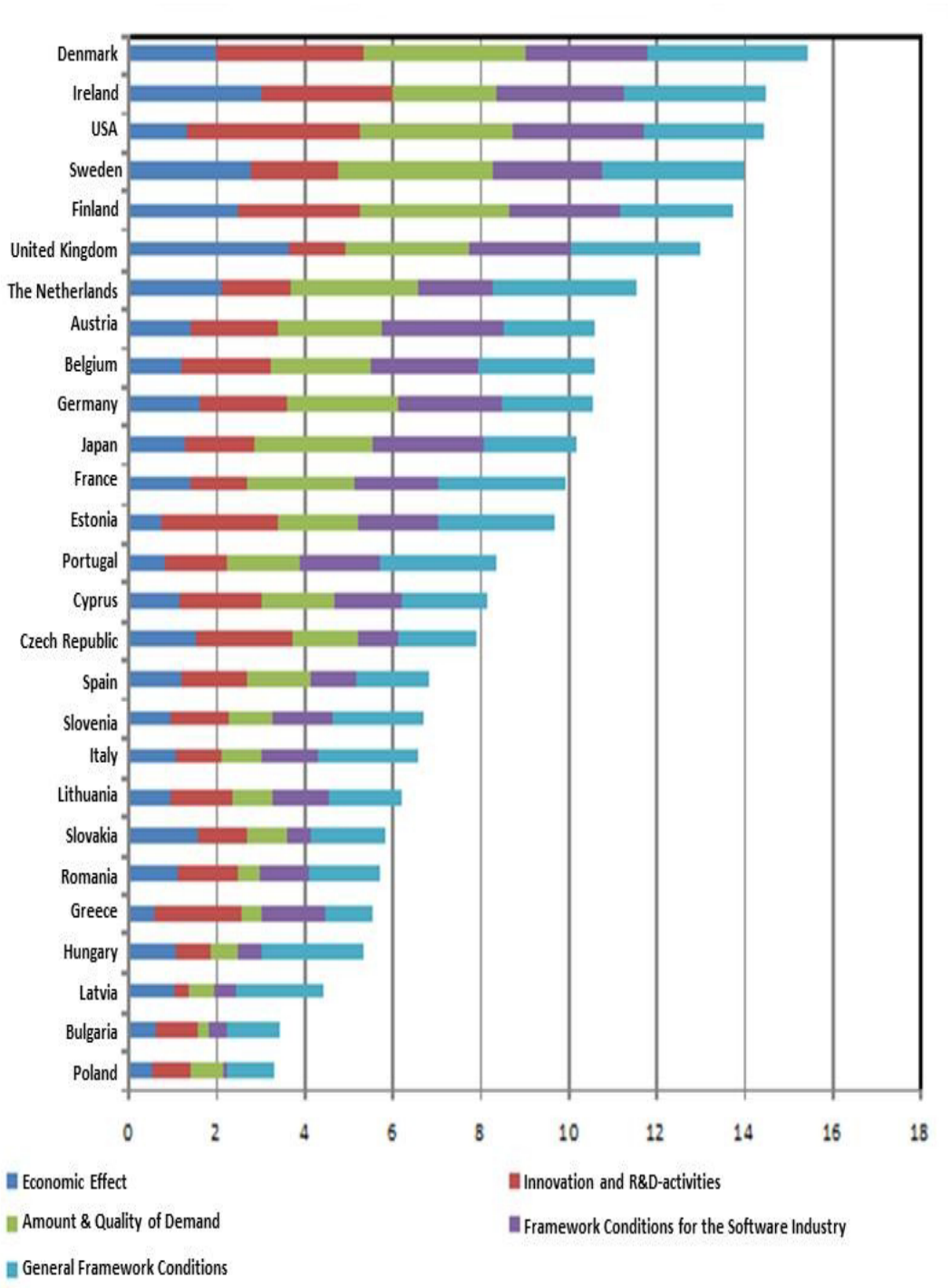
In 2010, the Fraunhofer Institute for Systems and Innovation Research (Dr. Timo Leimbach) published a study in which it compared the 27 EU Member States (plus the USA and Japan) in terms of the competitiveness of its software industry. The so-called "Competitiveness Index for the Software and IT Services Industry in Europe" summarizes this analysis.

Denmark is leading, followed by Ireland, the United States, Sweden, Finland, and the UK, which is slightly back from the leaders. The middle group is led primarily by such central European countries as Germany, France, Austria, and the Netherlands, which are trailed by Southern European countries (Portugal, Italy, Spain) and some Central and Eastern European countries (for example, Czech Republic, Slovenia). Other Eastern European countries, such as Poland, Latvia, and Bulgaria bring up the rear.

Taking the different categories and individual indicators into account, the overall picture looks fairly consistent. While the top countries are ahead in most areas (Ireland/Denmark), the less competitive countries are facing a mix of competitive disadvantages (Poland/Bulgaria). Certain

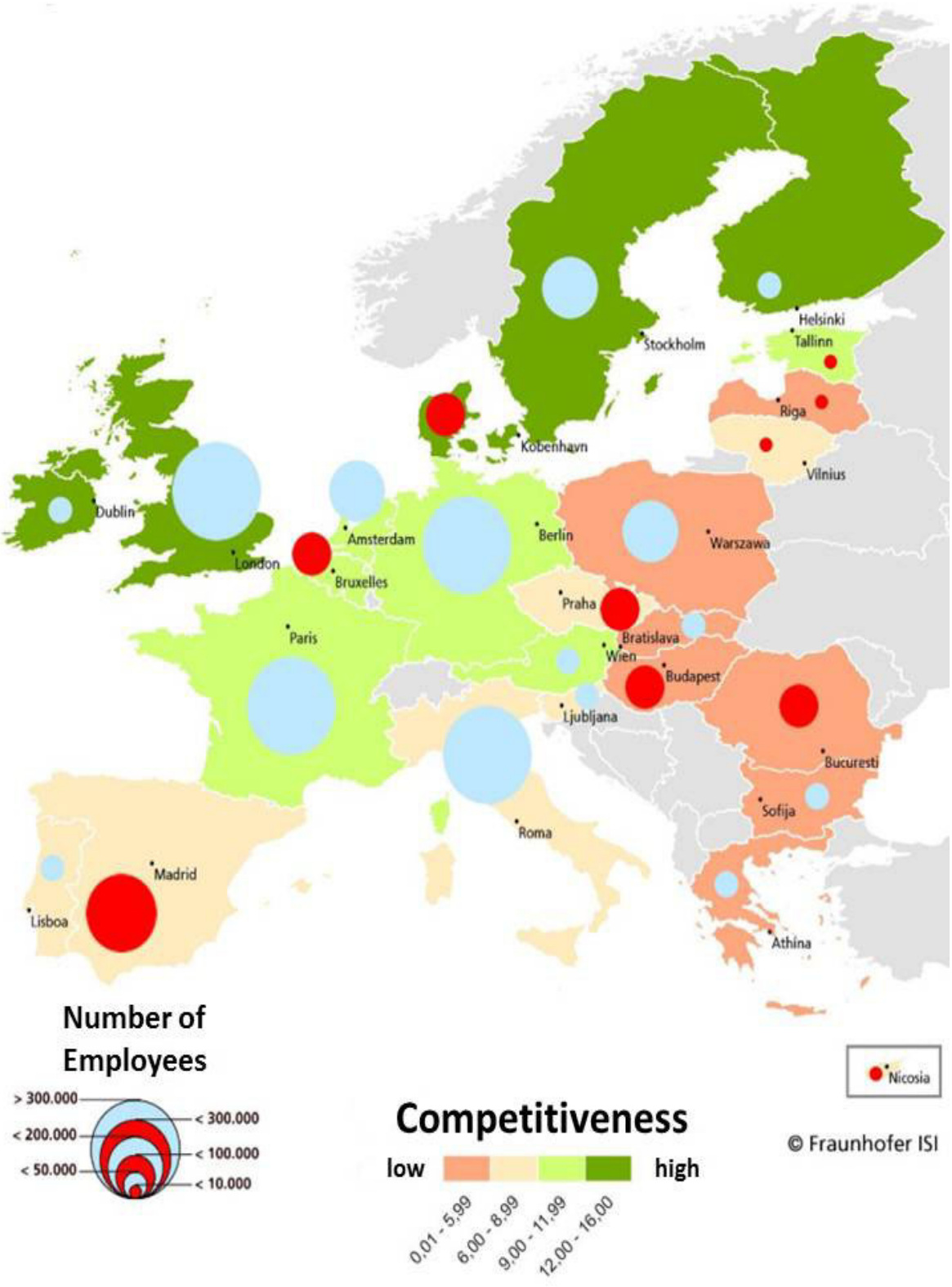
countries exhibit distinct strengths and weaknesses, like the UK which leads in the category "economic effects" but is way behind (19th) in the area of Innovation and R&D Activities.

With a view on the U.S. market, top results are achieved in almost all five categories, especially in the areas of Innovation and R&D Activities as well as Framework Conditions for the Software Industry. "Economic effects" is the only category in which the U.S. are having an average score. Japan only makes an average score and is way behind comparable European countries such as Germany and France in some areas. However, it has a very good standing in terms of "Level and Quality of Demand" and "Framework Conditions for the Software Industry".



Competitiveness Index for the Software and IT Services Industry in Europe[12]

[12] http://www.softwareag.com/corporate/images/Fraunhofer-ISI---Wettbewerbsindex-1.0-englisch_tcm16-76367.pdf



Composite index of competitiveness and sector size at a glance[13]

[13] http://www.softwareag.com/corporate/images/Fraunhofer-ISI---Wettbewerbsindex-1.0-englisch_tcm16-76367.pdf

Main Actors

The top eight software companies in Europe are[14]:

1. SAP, DE
2. SAGE, UK
3. Dassault Systems, FR
4. Software AG, DE
5. MIYS PLC, UK
6. Northgate, UK
7. DICOM Group PLC, UK
8. VISMA ASA, NOR

Here is also the striking the size: the revenue of the Top 25 of the European software companies are about 17,5 bn € (2009), and the R&D investments of the Top 100: 3,6bn. €. Compared to Microsoft: revenue 35,5 bn € and 5,6 bn € R&D expenses. That means, one US company exceeds the KPIs of the largest 25 European software companies regarding innovation power.

On-going Activities

Currently, there are two trends identifiable in this area. On the one hand EU member states implement national promotion policies and thousands of projects, including start-up programs, software research projects, and promotion programs (incubators). On the other hand, innovation is supported through strategic national innovation policies for software, like in Germany the Software-Cluster[15].

Benefits of International Collaboration

One of the main benefits for promoting international cooperation in software research and development is that it opens access to emerging and expanding markets. It further consolidates and strengthens the market leader position of the European software industry, specifically in the area of enterprise software. Thirdly, through cooperation with non-EU-partners the exchange of software researchers, developers and experts is facilitated and economies of scale in terms of investments into R&D and innovation can be generated.

3.8 Robotics

Scope

Robotics is strategic for ICT and for Europe. Robotics connects and integrates the world of ICT (hardware and software) with many different technologies and application domains, such as machine tools and automation, materials, services, social innovation, health, Ambient Assisted Living, just to mention a few, thus creating many opportunities for extending the reach of ICT beyond its traditional domains. Robots add to ICT the ability to actively interact with the physical world, including objects and people. Since their initial and then continuous success as machine tools for advanced manufacturing and automation, industrial robotics and automation evolved to become a key industrial sector and a field in which Europe stands as an international leader.

Amongst the actors in this sector it is worth mentioning companies like Kuka in Germany, ABB in Sweden, Comau in Italy, Aldebaran in France which successfully compete with counterparts in other developed countries. The robot cleaner “Roomba” has been already sold in more than 7

[14] This ranking is not unique. For instance a similar classification established by Truffle, a venture capital company based on surveys conducted by CXP (http://www.truffle100.com/2011/ranking.php) shows some differences in the companies ranking below 5th, notably the appearance in 7th place of the Polish company Asseco.

[15] www.software-cluster.org

million, and the surgical robot “DaVinci” has been sold in about 2.000. What is extremely attractive for ICT, is that robots benefit from, and at the same time are a major driver for, the development of ICT infrastructures, components and solutions. Therefore, keeping this momentum and continuing to pursue leadership in research and industry is of strategic value for Europe. This goal can be better achieved also through International Cooperation.

On-going Activities

After decades of relatively small funding, research on Robotics has had a tremendous impulse during FP6 and especially in FP7 thanks mainly to the Challenge 2 of the ICT thematic priority, dedicated entirely to promote research on robotics and cognitive systems, and to the FET program. European robotics research is now recognized as possessing international leadership, and as such it is widely respected. This is why most non-European Countries have a strong interest in collaborating with Europe.

The main areas of development of European robotics is in service robotics, betting on the growth (somebody expects a real boom) in such applications as assistance to workers in factories (this being associated with the ageing of workers at work), and assistance to people at home, in hospitals, for personal mobility, in urban environments, for education and entertainment, for rescue. Small and large, cooperating and autonomous flying, sailing and submarine robots are being developed in Europe, with the potential to become real game-changers. The role of ICT inside robots (microcontrollers, MEMS, motors and drivers, etc.) and outside robots (Ambient Intelligence, communication systems, etc.) is recognized as a major factor for successful uptake of robotics technology, since it facilitates the functioning of the robot and at the same time the supervision of the robot from outside, guaranteeing safety and efficiency of operation.

New and large initiatives in Robotics are planned in the final phase of FP7 and, especially, within Horizon 2020, such as a PPP in Robotics, and an application to the Call for FET-Flagships.

Benefits of International Collaboration

The development of an international market for service robots (the one on automation is well established) can very clearly benefit from international collaboration. Issues like acceptability, standards, interoperability, safety, legal requirements, affordability, sustainability, sustainability have to be addressed and solved in order to favour the further deployment of the coming generations of robots.

Therefore, collaborative programs with countries like the US, Canada, Australia, Japan, Korea, Taiwan and China, should be encouraged, with the specific goal of putting together resources and efforts in order to break the remaining barriers (described above) to the massive introduction of robots (and related ICT technologies) to the market. This can be regarded as pre-competitive research and development, and, as such, critical issues as IPR and cooperation-competition can be managed quite reasonably. The European leadership in the field, and the continuous efforts that are expected to be put in Horizon 2020 in robotics to keep and strengthen this research and industrial leadership, together with a clear strategy that should be enforced, are important factors to ensure that international collaboration could be effective and productive for Europe.