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CIFRA: Challenging the ICT Patent Framework for Responsible Innovation

D3.2: Report on Assessment of Impact of proposed new Framings

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PREFACE

Social Sciences and Humanities (SSH) do not usually take a preeminent role in technical research projects. Sister projects arise as part of Horizon 2020 Framework Programme as a way to address this historical constraint and to allow SSH make a meaningful contribution to the shaping of the research agenda. To this regard, Sister projects are created to go beside the mainstream research in order to challenge existing biases in the research agendas and trying out more daring alternatives through the widening of imaginaries and by taking into account the SSH perspective.

CIFRA, as a Sister project, does not take the current status quo in the ICT patent ecosystem for granted, but on the contrary, explores the impact that potential new framings could have in ICT innovation and the value they could provide to the society.

Moreover, CIFRA project has addressed the ICT Patent ecosystem from the perspective of the Responsible Research and Innovation (RRI), thus with the aim of determining the way it can be better aligned with the values, needs and expectations of society.

1 INTRODUCTION

The importance of patents for the promotion of responsible innovation in ICT is in general acknowledged. There is an awareness of the various business models of the stakeholders involved in the development and commercialization of ICT-related technologies and the different role ICT patents and other intellectual property rights (IPR) play. Consequently, there is no single first best solution available. It is further acknowledged that the patent system is an integral legal framework, which tries to meet – being respectful of IPR – the requirements of both 'innovative step' and 'novelty' – regardless of the technology, industry or sector.

The objective of this study is to review the issues and possible improvements related to current framework for ICT patents to promote responsible innovation taking ethical aspects in particular of patents into account.

Among the different intellectual property rights, the CIFRA project chose to focus on patents because patents are particularly relevant in ICT. We acknowledge upfront that findings might not be generalizable to other IPRs or industrial contexts.

While the identification and analysis of the existing patent regime in WP2 is based on an assessment of the status-quo, WP3 provides an ex ante perspective focused on the assessment of future challenges and possible changes of the current patent regime relevant for ICT industries. Stakeholders having different positions in the various value chains of the ICT industries. To conduct an in depth analysis of the existing patent regime from a future perspective the compilation of more detailed information as well as qualitative assessments from the relevant communities is essential. A mix of qualitative and semi-quantitative assessment methods is applied in order to identify possible impacts of the proposed changes of the patent regime on innovation.

Information collected in WP2 about problems and shortcomings of the current patent regime are enriched by an in-depth evaluation of existing foresight studies and ex-ante impact assessments of possible future scenarios, including studies on technological development trends, future market growth and investments and existing foresight activities.

Then, all important stakeholders are consulted to capture their views on the present challenges and future economic and societal trends surrounding ICT related patents. Semi-structured interviews with stakeholders are conducted and complemented by focus group exercises with targeted industry experts. The identification of experts is closely coordinated with the identification of companies owning ICT related patents in WP2, but also extended to Open Source organizations and societal groups, like consumer organizations, affected by ICT-related patents. As a result of the interviews, a preliminary assessment of the proposed changes of the patent regime and challenges was reached.

Based on the literature review and the interviews, a stakeholder consultation has been implemented with the aim of identifying the most important challenges and prioritizing the main elements of possible changes of the current patent regime based on their impacts on innovation. In addition, the relevance of the various dimensions of responsible research and innovation regarding ICT patents is covered by the survey.

Finally, the outcome of the survey is compared to the results of the literature survey and the empirical analysis of WP2 and eventually integrated into an assessment of the impact on innovation focusing on three major topics and possible options.

2 PROBLEMS, SOLUTIONS AND FUTURE TRENDS FROM LITERATURE

2.1 INTRODUCTION

This chapter presents current problems with the patent system and possible solutions, as well as the possible future scenarios of the patent system found in relevant literature.

2.2 METHODOLOGY

In contrast to the literature reviews conducted in WP 2, which are mainly focused on academic studies published in peer-reviewed journals, the identification of foresight and impact studies related to the IPRs in general and patents in particular cannot only be focused on searches in the Web of Science, ScienceDirect and Scopus, because the majority of such studies are not published in scientific papers. Therefore, our approach is mainly based on searches in the Internet, including at the webpages of the European Commission and its Joint Research Centers, but also the patent offices. In addition, the citations of major studies have also been screened. Nevertheless, the number of studies and publications is quite limited. Finally, some of the experts, e.g. from the OECD or the JRC, interviewed have also been asked for relevant studies in order to validate our findings. However, our approach did not miss any significant study.

2.3 OVERVIEW OF IMPACT AND FORESIGHT STUDIES

The findings of our literature review of relevant foresight or impact studies, but also of position papers, are presented in the following table:

Table 1 Relevant studies

Author/year	*Title*
Halbert (2001)	Intellectual Property in the Year 2025, Journal of Futures Studies, vol. 6, no. 1, pp. 25–60.
EPO (2007)	SCENARIOS FOR THE FUTURE: How might IP regimes evolve by 2025? What global legitimacy might such regimes have?
OECD (2008)	The Economic Impact of Counterfeiting and Piracy, OECD, Paris
EPO and OHIM (2013)	Intellectual Property Rights Intensive Industries: Contribution to Economic Performance and Employment in the European Union.
Maxwell and Riker (2014)	The Economic Implications of Strengthening Intellectual Property Rights in Developing Countries. Journal of International Commerce and Economics, pp. 2-9.
EC JRC (2014a)	International Protection of ICT Intellectual Property and the Internationalization of ICT R&D
EC JRC (2014b)	How will standards facilitate new production systems in the context of EU innovation and competitiveness in 2025?
ECSIP (2014)	Patents and Standards: A modern framework for IPR-based standardization. A study prepared for the European Commission Directorate-General for Enterprise and Industry.
Lemley (2015)	IP in a world without scarcity, New York University Law Review pp. 460-515
EARTO (2015)	EARTO Answer to EC Consultation on Patent & Standards.
EC (2015)	Report of the expert group on patent aggregation. Directorate-General for Research and Innovation.
EC JRC (2015a)	Innovation in the European Digital Single Market: The Role of Patents
EC JRC (2015b)	Intellectual Property and Innovation in Information and Communication Technology (ICT)
EPO and EUIPO (2016)	Intellectual property rights intensive industries and economic performance in the European Union Industry-Level Analysis Report, Oct. 2016 Second edition.
DG GROW (2016)	Modernizing the enforcement of intellectual property rights.
EC JRC (2016)	Patent Assertion Entities in Europe
FTC (2016)	Patent Assertion Entity Activity – A Report of the Federal Trade Commission, Oct. 2016
OECD (2016)	OECD Science, Technology and Innovation Outlook 2016, OECD Publishing, Paris.
OECD/EUIPO (2016)	Trade in Counterfeit and Pirated Goods: Mapping the Economic Impact, OECD Publishing, Paris.
EC (2016)	Putting intellectual property at the service of SMEs to foster innovation and growth {COM(2016) 733 final}
AVANCI (2016)	Accelerating IoT Connectivity - Report
CRA (2016)	Transparency, Predictability and Efficiency of SSO-Based Standardization and SEP Licensing. A Report for the European Commission
EARTO (2017)	For Globally Competitive Standardization in the Digital Single Market: EARTO Voting Recommendations to Support Innovation in Europe (2017)

2.4 PROBLEMS AND SOLUTIONS

The patent system was developed during a time where interoperability of technologies did not exist, nor were there costless to create and share knowledge. With the development of Information and Communication Technologies (ICT), the patent system is struggling to find the right setting to provide appropriate incentives for innovation, research and development (R&D), while simultaneously enabling the efficient reuse and diffusion of technological knowledge. Moreover, the gaps of the patent system in regards to the requirements of ICT technologies have transformed the patent landscape for ICT into a volatile landscape, whose dynamics involve a series of problems for

all players. In this part of the Deliverable D3.2, some of the most relevant problems and potential solutions identified in the literature are presented. A more detailed list of the identified problems and potential solutions is presented as Annex 1 to this document. This part complements the work of the D3.1 of this project, which focused on the – theoretically available – solutions.

2.4.1 Identified problems

2.4.1.1 Identified problems regarding patent application and granting

Technological complexity: ICT technologies are highly complex. Due to their nature, it is to combine various components to one complex product. As consequence, ICT technologies are built from many parts developed my multiple actors (EC JRC 2015b). The combination of technological complexity with the cumulativeness of the innovation process creates problems such as technology fragmentation and fragmentation of patent rights in general and patent tickets in particular (EC JRC 2015b). The rising complexity of technologies has made it easier to patent block several technology providers with one single patent. In addition, there is an increase in probability of accidental infringement for companies. This is because the detection of possible infringements is made difficult by the complexity of the technologies (EPO 2007).

Low quality of the patent: One of the main concerns is the increasing challenge to maintain a satisfactory level of patent quality. The patent quality which is defined as "the degree to which a patent satisfies the statutory patentability requirements, leaves little doubt as to its breadth and discloses information that enables a person skilled in the art to implement that protected invention" (EPO 2012, p. 8). This pressure on quality is due to the challenges of the patent examination process and the inappropriate patent office policies, which also encourage the application of trivial and underdeveloped inventions (EC JRC 2015a).

The low-quality patent is also an issue regarding assertions. Assertions of low-quality patents might have negative welfare implications, such as, the encouragement of rent-seeking behavior. This might lead to a reduction of R&D resources by innovators threatened by patent assertion entities (PAEs). To counter the activities of PAEs will be likely made only by large companies having the sufficient financial resources and expertise. For the case of patents on computer-implemented inventions or "software patents", quality is of particular concern (EC JRC 2016).

Large number of patent filings in the ICT field: Particularly with digital communication and computer technology there is a continuous increase in the number of patent filings with the EPO and EUIPO (2016). A large number of patent applications increases the probability of granting patents potentially facilitated by insufficient quality checks. This expectation might again increase the number patent applications EPO (2007). The large number of patents in this field is due to the complex technologies and combinatory innovations. Currently, there is an exponential increase in the number of patent filings from the Asian economies in Europe (EC 2015a).

Computer-implemented inventions: With the current patent granting process, it is difficult to evaluate the patentability requirements of computer-implemented inventions consisting of a high degree of abstraction of the software algorithms. Furthermore, many applications end up being considered of a low quality. However, the increasing number of software applications demands a solution to properly assess them (EC JRC 2015b).

Open source software: In the ICT industry, there is an increasing coexistence between the acquisition of software patents to protect the products and the usage of open source software in the industry. The possible legal conflicts due to patent infringement by open source software are a concern in the

long-term, especially because of the hybrid software products in which open and proprietary software are combined (EC JRC 2015b).

Limited access to patent information: The restricted access to relevant patents information such as patents disclosure, changes in patent ownership, transactions, links to standards, prior art, patent licensing and other technical information related to new technologies generates a lack of market transparency (EC JRC 2015a). This lack of transparency leads to high operative and transaction costs EC (2015).

Additionally, intellectual property registers present problems such as, the lack of harmonized names of the patent applicants. As a result, the same applicant may have several separate register accounts derived from each filing. The lack of comprehensive information leads to limited information about the applicants additional to the contact information. These issues complicate the tracking of the total files belonging to one single applicant.

Lack of market transparency: As a consequence of the limited access to patent information, there is a lack of information about the market participants and their intentions EC JRC (2015b). Another cause for the lack of transparency is the lack of links between all existing data collections on technical knowledge and data on patents, which creates a shortage of market transparency. Many managers of this information have limited skills in defining how to create these links, and on defining a set of criteria and incentives for stakeholders to open their data while ensuring control over the assets (EC JRC 2015a).

In the case of patents, there is a variety of different collectors and managers of this information. These include patent authorities, public institutions, companies, patent pools, IPR brokers, open source and other platforms in which collaboration, exchange and licensing are enabled (EC JRC 2015a).

Lack of transparency regarding standard-essential patents (SEPs): Efficient SEP licensing is restrained by the lack of transparency on SEPs regarding patent´s information, its scope, validity, ownership, and enforceability. Regarding subsequent owners of SEP, there is a lack of information since subsequent owners are not obliged to declare patent as essential, as only the initial patent owner in the case of licensing on FRAND terms has to. In addition, there is an absence of concrete licensing practices of SEPs. An inefficient licensing of SEPs affects standards and thus obstructs their economic and societal benefits.

The rules adopted by SSO to improve transparency on SEPs, such as an *ex ante* disclosure of SEPs and the databases on these disclosures have constraints such as patent declarations missing details, e.g. of validity, essentiality, and up-to-datedness of their legal status (ECSIP 2014).

Polarization on the debate of the fair, reasonable and non-discriminatory licensing terms (FRAND): There is a lack of clarity on the definition of FRAND ECSIP (2014). The specifications of what comprises FRAND is not determined by the IPR policies of SSOs. Rather, are these left to the bilateral negotiation or the courts. The outcome of bilateral FRAND negotiations are determined by factors that are unclear and consequently, have to be studied in more detail. In addition, the absence of relevant and solid empirical evidence on royalty stacking and hold-up problems related to SEPs makes the debate on FRAND merely theoretical (EC JRC 2015a).

The role of patents in cumulativeness innovation: Patents seem to have difficulties creating solid innovation incentives in industries based on high cumulative innovation such as in ICT. Patent protection might increase the cost of developing work from existing ones because of the various

permissions the follow-on creators have to obtain. In addition, these inventors might face hold-up problems EC JRC (2015b).

SMEs and the patent system: The use of the patent system by SMEs is not fully exploited. This is due to the high cost of the procedures, such as pre-grant costs and patent attorney fees, which are a barrier for the products and services of the SMEs and start-ups attempting to enter the market. In addition, most of the SMEs do not see the benefit of using the patent system, do not have the required expertise to use it and lack the necessary finance to legally protect their patents and to tackle possible infringing activities by other 'larger' companies EC (2015), EC (2016). The few SMEs that use the patent system mostly stay local and do not dare go international, for instance by registering EU trademarks (EC 2016).

High transaction costs: The transactions costs are costs related to a) search and information (over the patentability of a technology and/or relating licensee costs); b) bargaining and contracting (including negotiation); and c) policing and enforcement (control processes, such as payments and conditions of contract met) (ECSIP 2014). For the ICT sector, the costs are even higher in the searching stage, due to the large number of patents that are required to be assessed by companies to avoid infringement (EC 2015a). The transaction costs are increased by market failures such as information shortage, information asymmetry, and abuse of market power as well as by the opportunistic behavior from patent owners ECSIP (2014).

2.4.1.2 Identified problems regarding enforcing and implementing patents

High litigation rates: The high litigation rates are caused by various factors, such as lack of transparency in the patent system, opportunistic business behavior; unclear conditions of FRAND and its transfer conditions (change of SEP owner); litigation PAEs. In addition, the increase in the number of patents in the ICT sector is causing an increase in the number of legal battles regarding patent validity and infringement. In the US, software-related patents were involved in 50 % of the lawsuits between 2007-2011 (GAO (2013) in EC JRC (2015b)).

Royalty stacking: Royalty stacking is a constellation when royalties are stacked, one on top of another. It occurs when a single product contains multiple patents, and each patent owner, in particular of SEPs, sets a high individual royalty to the licensee without considering the other royalties that also needs to be paid by the licensee to the other patent owners in order to commercialize a product (ECSIP 2014). In theory, the cumulative payable royalties discourage new investments in R&D hampering innovation as a whole (EPO 2007), but sound empirical evidence is missing.

Patent thickets: Patent thickets are defined as an overlapping set of patent rights, which requires innovators to reach licensing deals for multiple patents from multiple sources. They often lead to hold-up or even royalty stacking. Companies are motivated to use their patents as bargaining tools and to increase the number of patents they hold, thus increasing the number of patent filings (EPO 2007).

Thickets place barriers in searching for prior art, which causes a decreasing in the quality of patents granted by patent and offices. Patent thickets are often seen in the ICT sector and often harm the Small and Medium Enterprises (SMEs) and companies that need to in-license technologies (EC JRC 2015b).

Standard Setting Organizations (SSOs) and patent pools seek to cope with patent thickets through the adoption of IPR policies to regulate the licensing of the relevant patents. However, controversies on these IPR policies exist. For instance, the royalties of the Fair, Reasonable and Non-Discriminatory

licensing terms (FRAND), which are adopted by various SSO, need to improve its definition of fair and reasonable to improve the transparency of the royalties (EC JRC 2015b).

Disruptive or litigious activities of Patent Assertion Entities (PAE): PAEs are the most controversial type of patent intermediaries (EC JRC 2015b). They are considered as businesses that collect third parties´ patents and try to obtain benefits (revenues) against alleged infringers (FTC 2016). They strategically concentrate on high-tech patents, especially of companies in the ICT industry, and hold large portfolios, often containing hundreds or thousands of patents (FTC 2016). An increasing number of patent lawsuits are due to PAE 'patent trolls', counting for three out of four of accusations of infringing a PAE patent in the UK (Helmers et al. (2013) in EC JCR (2015b)). PAEs assertions target primarily the more vulnerable and often lower segment of the supply chain such as telecom operators EC JRC (2016). Also known as 'patent trolls' are patent holders who attempt to obtain profits from patent infringers far beyond the actual value of the patent, and often do not manufacture or produce any product or service based on the owned patents. PAE focused on *ex post* patent transactions target businesses that already (alleged) use within their products the patented technologies (FTC 2016).

The uncertain usability of patent bundles in the ICT sector: Patent bundles are thought to be used in order to exploit the aggregated value driven by cost and the market. However, it is unclear how ICT companies can mix the different IPRs: patents, copyright, and trademarks in an effective manner (EC JCR 2015b).

SEPs problems: Standards based on patents could present favorable circumstances for the rise of opportunistic business behaviors from SEPs. In the last years, the number of SEPs has increased primarily as a consequence of the increased number of patented technologies that are included in standards, and of the patents declared as SEPs. The rise in the number of patents declared as SEPs are part of the strategic behavior of companies in owning as many SEP as possible. This strategic behavior leads to over- disclosure and over-inclusion of patented technology in standards (ECSIP 2014). Some of the opportunistic business behaviors from SEPs include: patent ambushes and submarining, hold-up and reverse hold-up, categorical discrimination against new entrants, unsolicited bundling of SEPs with other patents.

- *Patent ambushes and submarining*: It happens during the standardization development process, when standardizers are not aware of patented technology being included into the standard under development. For instance, when a participant does not reveal in advance the information on a current/or future ownership of a patent that is relevant to the standard in question. This information would be only revealed after the standard has been adopted, threatening the implementation of the standard and creating the risk of negotiating licenses under unfair conditions.
- *Patent hold-up*: Patent hold-up happens *ex post,* when patent holders have a greater bargaining power over implementers who have at that point used resources specific to the questioned patent. The patent holders use its advantageous position to set high and many times unreasonable royalties (ECSIP 2014). The high royalty is also set to cover the possibility of the licensing negotiation failing due to an accusation of patent infringement e.g. as 'patent trolls' and 'patent privateers', and the subsequent injunction. In addition, patent owners have the power to discriminate between licensees. In the context of standards, firms manufacturing standard-compliant products run the risk of implementing standards involving intellectual property rights (hence hold-up). In addition, a distortion of the market could occur due to the categorical discrimination. For instance, the patent owner could discriminate against new entrants, established manufacturers, or parties not holding SEPs.

- *Patent reverse hold-up*: In this case, the implementer has a greater bargaining power over patent holders during licensing negotiations. Thus, the royalties received by patent holders could be reduced to a rate lower than the value of the patent (CRA 2016).

2.4.2 Identified solutions

2.4.2.1 Identified solutions patent application and granting

Quality of patents: Patent quality should have appropriate policies and examination procedures in the patent offices to discourage trivial, insufficient or underdeveloped patent applications (EC JRC 2015a). The patent system requires a harmonized approach to high-quality patents through a set of examination criteria for patents applications (EC JRC 2015a). The measures to be taken in order to improve patent quality should be cost efficient and should not extend the patent procedure (EC 2015a). The following actions EC JRC (2016) are suggested in order to limit large-scale assertion of low quality patents: to ensure that the standards maintained in patent granting procedures are also of the highest quality by continuously promoting effective ways of conducting prior art search that fully utilizes technological advancements, and to use patent fees as a market-based mechanism which acts as a screening device to "raise the quality bar".

Improvements in the transparency of patent availability and ownership: In order to increase transparency in the patent market, the patent offices should consider the possibility of requesting the registration of patent ownership and changes in ownership (EC 2015a). Transparency related to SEPs would be improved through different measures (CRA 2016) such as developing random independent tests of essentiality, making public the royalty rates determined through arbitration, forbid unilaterally imposed confidentiality clauses by one of the contracting parties, and making *ex post* specific declarations in order to link those relevant parts of the standard to the families of declared patent.

Augmented patent databases: The patent database could be augmented with a 'crawler-based' approach, in which content would be automatically generated and presented into a unified format, and additional functionalities such as inter alia alerts, links, and the grouping of patents would be added (ECSIP 2014).

Crowd-sourced validity checks: The costs of validity checks could be reduced for instance, by incentivizing the larger expert community to perform these checks (ECSIP 2014).

Improvement of the measures to support the use of patents by Start-ups and SMEs: For the case of Europe, some of the possible improvements suggested by the European Commission (EC 2016) are: Streamlining European IPR awareness schemes for SMEs and providing a cooperation platform for Member States; Developing an EU IPR mediation and arbitration network for SMEs; Encouraging the creation of European-level insurance schemes for litigation and IP theft, building on a common IP valuation method; Improving coordination of IPR support funding schemes, including by means of a possible guidance to Member States and by developing monitoring methods their impact; and Improving and developing IPR pre-diagnosis services, so SMEs can include IPR in their business strategy.

2.4.2.2 Identified solutions related to enforcing and implementing patents

Patent pools: Patent pools aim at mitigating transaction costs, avoid royalty stacking, improve market transparency, speed-up the access to technologies, offering non-discriminatory and equal

access to all potential licensees. They are perceived as licensing model that successfully allows the arrangement for patent collaboration and benefits the patent market as a whole (ECSIP 2014).

Technology transfer in the ICT field could be further facilitated if relevant benchmarks are drawn from examples of efficient patent pooling and their effects on patenting incentives (EC JCR 2015a). For the case of SEPs, patents pools could be improved by strengthening the relationship between SSOs and pools; creating incentives to attract the participation of SEP holders in patent pools; encouraging the participation in patent pools of other institutions e.g. universities and SMEs (EC JRC 2015b).

Patent supermarkets: Patent supermarkets are a way to facilitate patent licensing. Patent supermarkets standardize the way in which patents are offered and enable an easy choice of what to license (ECSIP 2014). Patent supermarkets are similar to patent pools in the sense that they are based on multiparty agreements, and they serve as 'agents' between licensees and patent owners. However, in patent supermarkets mainly individual patents chosen by the licensees instead of patent packages offered by the patent owners are marketed.

Clearing houses: Clearing houses are usually two-sided markets that attract licensors and allow them to identify potential licensees. According to Van Zimmeren et al. (2006) in ECSIP (2014), there are different types of clearing houses classified by means of the service they offer. Firstly, Information clearing house, which is the basic concept offering access to (protected) information, like a database. Secondly, technology exchange clearing house, which adds to the database service a platform for negotiation between licensors and licenses. Thirdly, open access clearing house, which offers access and use on open access royalty-free basis. Fourthly, royalty collection clearing house, which offers a access and use of standardized licenses, royalty collection, monitoring of the patent rights transfer to clearing houses, independent dispute resolution mechanisms ECSIP (2014).

To minimize the legal uncertainty to minimize PAEs questionable activities: Some PAEs take advantage of the legal uncertainty of the system, thus minimizing these uncertainties by directing the policies towards this objective, will reduce these behaviors from PAEs. As suggested by the 'EC JRC (2016) Patent Assertion Entities in Europe report', this can be achieved by increasing patent ownership transparency. This ensures that the UPC courts strive for the highest quality, supported by highly technical, specialized judges who have substantial experience in the subject matter, and increasing the clarity of FRAND licensing commitment for SEPs.

Improvements to SEP: The role of SEPs could be improved if relevant and solid empirical evidence on the licensing of SEPs is produced and there is a further support from SSOs, policymakers, and/or the companies involved in the standards setting and in the licensing of SEP (EC JRC 2015a). Additional improvements regarding SEPs issues are:

- *Improvements to the patent declaration system for SEP*: Improvements to the patent declaration system for SEP could be done by updating key events of patent declarations, such as the standard´s adoption, SEP´s granting, SEP´s invalidation or expiry, ownership transfer; more precise and informative patent declaration, such as information to substantiate essentiality; routine checking of essentiality of declared patents; adding of information on licensing in SSO database; restricting usage of blanket disclosures; notifying transfer of SEP ownership; linking the databases SSOs and patent offices; improvement in the efficacy of the SSO databases in a cost efficient manner; and improvement in the access to prior art material by patent examiners (ECSIP 2014).
- *Concrete licensing practices of SEPs*: The study and definition of concrete licensing practices of SEPs and their impact on the transparency of patent markets, competition, and

innovation in the field of ICT in Europe will help to avoid difficulties on SEP-licensing negotiations and the resulting litigation (ECSIP 2014).

- *Efficient dispute resolution mechanisms for SEP*: Some possible efficient mechanisms to resolve disputes are arbitration, mediation, "med-arb", and mini-trials (ECSIP 2014).
- *Clear commitments in case of transfer of SEP ownership*: Subsequent owners of SEPs could be bound to declare the patent by re-defining the FRAND commitments, in a way to bind the subsequent owners of SEPs to the initial FRAND commitments, to tie the commitments to license SEPs on a reasonable and non-exclusive basis to the patent itself by using a License-of-Right system (ECSIP 2014).
- *SEPs and FRAND*: The FRAND commitments aim at tackling the hold-up issue and even at alleviating the royalty-stacking problem (CRA 2016). Clarifying FRAND royalty rate and royalty base would benefit negotiating parties as well as adjudicators. Some improvement proposed are: “The royalty rate could be defined in relation to its economic value, its ex ante value before standard adoption or the incremental value over competing technologies; The royalty base could refer to the final product or to the component implementing the patent and the related question on the step in the value chain where licensing occurs.” (EC 2014).
- *Royalty-stacking clauses:* Improvement of the royalty-stacking clauses for patent licensee on the first license agreement, in which it states that the royalties payable by the licensee under the first license agreement are to be reduced in the case of further royalty payment to other patent owners.
- *Improvement of the guidance on the inclusion of patented technologies*: For those adopting standards, a better guidance on the inclusion of patented technologies in their respective standard could help to lower the number of SEPs and to increases the quality of the remaining SEPs. The benefits of better guidance could be an increase in the number of innovators eager to engage in R&D, a reduction of unnecessary costs associated with over-inclusion of technologies and complexity of standards such as royalties, a better promotion of the standard, a reduction of costs associated with oligopolistic competition in the upstream market for necessary technologies (ECSIP 2014).

2.5 FUTURE TRENDS

The uncertain future development of the IPR system has been addressed in a number of studies. In this part, a summary of the most relevant foresight studies is presented.

In 2001, Halbert (2001) predicted three possible future scenarios for the IPR system (in 2025). The first scenario is the 'Chinese and Indian Hegemony – the Rise of the East'. Here, Asia specifically China and India rises as a hegemonic force in IPR and technology, due to their already strategic position as the world´s technology manufacturers. The second scenario 'When Corporations Rule the World – Globalization and Western Hegemony' is when the power of IPR is retained by multilateral corporations and their Western hosts. The third scenario 'The Open Source Revolution and the Demise of Intellectual Property' is in which exchange is done in a more democratic way and the public good is placed over the private. In this scenario, the creative work is protected by sharing another alternative protection system to the property ownership systems. For Halbert (2001), the third scenario is the most desired one, because through collaborative models the centralization of IPR assets and the IPR ownership by few ones are avoided. The open source movement is taken as an example of this scenario. Halbert (2001) also calls out for an active participation of the people to create alternatives to the current IPR system, in order to prevent perhaps a less favorable future scenario in which the IPR rules the world.

Six years after the study by Halbert (2001), one of the most relevant foresight studies was published: "The EPO (2007): Scenarios for the Future". The study outlined the key factors and significant challenges anticipated by experts that are likely to influence the future of patenting and IPR at the global level. The study describes the evolvement of the IPR regime by 2025 in four scenarios. These four hypothetical scenarios are the result of the influence of five driving forces identified as the most important trends affecting the IPR system. The IPR system is described as being impacted by multiple strains such as political, economic, societal, environmental, technological and historical developments, over which there is no control from stakeholders nor IPR protectors. The five identified driving forces are 'power', 'global jungle', 'rate of change', 'systemic risks', and 'knowledge paradox'.

The 'power' refers to the redefinition of power caused by globalization. New powers are built from alliances across national boundaries like multinational corporations, civil society organizations and global networks of political and special interest movements, regional trade blocs etc., which challenge the traditional governments´ power.

The 'global jungle' is characterized by competition among countries, regions, global companies, markets and workforces, business and universities etc. caused by the faster pace of change and economies of scale resulting from globalization. In this scenario, it is difficult to predict which of these players will survive and for how long.

The 'rate of change' has to do with the growing divide of rates of change between global economic markets, technology, political cycles, which are short-term, and those of legal institutions such as the IPR system, human psychology, and the environment, which are long term. This divide challenges the interaction of these areas and the institution´s capability to cope with the rapid rates of change.

The 'systemic risk' is about the high dependence of today´s humanity 'a global society', on complex natural and man-made systems. Those risks have turned from traditional natural hazards to complex systemic risks, in which the tipping points threatening them are unknown.

The 'knowledge paradox' refers to the paradox that today´s information society places by facilitating the access to information, thus increasing the knowledge acquisition. Thus, the ability of the patent

system to remain as the framework to protect and exploit knowledge is jeopardized by the search of new cheaper and faster methods.

These five forces are driving the IPR world, and depending on how each of these forces evolves, the future direction of the IPR world will be shaped, creating each a different scenario. The EPO (2007) investigated four of these possible scenarios: 'Market rules'; 'Who´s game?' 'Three of knowledge'; 'Blue skies'.

'Market rules' concerns the world where business is the dominant driver. Multinational corporations build powerful patent portfolios containing key technologies enabled by new patentable subject matters and services, they also enforce the use of patents, and patents become financial assets.

'Who´s game?' refers to the world where geopolitics is the dominant driver. The place of current dominant players in the developed world is taken by new entrants from the developing world, due to the insufficiency of the established ones in using IPR to keep their technological superiority and the ability of the new ones in implementing new methods to shape the evolution of the system.

'Three of knowledge' is about the world where society is the dominant driver. The IPR system is defeated by social movements such as the 'access to knowledge movement'. The main challenge is to be able to acknowledge the legitimacy of a certain reward for innovation while ensuring that knowledge remains a common good

'Blue skies' refers to the world where technology is the dominant driver. The society´s dependency on technology and growing systemic risks force the IPR system to change from its one-size-fits-all model to a customized model, which considers the specific needs of these new technologies, and others for the classic technologies.

These four potential future scenarios for the IPR system are complex and they show the uncertainty surrounding the future of the IPR system, which will be the consequence of the decisions made today by governments, business and societies.

A more recent study is Lemley (2015) called "IP in a World without Scarcity". The author argues that the current world is a world of scarcity "Economics is based on scarcity. Things are valuable because they are scarce. The more abundant they become, the cheaper they become." (Lemley 2015, p.461). Moreover, that "The IP laws were created in a world of scarcity. They sought to take ideas that were public goods—things that by their nature were not scarce—and artificially make them scarce by designating them as owned by someone" (Lemley 2015, p.504).

The author analyses IPR in a post-scarcity world. For instance, in this world, high-cost products will be the exception and cheap or free goods the norm. IPR-driven content will be limited compared to the vast number of content created without IPR. This world will require a rethinking and reshaping of the economy as a whole. In a post-scarcity economy, IPR will still exist but not as the main driver of innovation and creation.

These arguments are based on recent technological development, especially ICT technologies, which are allowing the reproduction of scarce goods in inexpensive ways. For instance, the internet has allowed for free or for a low-cost, the production and distribution of information content across borders.

For the case of information, the traditional IPR system is imperfect. The Internet has shown that openness and accessibility drive innovation and creativity, which undermines the classic theory behind IPR rights. In addition, the traditional economic theory of goods was thought for things that consume resources, and are tangible and unique. However, since information consumes few

resources, is not tangible and can be reproduced many times and used by many at the same time. Its scarcity is artificially set by IPR. However, the IPR are strong in those technologies that are expensive to produce but cheap to copy.

The government as a form to regulate market entry and market prices uses the IPR. However, similar to the last century´s economic markets, the IPR system might go through a 'deregulation' of the market, i.e. the 'free market', that might allow the market to grow without necessarily losing completely the control of the market, thus allowing the post-scarcity world to develop.

A summary of the potential future scenarios is presented in Table 2.

Table 2 Future scenarios of the IPR system

	Geopolitics rules	*Business rules*	*Society/openness rules*	*Technology rules*
Halbert (2001)	'Chinese and Indian Hegemony – the Rise of the East'. Here Asia specifically China and India rise as a hegemonic force in IPR and technology.	'When Corporations Rule the World	The Open Source Revolution and the Demise of Intellectual Property' is in which exchange is done in a more democratic way and the public good is placed over the private.	
EPO (2007): Scenarios for the Future	Who´s game? refers to a world where geopolitics is the dominant driver.	Market rules refers to a world where business is the dominant driver.	Three of knowledge, refers to a world where society is the dominant driver.	Blue skies, refers to a world where technology is the dominant driver.
Lemley (2015) IP in a World without Scarcity			In a post-scarcity world, high-cost products will t urn out to be the exception and the cheap or free will be the norm. IP-driven content will be few compared to the vast number of content created without IP. This world will require a rethinking and reshaping of the economy as a whole. In a post-scarcity economy IPR will still exist but not as a main driver of innovation and creation.	

3 EXPERT INTERVIEWS AND FOCUS GROUPS

3.1 METHODOLOGY

The structure of the guideline for the expert interviews and the focus groups have been derived from the literature review of WP2, but also from the insights of D3.1 of WP3 and in particularly the findings from the foresight and impact studies summarized in Chapter 2.

The identification of stakeholders for the interviews is not only guided by the value chain of ICT ranging from research to services, but also from the requirement to involve a broad range of stakeholders to identify and analyse ethical issues, like proposed by Oppenheimer et al. (2015) for analyzing ethical issues of IPR in pharmaceuticals and Stahl et al. (2017) for emerging ICT technologies in the context of Responsible Research and Innovation (RRI).

Finally, for the interviews, we contacted more than 70 stakeholders by email or telephone, which eventually led to 34 interviews performed between March 17 2017 and May 8 2017 lasting between thirty minutes to two hours including three written statements. These included companies operating in a number of different ICT fields, representatives of public and private organizations and academics. The experts were approached as a result of contacts with Telefónica and Fraunhofer.

Two focus groups sessions were performed. One focus group took place with more than 20 participants of the 'Fair Standards Alliance' in the context of one of their regular meetings with in Brussels in the afternoon March 15 2017 lasting around one hour. Due to confidentiality reasons, the participants did not allow the recording of the meeting. The other focus with five 'Open Sources' experts was organized in Berlin at the premises of Fraunhofer FOKUS in the afternoon of April 4 2017 lasting almost three hours. It was also recorded.

Table 3 summarizes the composition of respondents, which were interviewed. The interviews took place via telephone or by Skype. They followed a semi-open format (see Annex 2). Interviewees were first asked to assess the relevance of patents for ICT in general, and then to mention what they saw as the most important challenges faced by ICT patents. Finally, the interviewer presented policy proposals that had been mentioned in previous studies and publications in order to collect the views of the experts.

Table 3: Interviewed Types of Organizations and Number of Interviews

DGs of the European Commission	3
Research organizations	2
IPR Support Services	2
Patent offices	2
ICT patent owning companies	6
Telecom operators	2
Other ICT patent implementing companies	2
Patent pools	3
Academic experts	2
Open Source Software (OSS) ecosystem	3
SME organizations	2
Patent attorneys	2
Consumer organization	1
OECD	2

The analyses of the results of the interviews are presented in an absolute confidential manner, because almost no interviewees wanted to disclose their names or even the specific organization they are working for in this report. Due to confidentiality reasons, it was also not possible to record the interviews, i.e. only summaries of the interviews are used to produce the following summary of the interviews. As an explicit disclaimer, it has to be noted that the following statements are not representing the individual or collective views of the CIFRA consortium partners, being the Fraunhofer-Gesellschaft, Telefónica Investigación y Desarrollo SA, Universita Commerciale Luigi Bocconi or Universidad Carlos III de Madrid. These individual expressions or any propositions included herein are without prejudice to the recognized state of the law and binding international and intergovernmental treaties and norms.

3.2 IDENTIFIED CHALLENGES

3.2.1 Effectiveness of the patent system

The assessment of the interviewees related to the general effectiveness and efficiency of the patent system for ICT is highly dependent on the stakeholder group they belong to. The majority of the stakeholder groups view the role of patents positively in terms of promoting innovation in ICT, especially for ICT hardware, which is not different to any other hardware. In contrast to traditional utility models, ICT patents are used not only as a tool for protection but also to ensure that the inventor receives just compensation.

Patent owners or organizations commercializing patents without producing products claim that patents can be used by anybody without giving anybody a specific advantage. This perspective is not shared by organisations representing small and medium sized companies (SMEs). The companies owning patents claim that patents play an even more important role in telecommunications, because they provide even stronger incentives for investments in research and developments, especially in relation to standards. However, it is also pointed out – especially be the implementers – which the interests and rights held by the inventors and the implementers should be balanced. Furthermore, the increasing division of labour between technology developers and implementers increases the relevance of patents as bartering chips. Furthermore, patents should also ensure that they are an effective source for the sharing of knowledge about innovation.

In comparison to other protection instruments, e.g. utility models, the strength of patents is mentioned as advantage. However, the limited protection period of twenty years is perceived as more appropriate as the much longer protection period of copyright for software.

In contrast to the in general positive assessment of patents in ICT-related technologies acknowledging the critical perceptions, the members of the open source community in addition to the SME representative are very critical about the effectiveness of patents for ICT-related technologies. The main argument is the existence and effectiveness of copyright as a protection instrument related to software, which itself is becoming more and more important for ICT in general. Furthermore, patents in ICT are increasingly misused for legal and commercial disputes, which also explains their growing number. Besides this vicious circle, patents on software are – due to the missing code – not able to disclose details about the inventions, but only performance criteria. Finally, abolishing patents for ICT-related technologies would solve all possible conflicts with open source software.

3.2.2 Functions of ICT patents

3.2.2.1 Preventing imitation of inventions

The majority of stakeholders supporting patents in ICT highlight their function to prevent imitation of inventions, which allows inventors and investors to secure revenue from their efforts and investments. Without the existence of patents, companies owning patents would not have sufficient incentives to invest in R&D. Despite the expectation, that patent protected technologies will be outdated rather early in technologically dynamic environments, they argue that short product cycles require even more patents to re-appropriate their investments into R&D.

3.2.2.2 Securing own freedom to operate

In contrast to the protection function, only very few interviewees mention that ICT patents are also used to secure companies' freedom to operate, i.e. preventing the risk of infringements or litigations from third parties. Furthermore, patents are also in general not bought for defensive purposes.

3.2.2.3 Blocking competitors

In line with the limited defensive use, only one interviewee mentions that patents are used for blocking competitors. However, the representatives of the OSS community perceive patents as barriers for their innovation activities.

3.2.2.4 Knowledge sharing function

As intended by the system, patents should reveal also the content of the inventions. However, the information revealing power of patents does not obviously play a very significant role related to ICT patents, because any expert does not mention it.

3.2.2.5 Assets in negotiations

Whereas patents are neither used for defensive nor offensive purposes, at least some interviewees mention the role of patents as barter chips in negotiations in general, but also for cross licensing in particular.

3.2.2.6 Generating licensing revenues

The role of ICT patents to generate licensing revenues is perceived in general as rather limited, because the market for licensing has – despite the high expectations in markets for technologies, the reduction of transaction costs as a result of platforms – not yet very well developed. However, very few companies are focusing their business models on generating licensing revenues. Furthermore, linking patents to ICT standards is obviously promising and a successful strategy for some companies. However, it is also criticized that the effort of integrating patented technologies into standards is rather high and wasting many resources.

3.2.2.7 Enhancing reputation, measuring performance and rewarding employees

Finally, the interviewees do not mention the role of ICT patents to promote the reputation of the company or even of the single inventor. Consequently, patents in ICT are not used to measure their performance or as basis for rewarding inventors.

3.2.3 Challenges for ICT patents regarding patent application and granting

3.2.3.1 Technological dynamics in the ICT sector

Despite the higher dynamics in the ICT technologies and markets, patents are still a very attractive instrument for companies. This is not only supported by the high and still increasing number of patent applications, but also by the fact that many of them are renewed to the maximum protection period and even further prolonged via follow-up patents. These phenomena also reflect the intensity

of competition in the ICT sector. However, critical voices question the effectiveness of patents if they are valid for only a few years due to very dynamic technological progress. Here, already concerns related to the lengthy processes in the patent offices are raised which often lead to a final grant decision after half of the protection period has passed.

3.2.3.2 Technological convergence and fragmentation in the ICT sector

The pervasiveness of ICT technologies is increasing and ICT companies invest in R&D in other areas, as companies outside the ICT sector increasingly invest in ICT technologies. Consequently, the complexity of technologies and the related patents increase in contrast to the past, where one or very few patents could be attributed to a single product, such as in the pharmaceutical industry. Furthermore, the accumulation of technologies or consequential innovation is a further raising phenomenon, which requires the coordination between the owners of past and developers of new technologies. Especially, the role of interoperability is increasing significantly and expected to become more relevant with the Internet of Things. The fragmentation in the ICT sector and the patent landscape is perceived of being ambivalent. On the one hand, only a few large companies are responsible for the majority of patents, which is an indication that for them patents are still a very attractive tool. On the other hand, many small companies and start-ups own very few or even no patents at all. Besides this dichotomy the traditional closed innovation paradigm and their strong focus on proprietary strategies by making use of patents is confronted with both new paradigms of open innovation and other collaborative and sharing forms of innovation, including open source. Overall, the increasing complexity of ICT technologies including a further increasing number of patents and the progressing dynamics in ICT technologies is challenging the existing system and require more integrative and flexible solutions.

3.2.3.3 Consideration of prior art in patent examination practices

Both the increasing number of patents and the progressing dynamics of the technological change in ICT technologies are assumed to challenge the patent examination, because it may not adequately address the relevant existing prior art. However, the interviewees do not address this challenge. Very few request more time for prior art searches to avoid trivial patents. It is also pointed out that the quality of the examination process at the EPO (European Patent Office) is higher compared to that of the US Patent and Trademark Office (USPTO). The representatives of the OSS community question in general the feasibility of an effective prior art search in software.

3.2.3.4 Cost for applying for ICT patents

The cost for applying patents in ICT related technologies is for the majority of the interviewees not perceived to be a problem. Although the costs for large companies are quite high, they have resources reserved for these expenses. However, the follow-up cost, e.g. for translations, are critical. Finally, SMEs and single inventors might have problems with the high application costs. Nevertheless, a certain threshold might prohibit a larger number of trivial patents.

3.2.3.5 Speed of the granting process for ICT patents

Whereas the application costs are in general not perceived as a problem, the granting process for ICT patents is obviously more complex and faces a trade-off. On the one hand, according to the patent owning companies the technological dynamics is challenging the speed of the granting process at the patent offices. On the other hand, speeding up the granting decision is challenging the quality of the granted patents, which is also in the interest of the patent holder. Consequently, pushing towards a reduction of the period between initially applying for and eventually granting a patent within the framework of the available resources is not supported. However, delayed granting processes limit the opportunities to commercialize patents, especially via licensing. Finally, courts

might be able to correct inappropriately granted patents due to accelerated processes. It is also argued that patent offices offer fast track procedures, which are rarely used by the applicants. Consequently, the speed of the granting process is obviously not really a problem, in particular in the examination phase. In addition, companies make use of various options, like amendments, to delay the final decision or to withdraw their applications at all.

3.2.3.6 Language of ICT patents as a source of information

The language of ICT patents is perceived as problematic for the majority of the interviewees. Again, there is on the one hand a tension between the interest of the applicant of keeping the claims as generic as possible and the examiners objective to reach a high level of concreteness. On the other hand, inventors are not interested to disclose too many details, which is a counter force to language profusion in patent applications. In general, a specific expertise is needed to read and understand patents, especially since a common terminology is missing, which is a special problem of Standard-Essential-Patents SEPs. In addition, it is mentioned – in particular by the representatives of the OSS community – that the descriptions in patents are insufficient to understand the technology to be protected, which requires a direct interaction with the inventor. Finally, there is a tension between the engineers drafting the technical content of patents and patent attorneys translating them into legally effective documents.

However, drafting and reading patents is the profession of a whole community of experts, who are especially trained and experienced.

3.2.3.7 Quality of granted ICT patents granted

The quality of ICT patents is the most intensively debated topic among the interviewees. The majority of the interviewees, especially representing patent implementers, complain about the quality of patents. There are several reasons for this. On the one hand, incremental innovations are dominating in ICT related technologies. On the other hand, the current state of the art is more difficult to identify the dynamic ICT technologies. In addition to the limited resources in patent examination in general, the examination of patents in ICT is challenged by the rapidly volume of literature defining prior art and the need to recur on additional sources of prior art, like standards and the minutes of standardization processes. Overall, the large share of invalid patents decided in court cases confirms the low quality of patents. However, it is also pointed that the patent offices alone cannot assure a high quality of patents and the courts have to play an important role as final decision.

However, the majority of the interviewees also point to differences between patent offices. In general, the Europe Patent Office is granting patents of higher quality both compared to the USPTO, but also in relation to patent offices in Asia. Furthermore, the patent owners in particular observe a trend towards a higher patent quality, whereas others see even a deteriorating patent quality also generated by the further raising number of patent applications.

3.2.3.8 The statutory patentability standards for ICT patents (e.g. technicality, etc.)

The discussion about patenting of computer-implemented inventions or software patents is for the majority of the interviewees – with the exception of the representative of the open source software community – not any more intensively debated. However, since software is invading other areas of technologies, inclusive ICT hardware, the relevance of software patents is increasing. In general, there is the perception that it is still easier – despite some restrictive court decisions – to receive patents on software as such, but also for business patents in the USPTO, whereas in Europe software has to be embedded in technologies or suffice the criteria of technicality. The assessment of effectiveness of patents on software is ambivalent. Few voices remark that patents might not be

strong enough to protect software inventions effectively enough. However, it is widely agreed that patents should be awarded for innovative functions despite the in general incremental character of the innovations, whereas copyright should be used for the form.

3.2.3.9 Protection period of twenty years

The assessment of the adequate length of the protection period for ICT patents reveals a large variety of opinions. A relative majority supports the current maximum length of twenty years yet admit that this is not the first best choice. However, the technology-specific determination and implementation of the optimal patent protection period is not a real option due to many operational concerns and problems. Furthermore, the increasing renewal fees are a further instrument towards a first best solution. Nevertheless, interviewees representing patent owning and commercializing organizations argue even for a longer protection period due to the extended time from research to the final commercialization especially of hardware-based technologies. Few voices plead for the reduction of patent length to, for example, ten years for software-related inventions. In this context, the even longer protection period of copyright is also mentioned to be inadequate for software.

3.2.3.10 The scope of granted ICT patents is too broad

The scope of granted ICT patents is for the majority of the interviewees no problem at all or no specific ICT problem. However, the scope of patents granted in the US is obviously broader and perceived as more problematic compared to Europe. Furthermore, court decisions can correct for possibly too broad patents.

3.2.3.11 Problems of patent protection due to Open Source licenses

Open Source licenses are not mentioned to be a problem for patenting.

3.2.4 Challenges for ICT patents regarding enforcing and implementing patents

Moving to the problems after the granting of ICT patents, the costs and risks have to be considered. In general, only a few interviewees perceive a serious problem both for patent owners and for accused infringers. However, several interviewees point particularly to the relatively high costs for SMEs, which might explain their limited interest in using patents for protecting their inventions. Furthermore, there are significant differences in enforcement costs depending on the jurisdiction. In addition, high quality patents face lower enforcement costs and risks. Finally, their raise is also an expression of a high intensity of completion and the further development of markets of technology, e.g. via licensing and patent trade.

3.2.4.1 Litigation (infringement) of ICT patents

Parallel to the development of enforcement costs and risks related to ICT patents the likelihood of litigation or infringement should have been developed. Consequently, the ambivalence in the assessment observed related to the enforcement cost is reflected also in the statement of the interviewees related to litigation and infringement. On the one hand, several interviewees confirm an increase in litigation driven by the phenomenon of overlapping claims in ICT, but also due to many new entrants in the market confronted with infringement claims of incumbents. Again, the consequences for SMEs also as plaintiff are perceived as much more detrimental than for larger companies, especially in the US. Besides the general differentiation between large and small companies, the governance of the jurisdictions matter, i.e. SMEs are disadvantaged if the plaintiffs have to bear their own costs irrespective of the outcome of the court case. Furthermore, the likelihood of winning an infringement case, i.e. issuing an injunction, is relevant for plaintiffs' strategies. Consequently, interviewees point to the increasing number of litigations especially in Germany (DART-IP 2017) compared to rather stable of even decreasing numbers in the US.

Furthermore, the increase in litigation cases pushes the expectations related to licensing revenues, which make licensing negotiations more complicated and less likely to be successful. However, it is perceived by many interviewees that the majority of patent owning companies are not asserting their patents, because in some other constellations they are in the position of implementation others' patents.

3.2.4.2 Injunctions

Following the issue of litigation, injunctions as one extreme outcome has been discussed. The majority of the interviewees perceive an increase in injunction requests, especially since the interest in compromise between patent owners and implementers has been reduced and the inclination towards confrontation has instead been increased due to stronger interests in commercializing instead of implementing patents. The increased complexity of technology and products would prevent the use of 100 patents within a product, if just the use of one patent were blocked via an injunction. Due to this large leverage effect of one injunction, the plaintiffs are interested in selecting the court with the highest likelihood of success and largest impact in case of success, which leads to kind of forum shopping including the initiation of multiple courts cases searching for injunctions. So far, public interest reasons have prevented so far injunctions on telecommunication networks. Moreover, injunctions tend to be more restricted for SEPs, due to the licensing commitments under the corresponding SDO IPR policy. However, some guidelines (Huawei vs. ZTE case) have been issued lately that rule the circumstances under which they are allowable even for SEPs. Some voices argue that, courts have to issue – if at all – 'smart injunctions' considering both the complexity of the technology, the public interests, e.g. in case of network technologies, and the proportionality related to the damages. Here, again the economic consequences of injunctions for SMEs are in general detrimental.

The ambivalence of injunctions is further stressed by the governance of the patent system in few countries, i.e. the bifurcation of courts in which the issue of patent infringement and of patent validity are dealt with by different courts. The governance of the Unified Patent Court (UPC) does not rule out bifurcation, which is an attractive opportunity for Patent Assertion Entities, because infringement cases are dealt with in courts without a specific expertise.

3.2.4.3 Expected legal cost for resolution of conflicts regarding ICT patents

The expected legal cost are currently not an issue in Europe, because we have a culture of non-litigation and costs are low in Europe. This might change in the future to the implications of the Unitary Patent Court. However, here the expectations diverge. Nevertheless, currently SMEs face already significant challenges, because they have not as much capacity as big enterprises for patent searches, risk management and legal defense.

3.2.4.4 Legal uncertainty for companies creating or implementing ICT patents

In general, the interviewees raise concerns about the increasing legal uncertainty they face in creating and implementing ICT patents. Aside from the aforementioned increasing complexity accompanied by a larger number of patents owned by many more different organizations with different business models, the upcoming UPC creates some additional dimension of uncertainty. However, there are some expectations that the guidelines produced by the Court of Justice of the European Union in HUAWEI vs. ZTE case will provide some guidance for licensing negotiations.

3.2.4.5 Licensors are not willing to license ICT patents covering their technologies (hold-up)

Licensors and licensees might follow two rather extreme strategies in order to maximize their profits. Licensors may threaten licensees not willing to accept the requested licensing fees for their

patents with injunctive reliefs. This threat is especially credible, when the licensees have already made large investments based on the patented technologies or even implemented them in their products. The assessments of the interviewees related to hold-up are very diverging. On the one hand, the representatives of patent owners question its existence due to missing incentives and empirical evidence. On the other hand, patent implementers point to the relevance of hold-up, e.g. by being forced to license in large complete patent portfolios world-wide although they are only interested in a very few patents valid in specific jurisdictions. Furthermore, they complain that licensors are not willing to license their patents to all suppliers in complex value chains, but only to the producers of the final product. Furthermore, the hold-up problem gains in relevance by the entry of organizations following new business models, i.e. the pure commercialization of patents. This further differentiation of the value chain from technology development to implementation reduces the options for cross licensing and hence, most patent owners depend on technologies and patents of others and subsequently, their business models dissolves. There are further countervailing external factors influencing the likelihood of hold-up. The already mentioned likelihood of injunctions increases the negotiation power of patent owners especially related to hold-up. However, the further increase of the relevance of software will make opportunities to invent around the withheld patented technologies easier. This is also the case, when the protected technologies have a rather narrow scope.

3.2.4.6 Implementers of ICT patents are not willing to licensing in the third-party ICT patents covering their implemented technologies (hold-out)

On the opposing side of the assessments related to holdup is the perception of hold-out, i.e. implementers are not willing to license the external patents needed for producing their products in order to save licensing payments. Whereas the licensees observe hold-out only in single cases and argue that eventually, licensing fees will be paid for patents of high quality, the licensors however, perceive a serious problem. They argue that companies implementing technologies protected by patents owned by others do not face serious problems if they do not pay the requested license fees, even after agreeing on common licensing contracts. Consequently, litigation occurs, which is challenging in case of potential infringers with large market power, because they might try to invalidate the relevant patents or buy patents as a counterbalance. Here again, SMEs implementing patented technologies are at a disadvantage. One solution, especially for SMEs owning patents, could be the formation of patent pools to reduce the likelihood of hold-out, because licensees face lower transaction costs and eventually lower accumulated licensing fees. Finally, both patent owners and implementers raise some expectations that the decision of the European Court of Justice (EJC) in the Huawei-ZTE case will provide some guidance in case of conflicts in order to avoid litigation and injunctions.

3.2.4.7 Licensing agreements for standard-essential ICT patents (SEPs)

The previously raised problems related to licensing are further exacerbated in case of standard-essential patents. Due to the often missing opportunities to invent around or use an alternative to an established standard, the related patents give their owners a stronger market power. Consequently, hold-up of their owners has stronger implications for interested licensees. This increases the incentives of patent owners to invest in R&D close to existing and expecting standards, declare their patents to be standard-essential despite the restriction on agreeing to license them according to fair, reasonable and non-discriminatory (FRAND) conditions. Consequently, several problems arise. First, many patents are applied just before or during the standardization process and further changed via amendments. Consequently, the pool of patents relevant for the implementation of a standard is already very dynamic. Secondly, the declarations of patents being

essential are likely to be higher and made in a strategic manner in order to maximize the own share of a standardized technology, i.e. declarations are kept vague and made even after the publication of the standard. Since the pool of patents potentially relevant for a standard is dynamic and the patent owners behave very strategically in their declaring their essentiality, it is very challenging and costly to finally decide about their essentiality even after the publication of the final standard, because also the concrete implementation matters.

Even after a possible agreement on the essential patents, their pricing is challenging, which is crucial for the diffusion of the technology and the related standards, but also for the incentives related to the future investments into R&D related to ICT standards. The question is whether there should be a royalty cap for the sum of all relevant patents, although price fixing might raise anti-trust concerns. Furthermore, it remains open whether the specific implementation of the standard should be taken into account, i.e. does it matter whether a standard is implemented in a mobile phone or in car, or the smallest tradable component should be the reference for the license. In the production of very complex products many suppliers are involved, which raises the question in which stage the licensing in of a standard should take place, i.e. more upstream, e.g. with the chipmaker, or more downstream in the production of the final product. Finally, changing business models and new business models, i.e. PAE, challenge the whole ecosystem, because of their strong interest in commercializing instead of implementing patents in final products, which increases their intention towards litigation with injunctions as possible outcomes. Further challenge will create the expansion of the Internet of Things.

3.2.4.8 Pools of ICT patents

Patent pools are often proposed as solution in case of complex technologies including many patents owned by a large group of owners. Firstly, pools reduce the transaction cost for implementers. Secondly, they increase transparency regarding licensing terms. Thirdly, they might tackle both the problem of over-declaration of SEPs via own essentiality checks and the problem of royalty stacking via reducing the problem of "double marginalization". However, large manufacturers may be advantaged by pools, because SMEs have to pay higher rates per unit.

However, the effectiveness of patent pools is challenged if companies owning large patent portfolios do not join. The majority of interviewees shares this limitation. It is even mentioned that large manufacturers are avoiding pools because of their market power.

However, patent pools have been and are successful especially, for specific and often niche technologies. Nevertheless, the increasing complexity of technologies, especially in connection with the Internet of Things, and the entrance of new actors, e.g. the verticals, is challenging the function of patent pools in the future. However, a new organization called Avanci, "a new, open marketplace where those with essential wireless patents to share can license their innovations, and companies creating connected products for the Internet of Things can access the patented wireless technologies", may be able to get all major patent owners on board. However, it is too early to speculate about the success of Avanci.

Furthermore, concerns are raised that some patent pools might change towards patent assertion entities not hesitating to use injunctions to enforce their rights. This might happen if the participants have no own R&D and related patents anymore, because then the pressure of entering cross-licensing deals with other entities is also not working. However, pools might be an option for SMEs without the necessary negotiation power to commercialize their technologies and enforce their rights effectively.

Implementers complain both about several pools to negotiate with and about already about high prices for pooled licenses, especially if they are referring to specific implementations, e.g. cars. Another idea raised is that the increasing number of licensees might set up and promote an implementers driven pool. In general, the future development of pools in ICT and their effectiveness to tackle the various challenges.

3.2.4.9 Patent Assertion Entities (PAEs)

New business models, like those of patent assertion entities (PAEs), challenge incumbents and the implementation of ICT related technologies. A general challenge is the definition of PAEs, which are divided in good ones fostering licensing for the re-appropriation of R&D investments and bad ones using the cost of litigations to push the price for licenses. Furthermore, they might also develop over time from a patent pool to a troll. On the one hand, a significant share of the interviewees complain that PAEs focus in their business on the commercialization of patents, but not necessarily on their implementation in innovative technologies and products. Both SMEs, but also incumbents are using PAEs to enforce their rights. Since the corrective of cross-licensing does not work anymore, because of the further differentiation of business models, PAEs are more likely to sue potential infringers in courts and to use injunction as further threats to strengthen their negotiation power. This strong position is also used to expand licensing contracts to whole patent portfolios often including high shares of patents of low value, which are at large not interesting for potential licensees. On the other hand, PAEs are also perceived as a phenomenon reacting to market efficiencies, like hold-out, and especially SMEs and technology providers may get their fair market share based on their investments in R&D due to the business activities of PAEs.

The empirical relevance is ambivalent. PAEs are still much more relevant in the US confirmed by the number of court cases. However, recent developments show an increase of litigations driven by NPEs in Europe (e.g. Dart-IP 2017) and the governance of the UPC might increase the attractiveness of the EU for PAEs.

3.2.4.10 Commercialization of technologies protected by ICT patents

The commercialization of ICT technologies protected by patents is assessed quite ambivalent. On the one hand, the lower grant and opposition rates indicate a lower commercialization. On the other hand, the high and increasing numbers of patents and licensing activities present a high level of commercialization. However, the further division of labor between technology developer and implementors mean that the former are not necessarily use the technology they have developed and patented. Furthermore, patents have various functions. Besides the protection of technology from imitation, patents are also used – especially in ICT – for strategic reasons, e.g. securing freedom to operate or blocking competitors, which is an indirect form of commercialization.

3.2.4.11 Patents on computer-implemented inventions (CII)

The dispute related to patents on computer-implemented inventions (CII) in Europe, which already started in the last century, neither went down nor was it arranged. On the one hand, the representatives of the open source community, but also of SMEs, question the effectiveness of patents related to CII, often wrongly named “software patents”. On the other hand, companies active in patenting support in any case the granting of patents for CII, if they are embedded in hardware technologies. However, the majority of them does not support software patents as such and patents on business models and admit that the demarcation of patents on CII is challenging and not harmonized between the patent offices. Finally, some interviewees see no reasons for a special treatment of patents on CII, especially if they account for 60% of all patents according to a recent study (Frietsch et al. 2015).

In contrast, the OSS representatives see in general no need for patents having their origins in science and industrialization, because copyrights are sufficient for computer programs. By the way, the success of the software industry was not based on patents, but on secrecy as protection instrument. Furthermore, changes in mechanical technologies are rather transparent, which is different for computer programs dominated by many small – and often difficult to trace – incremental changes, which are no significant inventions. These representatives argue no additional need for protection for computer programs through patents, which would allow due to the high dynamics only a short period of protection, but a long period of barriers for other innovators. Finally, the need for patents to protect innovation will be reduced the more software will be integrated in innovative products in the future.

3.2.4.12 Interactions between ICT patents and Open Source Software

In general, the majority of the interviewed stakeholders – with the exception of the OSS community – perceives little problems for OSS by the existence of ICT patents. Most important, it is mentioned that OSS addresses copyright not patent right, which allows in principle a co-existence. Furthermore, within OSS one has to distinguish between ownership and access rights, which promotes its exploitation. In contrast, patents are dominated by the principle of ownership and protection, although their enforcement is more challenging in contrast to the more aggregated contents protected by copyrights. Finally, it has been noted that the copyright protection period is much longer than the twenty years for patents. Consequently, OSS and patents relate to different types of innovation and approaches to recover the investments into R&D, which are much higher and riskier in case of patents. The availability of both options generates some kind of healthy competition. Overall, OSS has certainly some advantages in dynamic environments and will achieve a higher relevance due the increasing importance of interoperability.

Many OSS licenses, like GPL, or Apache include patent clauses, requiring the contributors to abide certain restrictions with regards to the enforcement of their patents. Several interviewees including the representatives of the OSS community support this strict commitment. However, some of the OSS licenses do not impose any restriction related to patents and thus the use of any patented technology embedded in the software may be bound to a license.

In addition, there are options of dual licensing, in which case an OSS license is provided for a first version and a proprietary license for a second version, e.g. for new functionalities protected by patents. This approach can also be the other way for patent protected technology to coexist with OSS.

However, other interviewees perceive a challenge in integrating OSS and patents, because it is difficult to find a consensus, especially since patents generate property rights to be respected and even monopoly power, which might be misused, e.g. by trying to monetizing them via their inclusion in OSS. The representatives of OSS would see only a solution in general royalty free licensing of patents following the rules of the OSS licenses. Furthermore, despite the rather short life cycles in ICT many patents are applied for, which are in general challenging the more dynamic OSS developments.

Finally, the relationship between patents and OSS is perceived as similar to the tension between patents and standards. Like for SEPs, patents can protect the technology, but licenses have to be issued according to FRAND conditions, whereas OSS requires strictly an open source license. The next complication is generated by the development of OSS reference implementations of standards, which are in addition based on patents. Consequently, there is the tension that some implementers expect the OSS reference implementations of standards to be used royalty free and not according

FRAND rules, whereas the SEP owners are not willing to give away their patents for royalty free and therefore ready to sue the users of said OSS reference implementations. Another challenge is the potential legal incompatibility of OSS licenses use in said reference implementations and FRAND IPR policies of the associated SDO. One suggestion is to select an OSS license without patent clauses for the reference implementation of the standard, so the implementers would benefit from the software but still would have to take care of the necessary patent licenses. It is currently being discussed in some standardization bodies to develop OSS reference implementations under their umbrella to increase consistency and minimize these tensions. Nevertheless, there are no obvious and easy solutions for these conflicts and tensions, which are expected to increase in the future.

3.2.4.13 Others challenges

In addition to the above mentioned challenges, the experts mentioned the speed of court decisions as current challenge. Related to the future, open innovation is expected to generate further challenges because of the actors involved in the innovation process. From the technological perspective, the Internet of Things and the related increase in data will raise questions about data ownership, which might become more relevant than patents. Finally, SMEs will be challenged from all these future trends.

3.3 PROPOSED SOLUTIONS

3.3.1 Solutions for ICT patents promoting innovation related to patent application and granting

3.3.1.1 Application fees

Although according to some interviewees, higher application fees would distract patents of low quality, the majority of the experts perceive this instrument as not being effective in raising patent quality, because other costs associated with attorneys are much more relevant. In contrast, higher applications fees would generate higher costs especially for SMEs, whereas for large companies they do not matter. Overall, this instrument would further disadvantage SMEs. Therefore, some experts propose to reduce the application fees for this type of applicant. However, it was suggested that the increased revenues are could be used by the patent offices to increase their efforts in the examination processes and eventually patent quality.

3.3.1.2 Degree of novelty

In contrast to the limited effectiveness of raising the application fees, the quality of ICT patents can be increased by raising the required degree of novelty. Here, this requirement is – according to the majority of the experts – satisfactory fulfilled by the European Patent Office, but not necessarily in the US and only to a lower degree in China. However, the representatives of the OSS community suggest significantly increasing the novelty requirements.

3.3.1.3 Inventive step

Raising the required inventive step is certainly another option. However, the proof of the inventive steps is rather challenging. Therefore, most of the interviewees did not comment on this measure. However, the representatives of the OSS suggest that patent offices require more information from the applicants to make better decisions regarding the inventive steps eventually, leading to a much lower number of granted patents.

3.3.1.4 Patent scope

Narrowing the scope of patents is another alternative to raise their quality. However, the majority of the interviewees either is satisfied with the current scope of patents or sees no possibility to narrow it further without utilizing heavy investments. Some also did not comment on this measure.

3.3.1.5 Crowd-sourced validity checks support the patent validity checks by patent offices

One expert suggested that crowd-sourced validity checks could support the examination process of the patent offices.

3.3.1.6 Granting an ICT patent requires already the implementation of the invention

In some countries, there is the requirement of exploiting an invention, as otherwise lapse of the patent may be imposed as penalty. However, the majority of the experts do not support this approach as it leads to additional administrative costs both for the patent offices and for the applicants. Especially, research organisations, which are not interested in developing technology catered towards marketable products, would have limited chances to get their patents granted under such a system. Furthermore, if all details of the invention have to be disclosed, it would challenge the use of trade secrets. Finally, this requirement is not foreseen in TRIPS. However, the representatives of the OSS community are in favour of this proposal in order to eventually only grant patents with a commercial applicability.

3.3.1.7 Raising and specifying (e.g. related to technicality) the bar for patents on computer-implemented inventions

Raising the requirements for patents on computer-implemented inventions (CII) is supported, e.g. by disclosing more and more specific criteria. However, patents on CII are already a significant share of all patents, because many inventions already implement or rely on computer software. Furthermore, incremental inventions within a software, questions the necessary inventive step, although these small changes can lead to significant improvements in the performance of the software and consequently, the final products. The representatives of the OSS community favor an approach, which allows no patenting both of software as such, but also software in combination with technical inventions. Moreover, some of them even propose that all existing patents on CII should become invalid.

3.3.1.8 Software is excluded from patenting both for the program listing and the technical content underlying the software

The option is only supported from the representatives of OSS community.

3.3.1.9 Patents for "Software as such" are granted, i.e. the program listing is patentable

The general patentability of software was not mentioned as a possible solution.

3.3.1.10 ICT patents are granted within five years

Since the dynamics in ICT is rather high and the granting process by patent offices is rather slow, some experts propose introducing the requirement that patents have to be granted within five years to increase legal security for all other actors in the industry. If the granting process is further delayed (this also includes measures of the applicant), the application should become invalid

3.3.1.11 Renewal fees for granted ICT patents

In contrast to the ineffectiveness of raising the application fees for patents, higher renewal fees towards the end of the protection period are perceived as being effective by a significant share of the experts. The current structure of the renewal fees allows SMEs to enter the patent system and in case of success, provides them with the resources to pay the higher fees in later periods. Nevertheless, it also proposed by some experts that lower renewal fees might be an effective instrument to support SMEs.

3.3.1.12 The protection period for ICT patents

Despite the high dynamics in ICT the majority of the experts see no need to restrict the protection period as the applicants can determine when to terminate the patent protection. However, the representatives of the OSS would favor a drastic reduction of the protection period for ICT patents corresponding to the lifecycle of technologies and markets in ICT, because they perceive granted patents as long-lasting barriers for innovation.

3.3.2 Solutions for ICT patents promoting innovation related to enforcing and implementing

3.3.2.1 A declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.)

The declaration of willingness to grant a license for commercial use to anyone (L.O.R.) is considered as an interesting additional instrument, especially for companies using patents as defensive instrument or even as an element of an open source strategy. It is proposed to reward companies following this step by reducing the renewable fees, especially for older patents, and by expanding the patent protection period.

The FRAND declaration related to standard-essential patents is considered as a specific, but also a complementary form of a license of right. However, it is also pointed out that in case of patents of high public interest, the government should buy them and provide a license of right.

Nevertheless, there are serious concerns among the majority of the interviewees. First, it is pointed out that providing a license of rights depends on the specific framework conditions. The ambivalent discussions about the effectiveness and efficiency of FRAND as a specific form of license of rights confirms the challenging complexity of this approach, i.e. its effective implementation does not only require the declaration itself, but also further negotiations are necessary. Despite some support for this option, critical voices claim that the patent owners and licensors should still have the opportunity to decide about the licenses and the licensees. In particular, patent owners perceive a license of right as a too serious intervention and point to exclusivity as a major incentive for patenting, especially in the first years after application.

3.3.2.2 Patent pledges

Patent pledges are – like licenses of right – not well known to the majority of the interviewed experts. The informed experts confirm the effectiveness and efficiency of the instrument, because no specific contracts are needed. However, they do not perceive a need to support it further via public initiatives, because it is already well implemented by the informed users. Nevertheless, this might be an argument for initiatives to raise its public awareness, especially in combination with the promotion of specific technologies and eventually, in combination with Open Source. Consequently, critical voices, in particular patent owners, question the general applicability of the approach. First, the incentives of companies to register their patents in pledges might be limited because they are using patents for competitive purposes. Secondly and more importantly, the legal treatment of patent pledges differ between territories, especially between Europe and the United States, which challenges their effectiveness within a global market.

3.3.2.3 Technology exchange clearing houses

'Technology exchange clearing houses' are well known and established institutions in the pharmaceutical and biotechnology industry. However, they are not yet well established in the ICT sector. Consequently, the majority of the experts has either no opinion or no qualified assessment about their effectiveness or efficiency in ICT. Nevertheless, a significant share of experts confirms that clearing houses could have the potential to facilitate the licensing of ICT patents. The Open Invention Network was mentioned as a specific and successful example of a clearing house. However, it was criticized, that the large and growing numbers of ICT patents might challenge the effective and efficient functioning of clearing houses. Furthermore, it was mentioned that – in contrast to pharmaceutical patents – ICT technologies are immediately implemented, which challenges the mechanisms of clearing houses. Finally, some examples of models similar to clearing houses failed in ICT.

3.3.2.4 Regulations of Patent Assertion Entities (PAEs)

The ambivalent activities of Patent Assertion Entities (PAEs) are intensively discussed among the interviewed experts. However, the assessment of the interviewed experts related to initiatives trying to restrict their activities and businesses differs. On the one hand, the majority of the experts promote the regulation of PAEs especially, by restricting their options to ask for injunctive reliefs. Furthermore, PAEs should be not allowed to shop around in different courts to achieve injunctions. However, concerns were raised that this might be possible in Europe in the future within the Unified Patent Court. Finally, it is proposed to let PAEs pay for the court costs. However, the major difficulty -even faced by the supporters- of these policies is the appropriate definition of PAEs. It is proposed

to define PAEs as organizations, which do not own any patents, they applied for, or do not perform own R&D. Nevertheless, implementing this definition effectively is challenging.

Aside from the challenge to agree upon and implement an appropriate definition of PAEs, there are also experts who perceive PAEs not only as institutions and as part of the system to increase market transparency and efficiency, but also a source to generate revenues for financing R&D. Since antitrust laws also apply to PAEs, few experts argue that there already exists – at least in theory – a regulatory framework in case of misuse. Therefore, existing loopholes in the court system should be closed instead of establishing new regulations that target PAEs.

3.3.2.5 Information incl. product specifications and licensing fees for Standard-Essential ICT patents

Standard-Essential patents (SEPs) are an intensively discussed topic in the context of ICT patents in general. In particular, their essentiality and their licensing conditions are challenging the implementers of technologies and standards. Therefore, more transparency related to SEPs is demanded via the publication of information about technical details relevant for their implementation as well as the licensing fees, which can be justified by the non-discrimination requirement of FRAND. However, some interviewees, in particular licensors, question a general definition of FRAND and therefore do not support the publication of further licensing details about SEPs. Further proposals include the improvement of the declaration databases, including the timely update of changes, e.g. of ownership, but even also a complete disclosure of claim charts of all SEPs, which is perceived as additional burden by the patent owners. Furthermore, essentiality tests are proposed without providing details about their concrete implementation. In addition, it remains open which organisation has to pay for these checks. In general, the practical steps to be taken by SEP holders before seeking injunctions proposed by the decision of the EU Court of Justice Judgment in Huawei v ZTE are appreciated, but also criticized as being not flexible enough.

3.3.2.6 ICT patent pools

Another proposal especially related to SEPs, but also appropriate for ICT patents in general, is the formation of patent pools. There is some limited endorsement among the interviewees to publicly support patent pools in general via public interventions, but also with the support of standardization bodies. Patent pools are particularly supported in case of patents as outcome of public research projects, especially related to new technological infrastructures or standards. The objectives are either to promote the diffusion of their technologies, but also securing freedom to operate especially for SMEs relying on these infrastructure technologies. Furthermore, patent pools increase the requested transparency of licensing rates, but may be also performing the mentioned essentiality tests, especially in the case of SEPs.

In contrast to the supportive attitude towards patent pools, a significant number of experts do not perceive a need to support the formation of patent pools actively. First, large companies have sufficient incentives to join patent pools as licensors including disclosing rules of royalty sharing. Second, licensees are interested in taking licenses through patent pools in order to reduce their risks related to infringement and licensing payments. Therefore, both licensors and licensees, which will increase significantly in number due to IoT, should have sufficient incentives to form patent pools as one-stop-shops. Public interventions might create a bias in the markets, unintended negative side effects- especially in dynamic contexts- and form additional intermediaries. They are difficult to monitor and to guide and interested in seeking rents, which is negative both for licensors, but especially licensees. Here, it is criticized that some patent pools ask for high entry fees. In addition, public policies supporting the formation and development of bilateral or joint licensing programs, incl. providing incentives for organizations to develop these, are not supported. Therefore, policy

makers should restrict themselves to setting favorable framework conditions for the stakeholder-driven development of patent pools and not intervene further into the market and definitively abstain from compulsory licenses via patent pools.

3.3.2.7 Compatible licensing solutions for Open Source Software and ICT patents

Achieving compatibility between Open Source Software (OSS) and ICT patents is a challenge. A few interviewees suggest that government intervention could promote such a compatibility. However, the majority of the experts sees either no justification for such an intervention – expect in areas with public interest – or questions its effectiveness. Firstly, it is claimed that there is no or even little interaction between OSS and patents. Consequently, the transparency related to this interaction is sufficient. Furthermore, those market actors interested to find a solution are able to do so with public support. Secondly, compatibility between OSS and patents is only achieved – especially expressed by the representatives of the OSS community – if patents are registered in patent pledges or can be used royalty free. This solution would also be consistent with the FRAND requirement for SEPs. The alternative would be that the relevant source code could not be claimed to be OSS. However, a significant share of the experts are not convinced about a compatible solution between OSS and FRAND currently been investigated by some standardization organisations, like ETSI. Finally, there is also limited expertise about the interactions between OSS and patents.

3.3.2.8 Transparency of licensing terms of bilateral licensing agreements

In order to facilitate the licensing of patents there are on the one hand strong forces, which support initiatives the publications of bilateral licensing terms, especially from the side of the implementers. Therefore, the approach, e.g. used by Avanci and Via Licensing, to publish the licensing fees for using mobile telecommunication technologies differentiated by the various applications is appreciated. Furthermore, the already mentioned improved transparency of the licensing terms for SEPs is supported, which is further promoted by the activities of patent pools. However, the majority of the experts, especially from the patent owning companies, do not see a need or benefit from disclosing the conditions of bilateral licensing terms, because they should be confidential and restricted to the involved parties. In addition, even in the case of one specific patented technology the licensing terms may vary due to the negotiation power and the business models of the involved parties. Finally, forcing companies to disclose these terms might lead to an increasing use of trade secrets, which further reduces transparency. Therefore, the majority of the experts perceive the current rules of competition law to be sufficient as a framework for licensing of ICT patents. And some stock markets, e.g. in the US, require the disclosure of licensing deals having an influence on the companies' performance in order to secure transparency for the shareholders.

3.3.2.9 Defensive ICT patent aggregators

Defensive patent aggregators are perceived as valuable organizations, especially for SMEs. However, specific public support is not recommended. On the one hand, the existing defensive patent aggregators work well. Furthermore, it is difficult to support their foundation effectively. On the other hand, it is also mentioned that patent aggregators per se are not supporting competition and might collaborate with PAEs or even turn their business models into PAEs, which is critically perceived (including the representatives of the OSS community). Overall, the majority of experts supports the existence and function of patent aggregators, but provides no proposals related to specific public interventions.

3.3.2.10 Insurances against ICT patent litigations

Insurances against patent litigations have been discussed for a long time. However, it is not a very convincing approach for the interviewed experts. On the one hand, the demand for such insurances

is probably limited to small and young companies. Large companies have the resources to handle patent litigation or infringement cases without the involvement of an insurance company. On the other hand, the suppliers of such insurance schemes are challenged by adverse selection and moral hazard, the typical market failures in the insurance market. In detail, companies having higher likelihood of being accused of infringing the patent rights of others might ask for such insurance. In addition, companies might change their behavior after having such an insurance protection towards more strategies increasing the risk of infringement. Consequently, the insurance premiums are difficult to calculate, which will lead eventually to rather high insurance fees making the policies less attractive for potential customers. Overall, a public or publicly supported insurance scheme might be the only solution.

3.3.2.11 Trade secret regulation

The implementation of the new European Trade Secrets Directive aiming to standardise the national trade secret laws in EU countries against the unlawful acquisition, disclosure and use of trade secrets might have implications on the incentive to file patents also in ICT. Some experts expect no implications at all on patenting, especially for ICT, because interoperability requires the disclosure, e.g. of interfaces. However, others expect some impacts. On the one hand, there might be a shift towards trade secrets, especially for process inventions, because of lower costs, which is attractive for SMEs, despite the higher risks. Eventually, trade secrets will reduce incentives for contributions to open solutions leading to more proprietary technologies, which explains the rather critical position of the OSS community. On the other hand, trade secrets are often complementary to patents, which might then even generate a push for patents. In summary, the common regulatory framework related to trade secrets is appreciated, whereas the implications for ICT patents might be quite heterogeneous depending on the characteristics of technologies and the inventors.

3.3.2.12 Mediation and arbitration procedures

Mediation and arbitration procedures are voluntary options to reach mutually satisfactory settlements in case of patent disputes in order to avoid decisions by courts. Sometimes courts recommend mediation, which is more flexible, even allowing one partner to leave the negotiations. In general, mediation and arbitration are rarely used exceptions, but more relevant in systems with weak courts. However, they are more often used in Europe than in the US, where companies are more likely to follow litigation strategies.

It is suggested, that the negotiations should take place on portfolio and not on patent level and question of patent validity and infringement. Overall, mediation and arbitration are perceived by the experts as effective and efficient approaches for conflict resolution, which requires sufficient expertise by mediators and arbitrators, but also resources and trust. However, the majority has no or only little experience with these approaches. Single experts report some dissatisfaction with WIPO guidelines related to mediation and arbitration.

Despite its confidential character, mediation and arbitration require and foster the internal sharing of information between the involved parties. It is criticized that the confidential procedures do not allow for the free sharing of information, especially by the representatives of the OSS community, and therefore the reliance on experiences of previous mediation and arbitration procedures.

Although they are voluntary mechanisms, large companies might enforce them, e.g. large customers might prohibit suppliers to go to court or sell patents to PAEs. It also reported that arbitration between large players can be quite difficult and the identified compromises are not always satisfactory. Therefore, companies have incentives to shop around between various mediators and arbitrators in order to find one that is most favorable, e.g. from the perspective of licensors.

Furthermore, mediation and arbitration should be avoided in case of SEPs, which require more transparency regarding licensing terms.

3.3.2.13 Legal costs for ICT patent disputes

Whereas the court fees as such are perceived as of little relevance, it is suggested to promote faster and less expensive dispute solution mechanisms at courts. Therefore, there should be strong incentives to attract only the most valuable patents to the courts. The sharing of court costs between plaintiff and defendant should be shaped accordingly. For example, sharing the cost in the US puts sufficient pressure on the potential infringer to pay licensing fees in order to avoid high penalties, e.g. the double or triple of licensing fees, or damages for the company value. If injunctions cannot be avoided, “smart injunctions” are suggested, which do not endanger the survival of the infringers and even the functioning of whole markets and technologies. Similarly, the companies that win the case should be compensated in order to restore their financial position to that prior to the court case. Finally, companies misusing the court system should be forced to disclose all the relevant details about their patents up to the option of making their patents invalid.

3.3.2.14 Court System

Specialized courts are proposed, which deal only with patent disputes including both questions of patent validity and infringement. In some jurisdictions it is possible to decide about infringement and validity in different courts. This bifurcation is perceived a quite dangerous, especially for SMEs faced with higher costs and risks. Therefore, it is recommended that regarding infringement, i.e. injunctive relief, and validity, i.e. nullity, should be decided before the same court. Taking account that a significant share of patents is invalid, then the risks created and the resources needed for decisions on infringement could be saved within one court case. However, according to the Agreement on a Unified Patent Court, this bifurcation which is already an option in some jurisdictions, e.g. in Germany, will also be possible on a European level in the future. If one decides about a separation, then a very effective and efficient interface between the two courts should be established.

3.3.2.15 Others solutions

Finally, many interviewees suggest support for SMEs in patent application and implementation, but also in court disputes. However, there are also concerns about the need and the effectiveness of such SME-specific measures. First, they can decide themselves about getting involved in patenting. Secondly, SMEs are often owned by large companies, which would benefit from such supporting policies. However, raising the awareness and understanding of the whole patent system starting from R&D projects, but also including the opportunities of OSS is certainly an effective and efficient approach.

3.4 Dimensions of Responsible Research and Innovation

In the final part of the interview, the interviewees have been asked for the relevance of patents in ICT for the dimensions of responsible research and innovation.

According to the European Commission (https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation), "Responsible research and innovation (RRI) is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation." In practice, RRI is implemented as a package that includes multi-actor and public engagement in research and innovation, enabling easier access to scientific results, the take up of gender and ethics in the research and innovation content and process, and formal and informal science education.

In general, the vast majority of the experts has yet not been confronted with RRI and consequently no in-depth understanding of RRI, which is in line with the conclusion by Stahl et al. (2017) of the need to involve and sensitize stakeholders related to the ethics of emerging fields of ICT. They also find that it is not always clear what are the incentives of companies to consider RRI at all and how to integrate them into their existing organizational structures and processes.

3.4.1 Open Access to Scientific Results

In general, the understanding of access to scientific results is both quite heterogeneous and conflicting. First, some interviewees understand within the open access to scientific results as the option to use these royalty free or like open source. However, others understand that OSS is only one specific way of open access. There is still a significant reluctance among the interviewees to support open access, also related to the results of research projects and regarding to the unclear implications for patent portfolios of universities and research institutes. The trend towards open access might create tensions between research organizations and companies in common research projects, because the pressure to publish for researchers restricts the option to patent. Some suggest even a grace period before open access should be applied. Moreover, the relevance of secrecy for companies is pointed out. However, there is also a significant support for open access, especially from the OSS community, because it is expected to foster the diffusion of content – in contrast to patents – and consequently innovation endorsing the position claimed by Stallman (1992).

The relationship between open access and patents is assessed quite differently. On the one hand, some experts see no links between patents and open access to scientific results at all, because the patent offices have already today access to more or less all scientific results in their searches for prior art. On the other hand, it is also expected that the unrestricted access to all research results via open access will both reduce the likelihood of patents to be granted and increase the chances of invalidity cases.

In summary, the expected implications of the trend towards open access of scientific results on patenting are perceived differently by the interviewees ranging from no impacts at all to rather negative impacts. However, the open and easy access to scientific contents might push innovation supporting the position of the OSS community.

3.4.2 Ethical aspects

Similar to the topic of open access, the majority of experts perceive no ethical issues related to ICT patents. The representatives from industry do not mentioned ethical issues, because they relate ICT in general not with life-threatening technologies. However, ICT-based medical devices directly

related to health and indirectly threats by autonomous driving and other security related applications, like drones, are explicitly mentioned as exceptions. Furthermore, artificial intelligence has an ethical dimension, because its results should be available for everybody. However, the question is also raised whether artificial intelligence might own patents itself.

Telecom operators in particular mention that infrastructure is in the public interest, which has an ethical dimension. Therefore, patents should be not misused to restrict the access to or to block the functioning, including the security, of networks. This concern was also raised by patent pools. Furthermore, the access of developing countries to ICT technologies via lowering licensing costs could satisfy ethical concerns.

Companies implementing ICT patents mention the trade-off that the results of publicly funded research should be available for free for the society, whereas ICT patents should still provide adequate incentives for conducting private R&D.

Organizations representing the interests of SMEs complain that patents hinder the democratizing of innovation, especially for SMEs. Research organizations also mention this threat for SMEs. This request is in line with the position of the OSS community pointing to the fact that OSS is already based on democratic principles. Consequently, ICT patents should restrict neither industry, government (e.g. software for elections) nor society ("code is law"). Especially, the access to the Internet has an ethical dimension discussed in the context of digital divide and inclusion, e.g. mentioned by Rogerson (2011) and Stahl et al. (2014) as future challenge. Consequently, nobody should restrict others via software in general, and patents on software in particular, because they might restrict the freedom to access the right information and the Internet. In addition, software can, for instance, change political views, e.g. via fake news, and influence the process of political decisions.

Research organizations claim that assuring high patent quality is an ethical issue. However, the incentive function of patents has to be assured in order to promote technical progress.

The representatives of the European Commission perceive little similarity to pharmaceutical patents, because ICT is in general no life-saving technology. However, indirect ethical concerns related to privacy and data protection already defined as major topics in the literature review by Stahl et al. (2016), but also to AI and robotics are mentioned.

A representative of a patent office sees ethical issues only indirect depending on the type of technology and the perspective. Since technology is more dynamic than the legal frameworks, e.g. for autonomous weapons (drones) or cars, new laws have to consider existing ethical values (Rogerson 2011)in order to tackle upcoming ethical issues, e.g. via foresight exercises like conducted by Markus and Mentzer (2014) or Stahl et al. (2017). Finally, the privacy implications of ICT have obviously an ethical dimension, which has been mentioned by some experts reflecting its prominent role in the literature revealed by Stahl et al. (2016). In particular, the consumer organization complain that patent offices do not consider ethical issues related to granting patents in ICT, e.g. on technologies affecting data protection or privacy. Explicitly, the Facebook patent on credit rating based on Facebook friends is mentioned.

3.4.3 Overall, the interviews with the experts confirm the results of the literature review. In contrast to the ethical debate of pharmaceutical patents, there is no specific ethical debate on ICT patents, but on the ethics of ICT in general. However, the intensive discussion about pharmaceutical patents could serve as a starting point for a more rigorous ethical debate on ICT patents, because of the existence of some immediate life-threatening ICT technologies, of the generic character of ICT infrastructure and of the impacts of ICT on privacy and data protection, which are intensively discussed in the general discourse about the ethics of ICT (Rogerson 2011) and computers (Stahl et al. 2016) . Finally, the inclusive function of ICT for societies, especially in developing countries, could contribute to achieve responsible research and innovation (e.g. De Keersmaecker 2017). Other Dimensions of Responsible Research and Innovation:

The other dimensions of responsible research and innovation, i.e. engaging society (public engagement), gender aspects, and promoting (in)formal science education, are in general not mentioned by the interviewees. Only, the strong gender bias is observed, but perceived as difficult to change. In addition, the involvement of users via open innovation could be seen as a way to engage society in innovation. Finally, a better education also in patenting could help to improve the changes to tackle the various challenges.

3.5 SUMMARY

Overall, the interviews provided a broad and rather comprehensive spectrum of the challenges for patents in ICT, but also revealed that the current system is able to tackle the various challenges. Obviously, there is a significant disagreement about the relevance of the various problems raised between the various stakeholders interviewed. Consequently, they interviewees are also in general not agreeing about the effectiveness of the various approaches to tackle the challenges. These findings are in line with the insights from the literature reviews. This is also the case for the various dimensions of responsible research and innovations, which have tackled only as ethics in ICT in general in the literature (see D2.3), but very limited in focusing of the ethics of patents in ICT. However, here the level of disagreement is rather low between the experts, who have obviously not yet been confronted with this perspective.

4 STAKEHOLDER SURVEY

The questionnaire of the survey is based on the review of the literature and the interviews with stakeholders including the input from the focus group exercises summarized in the previous chapter. It aimed to collect the opinions and attitudes of stakeholders involved in or connected with the ICT sector towards the current patent regime framework relevant for responsible innovation.

The answers to the questions of the survey are interpreted as personal opinions and not necessarily as the organizations' official position. The answers have been treated with absolute confidentiality.

The co-operation and opinion from the experts have been deeply appreciated by the CIFRA project, since they support the further development of an innovation-friendly patent regime for ICT in the European Union.

4.1 METHODOLOGY

The stakeholder survey has been structured according to the guideline used for the expert interviews, but contains in detail the following sections. After defining both ICT patents and responsible research and innovation, the experts are asked for their opinions on the subject as well as to provide some information about their organization including, their innovation activities. These generic sections are followed by questions regarding the use of Intellectual Property Rights by the organization and the effectiveness of ICT patents in achieving specific objectives. These include, preventing the imitation of inventions or blocking competitors.

The first major part of the survey includes the assessment of challenges for ICT patents related to innovation in the experts' organization. This part is built on the challenges identified in WP2, the literature review and the interviews incl. the focus groups performed in WP3. The second major part of the survey includes proposals for specific changes of the current patent regime in order to make it more conducive to innovation. Both sections are divided into challenges and solutions regarding:

- patent application and granting to effectively promote innovation including research and development in ICT.
- enforcing and implementing patents to effectively promote innovation including research and development in ICT.

The last question is on the relevance of the five dimensions of implementing Responsible Research and Innovation (RRI) regarding ICT patents. In addition, the experts are asked to specify the role of ICT patents related to the five dimensions of implementing RRI.

In the disclaimer of the questionnaire, we highlight our very broad understanding of ICT patents following the OECD STI working paper on ICT-related technologies (Inaba and Squicciarini 2017) including both traditional telecommunication and Internet related technologies, such as the Internet of Things (IoT) and their various applications, e.g. electronic payment systems, imaging and sound technologies, and gaming, and also in vertical industries, incl. automotive or energy.

Furthermore, we also consider patents on computer-implemented inventions (CII), being aware that under the European Patent Convention "programs for computers" are not regarded as inventions for the purpose of granting European patents.

A copy of the survey can be found in the Annex 3.

After completion of the majority of the interviews, the questionnaire has been drafted and distributed to several experts representing different stakeholder groups asking for their feedback in May 2017. Based on these responses, the final questionnaire has been shortened and optimized in various feedback loops in order to assure a better comprehensibility. It has been openly distributed online via the link https://inno.limequery.com/228186 between June and August 2017. The target audience were the members of the ETSI IPR Special Committee, which have been directly approached twice via their mailing list. The Free Software Foundation Europe FSFE, the mobile operators organization GSMA, the Open Invention Network OIN, the European Association of Research and Technology Organization EARTO, the European DIGITAL SME Alliance, the largest network ICT small and medium sized enterprises in Europe, of the Bundesverband IT-Mittelstand BITMI, the German member association of DIGITAL SME, of the European Patent Lawyers Association EPLAW distributed emails to their members including a link to the online survey. In addition, both the European IPR Helpdesk and the German Patent and Trademark Office DPMA posted information about the survey as well as the link to the survey on their homepages. Finally, representatives of the companies identified in WP2 as being responsible for the majority of the patent applications were invited in person via email to participate in the survey.

Consequently, the approached groups covered all main stakeholder groups already covered in the interview. Due missing information about the number of members in the mailing lists of the above-mentioned organizations, it is not possible to exactly determine the number of organizations or individual experts, which have received an email with the link to the survey. In addition, the recipients have been invited to forward the email to further experts. Consequently, it can be assumed that way above one thousand individuals or organizations have received the email with the link to the survey. This very open approach is in general applied in the open consultations of the European Commission or the impact assessments performed on behalf of the European Commission in order to allow all interested stakeholders to participate. Furthermore, the debate about the ethics of ICT also ask for a broad involvement of all directly or indirectly impacted stakeholders (Rogerson 2011). Recently, Stahl et al. (2017) emphasize in their foresight study about ethical issues in emerging fields of ICT the important role of all stakeholders in order implement Responsible Research and Innovation (RRI) in practice. This broad coverage of stakeholders has been already realized by the composition of the interviewees and has been applied in the stakeholder consultation via a broad an open survey. Indeed, such a procedure is in contrast to approaches in academic studies, which draw from a homogeneous universe, e.g. of companies, a specific closed random sample in order to calculate response rates and check for response biases. However, since we cover both ICT companies in the widest sense, legal and other services, independent software developers and research organizations, both defining the universe, drawing random samples and calculating response rates is not feasible.

Finally, due to the support from some interviewees and their contacts plus the support of the above-mentioned organizations, it was possible to receive 839 feedbacks in total. Despite the length and complexity of the questionnaire, 167 respondents answered the questionnaire from the beginning to the very end. This is a rather high number compared to the just one hundred respondents to the official public consultation of the European Commission on patents and standards closed in 2015.[1] Therefore, we conclude that the topic of ICT patents is relevant and our approach accepted by the addressed stakeholders.

[1] http://ec.europa.eu/growth/content/public-consultation-patents-and-standards-modern-framework-standardisation-involving_en

4.2 SAMPLE CHARACTERISTICS

The sample of the respondents to the survey can be described according to the several information about their individual position, but mainly about the characteristics of their organization.

The respondents are active at the top management level, in the legal department, in research and development and in IT or the software department.

Table 4 Position of Respondents

Chief Executive Officer (top management)	110
Member of Legal/Patent Department	84
Member of Research and Development Department	101
Member of IT/Software Department	154
Independent Software Developer	87
Other	46

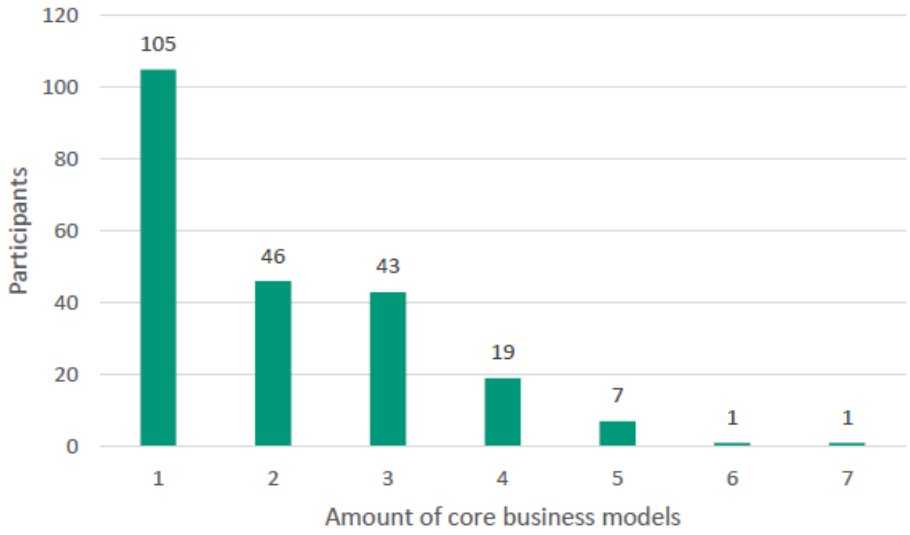
More important than the position of the respondents is the business model of the organization they work for. Table 5 reveals the large number of answers from the software, but also the service sector. Respondents represent the entire ICT value chain from R&D to individual component manufacturers as well as the producers of the end products and even lawyers, i.e. companies providing IPR services. Therefore, all the important stakeholders identified via the literature review and the interviews have responded to the survey.

Table 5 Organizations' Core Business Model (multiple answers possible)

Company producing final consumer products	85
Company supplying components	63
Network operator	34
Software supplier	141
Independent Open Source Developer	43
Research institute (Private)	21
Research institute (Semi-Public and Public)	33
Service company	120
Company providing IPR services	32
Other	28

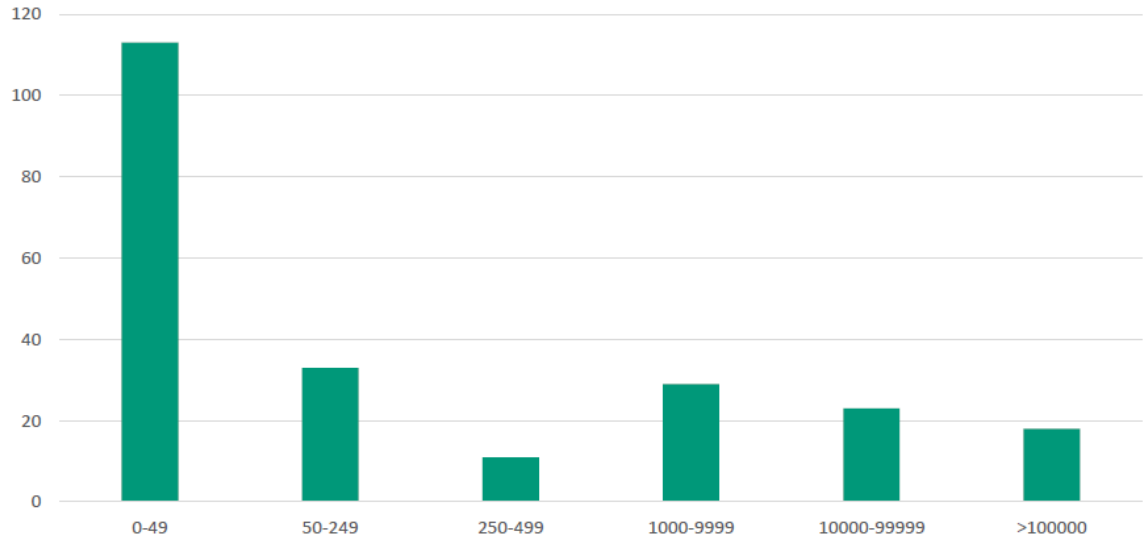
However, the option to tick several business models allow us to reveal that around half of the respondents work in an organization with one business model. A quarter has a business model based on a mixture of two and another quarter based on even three different business models.

Figure 1 Number of Organizations' Core Business Model



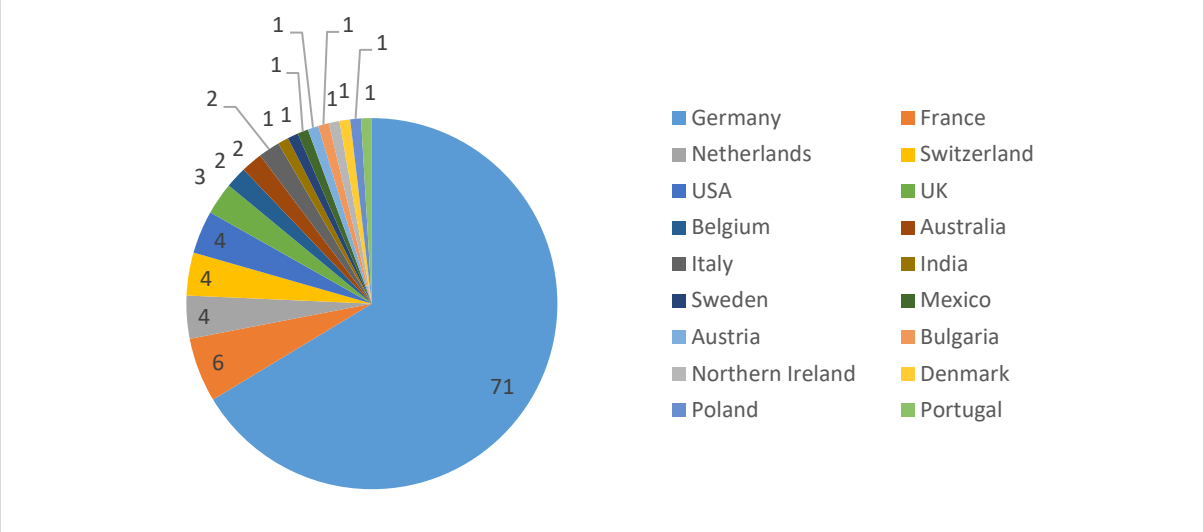
Related to the business model is the size of the organization or company. Roughly, two thirds of our sample are SMEs with up to 249 employees and one third are large companies. Consequently, the representation of the interests of SMEs is assured by this size distribution of the respondents.

Figure 2 Number of Employees



Finally, it is worth considering the country of origin. Here, we observe that only around one hundred respondents provide information about their country of origin. However, there is rather strong bias to answers from Germany. This is justified by Germany as the country with the highest share of patent applications at the European Patent Office. Nevertheless, according to the shares of patents more answers from France, the United Kingdom and the Netherlands have been expected. Overall, we observe a country bias probably as a result of Fraunhofer hosting the survey and where the German Patent and Trademark Office and other German institutions were promoting it.

Figure 3 Country of Origin



Finally, the innovation activities provide interesting background information, because they might explain both the use of various Intellectual Property Rights (IPRs) and the assessments of problems and solutions, the main part of the questionnaire. The share of more than 80% of the respondents claiming to have introduced a product innovation is higher than the average numbers calculated based on the Community Innovation Survery CIS (e.g. Rammer et al. 2016). Therefore, we have a rather innovative sample of companies introducing product innovations to the market. In contrast, the share of process innovators is significantly lower. The same is true for marketing and organizational innovations.

Table 6 Type of Innovation

	Product	Process	Marketing	Organization
No	48	100	178	170
Yes	232	170	76	92

Driven by the high share of product innovators, more than one third of the respondents have applied for patents. Consequently, this share is even higher than the ratios reported in the Community Innovation Survey (which are around 20%). The reason is that more than 80% of the large companies have applied for patents, which is similar to the shares reported in the Community Innovation Survey. In contrast, this is the case for less than 20% of the responding SMEs. We observe a high correlation between company size and the inclination towards patenting.

However, besides the high share of respondents having applied for patents it has to be pointed out that almost half of them registered trademarks and claimed copyright. Therefore, one major finding is that patents – even for this sample of companies does not play in the sense of usage – the most important role among the set of IPRs.

Table 7 Use of Intellectual Property Rights

	Patent	Utility Models	Industrial Designs	Trademarks	Copyright
No	158	186	181	130	119
Yes	84	47	54	108	115

However, the high licensing activities both inward and outward, which are more than quadruple the number found in the German Community Innovation Survey (Rammer et al. 2016), are in line both with the high patent intensity of the sample and the need of the complex ICT industry to integrate technologies from producers of complementary products. This is confirmed by the fact that the higher share of more than one quarter of the respondents is licensing in, whereas less than on fifth is licensing out. Surprisingly, only 10% of the respondents is involved in cross licensing. This is an indication of the further differentiation of value chain in ICT, which increases the need to license in, but reduces the opportunities for cross licensing.

Table 8 Licensing activities

	Own patents rights licensed out or sold to third parties	Patents of third parties licensed in or bought	Others, incl. Cross-licensing
No	191	172	191
Yes	45	62	22

The differentiation of the value chain in the ICT sector and the role of patents can also be seen in the shares of patenting companies. For example, almost two thirds of the semi-public or public research institutes and the companies supplying components have applied for patents, whereas less than half of the companies producing final consumer products and the network operators own patents. These figures reveal the flows of patent protected technologies towards downstream stages, but also that cross licensing among companies active in this stage is less likely, because less than half of them owns patents.

Overall, the assessments of the respondents to the main parts of the questionnaire will be differentiated according whether their organizations own patents or not, according to company size, business models and eventually the country they are located in. These analyses will help to test the robustness and validity of the results.

Table 9 Business models and patenting

Organization's core business model	Application for patents	
	Yes	No
Company producing final consumer products	28	41
Company supplying components	27	17
Network operator	12	15
Software supplier	31	84
Independent Open Source Developer	7	30
Research Institute (Private)	6	11
Research Institute (Semi-Public and Public)	13	8
Service Company	23	74
Company providing IPR services	12	11

4.3 SURVEY RESULTS

In the following section, we are presenting the results of the stakeholder consultations. Since we have addressed a very broad range of stakeholders, we are in general not displaying overall average but differentiated by different groups. Due to numerous options to differentiate the answers, we present in the chapter the results differentiated between respondents working in organizations owning patents and those not owning patents, because here the most significant differences can due to their diverging interests be expected, which is in general confirmed. In addition, the results have been further differentiated according to the position of the respondents within his or her organization, the size of the organization, the business model of the organization and eventually the answers from Germany as an jurisdiction with a strong support of the patent system to the answers from respondents frm other countries. However, the most relevant insights are integrated in the text, but all the figures of these analyses can be found in Annex 4.

4.3.1 Effectiveness of ICT patents

In order to establish a reference point for the assessment of the problems, the participants have been asked for their assessment of ICT patents in achieving specific patent-related objectives identified by Blind et al. (2006).

Overall, for none of the objectives is the effectiveness of patents rated high, even by the patent owners. The limited effectiveness of patents in comparison with other protection strategies was already revealed the Cohen et al. (2000) survey. However, the ranking of the effectiveness is different compared to Cohen et al. (2000). Firstly, the protection from imitation of invention achieves only a medium effectiveness. Secondly, patents are mostly used as barter chips in negotiations, which has already been revealed by Blind et al. (2006). Thirdly, using patents by securing freedom to operate is surprisingly important for the respondents. However, the survey targeting the owners of standard-essential patent owners by Blind et al. (2011) reveals freedom to operate already as the most important motive to patent. Finally, using patents to enhance the own reputation is ranked above medium effectiveness. This is also in line with the finding of Blind et al. (2011) of using patents for signaling own technological competencies. Surprisingly, the licensing generating revenues via patents is ranked lowest. Analysing the assessment of the respondents not owning patents, which is quite similar to SMEs' perception, it becomes obvious that they see the highest effectiveness of patents in blocking competitors.

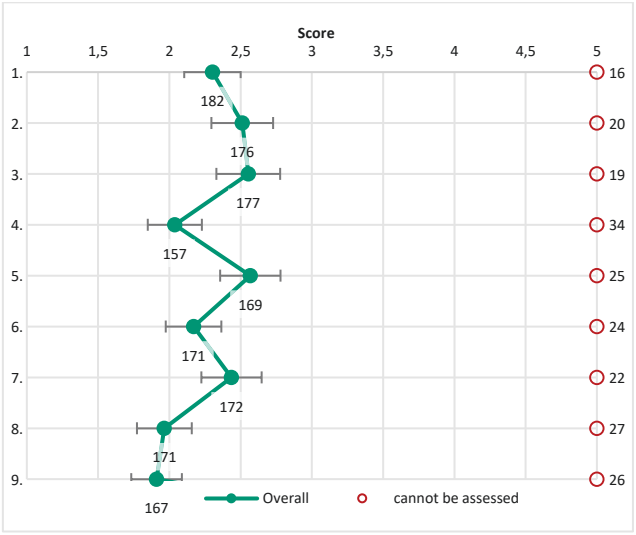
Furthermore, the differentiation of the responses depending on a company's business model reveals further details. Firstly, independent software developers are most critical regarding the effectiveness of patents in all dimensions, in particular, to their – relatively unfamiliar – coordination function in research processes. However, they consider patents as being effective to block competitors. Secondly, companies supplying components are very positive about the effectiveness of patents in most of the dimensions. Thirdly, network operators are asides from the independent software developers, the most threatened by the blocking function of patents but in contrast, are positive related to using them as assets in negotiations.

Finally, the perception of the differences in the national patent laws and in particular in their implementation can be analyzed by differentiating the answers of the patent owners in Germany from those outside Germany. Interestingly, the respondents from Germany perceive patents in ICT more effective in securing their freedom to operate, which might be due to higher quality, whereas they are – compared to the respondents outside Germany – less convinced about ICT patents for

measuring performance in R&D or rewarding employees. These are interesting differences, which reflect a variety of patent cultures and strategies framed by different legal framework conditions and their implementation.

Figure 4: Effectiveness of ICT patents ranging from very low (1) to very high (5)

1. Preventing imitation of inventions, e.g. for securing the means to obtain a return on the R&D investment
2. Securing own freedom to operate by disclosing prior art (e.g. to prevent legal conflicts)
3. Blocking competitors
4. Using the coordination function in research processes and collaborations incl. open innovation
5. Using as asset in negotiations (incl. cross licensing)
6. Generating licensing revenues
7. Enhancing reputation
8. Measuring performance of research and development
9. Rewarding employees



4.3.2 Challenges for ICT patents

After providing the general background of the respondents, their usage of patents and their assessment of the effectiveness of patents, we now move to the first major objective of the impact assessment namely, the evaluation of the challenges related to ICT patents. Here, we divide the challenges between those related to patent application and granting on the one hand and those related to enforcing and implementing patents on the other hand. The rating revolves around five possible answers ranging from “totally disagree” to “totally agree”.

Not surprisingly, the companies not owning patents and consequently, the SMEs face to a larger extent the identified challenges. However, there are a few exceptions, which shall be further elaborated later.

The statement that received the highest level of agreement was “The scope of granted ICT patents is too broad”, which is particularly criticized by those companies that do not own patents. However, not only the broad scope, but also the length of patent protection is criticized as being too long. Furthermore, the quality of ICT patents granted is perceived to be low, which might be closely related to the critique that “patent examination practices do not adequately consider relevant existing prior art”. These skeptical assessments are in particular driven by the answers of the independent software developers. Due to their general skeptical attitude towards patents, they perceive the differences of “the statutory patentability standards for ICT patents (e.g. technicality, etc.)” among patent offices not so much as a problem. Regarding this statement, there is also no significant differences between the answers of the patent owners and the other respondents, but also between large companies and SMEs. However, a rather high share of more than one quarter of respondents, most of them SMEs, is unable to provide any assessment.

Overall, the challenge that “Implementations cannot be effectively protected by patents because they include code under an Open Source license that includes patent licenses” is perceived only as ambivalent as well as the high cost for applying for ICT patents. In the latter, the significant differences between patent owners and the other respondents even disappear. The same is true for the assessment of the speed of the granting process for ICT patents, which could also not assessed by a quarter of the respondents.

Finally, the patent owners perceive significantly less problems for ICT patents due to the technological dynamics or technological convergence and fragmentation in the ICT sector compared to the other respondents, in particular the independent software developers. For the latter, “the language of ICT patents is too complicated to qualify as a good source of information” is also perceived as a major problem, which has already been expressed by the interviewees of the OSS community.

Figure 5 Assessment of the challenges for ICT patents regarding patent application and granting ranging from totally disagree (1) to totally agree (5)

1. Due to the technological dynamics in the ICT sector, patents are not effective to protect innovation
2. Due to technological convergence and fragmentation in the ICT sector, patents are not effective to protect innovation
3. Patent examination practices do not adequately consider relevant existing prior art
4. The cost for applying for ICT patents is too high
5. The granting process for ICT patents is too slow
6. The language of ICT patents is too complicated to qualify as a good source of information
7. The quality of ICT patents granted is low
8. The statutory patentability standards for ICT patents (e.g. technicality, etc.) differ among patent offices
9. The maximum protection period of 20 years is long for ICT patents
10. The scope of granted ICT patents is too broad
11. Implementations cannot be effectively protected by patents because they include code under an Open Source license that includes patent licenses

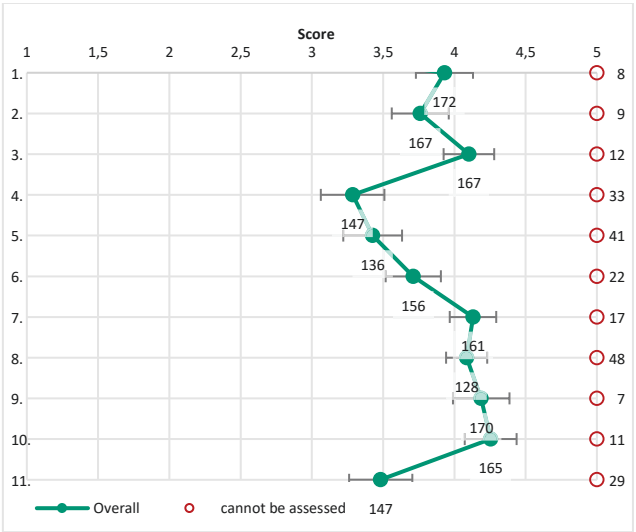
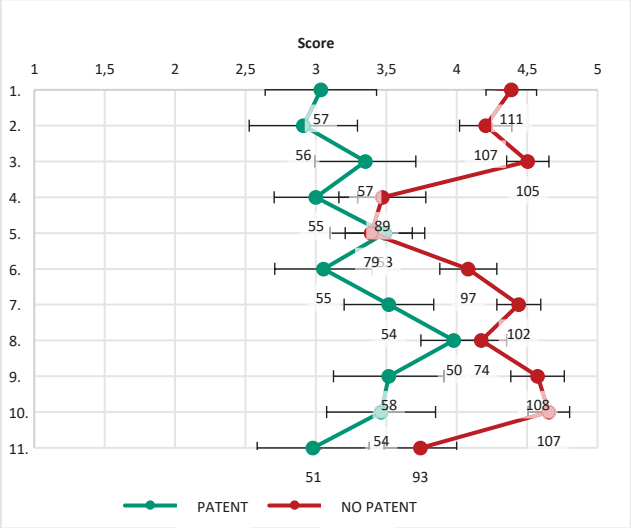


Figure 6 Assessment of the challenges for ICT patents regarding patent application and granting ranging from totally disagree (1) to totally agree (5) (patent owners vs non-patent owners)

1. Due to the technological dynamics in the ICT sector, patents are not effective to protect innovation
2. Due to technological convergence and fragmentation in the ICT sector, patents are not effective to protect innovation
3. Patent examination practices do not adequately consider relevant existing prior art
4. The cost for applying for ICT patents is too high
5. The granting process for ICT patents is too slow
6. The language of ICT patents is too complicated to qualify as a good source of information
7. The quality of ICT patents granted is low
8. The statutory patentability standards for ICT patents (e.g. technicality, etc.) differ among patent offices
9. The maximum protection period of 20 years is long for ICT patents
10. The scope of granted ICT patents is too broad
11. Implementations cannot be effectively protected by patents because they include code under an Open Source license that includes patent licenses



In comparison to the level of agreement to the challenges in the application and granting of ICT patents, we observe an even higher support to the problems related to the enforcement and implementation of ICT patents. In addition, there is only a minority of problems where the patent owners and the other respondents disagree significantly. Obviously, the patent owners perceive much more difficulties in enforcing and implementing their patents compared to the application and granting phase. Finally, a large share of respondents also have problems assessing the various challenges.

The top three challenges according to the respondents' assessments are the following. In contrast to most other challenges, the patent owners agree significantly less to these three statements. Firstly, the expected legal cost for resolution of conflicts regarding ICT patents are considered as rather high, whereas the cost for enforcing granted ICT patents are less of a problem. Secondly, it is feared that ICT patents owned by Patent Assertion Entities (PAEs) will increase the legal uncertainty for the implementers of ICT related technologies, whereas the general legal uncertainty for companies creating or implementing ICT patents is rated significantly lower. Thirdly, the use of ICT patents protected technology generates problems for the use of Open Source Software, which is in particular stressed by the independent software developers and is in line with the fear already expressed in the interviews. They are also most critical against patents on computer-implemented inventions (CII), in brief, software patents, because they might create difficulties for innovation of ICT-related technologies. Consequently, they, but also all other respondents, perceive the least problems for ICT patents by using Open Source Software.

In contrast to the interviews expressed in the literature, the rated second least problem is the threat of courts granting an injunction to prevent infringements of ICT patents. Here, the fear of the independent software developers is still highest, whereas the companies providing IPR services, i.e. patent lawyers and attorneys, perceive the least difficulties. However, the general likelihood of litigation (infringement) of ICT patents is considered to be higher, again explicitly expressed by the independent software developers.

Focusing on hold-up's, i.e. licensors' unwillingness to license ICT patents, and hold-out's, i.e. implementers' unwillingness to license in third-party ICT, we observe no significant differences. Surprisingly, patent owners do not agree significantly more to the hold-out problem as the others,

i.e. potential licensees, who perceive hold-up as the more severe problem. However, looking at the differences between business models, the companies producing final consumer products as well as the network operators, -often accused for hold-out- consider this less a problem compared to hold-up. In contrast, companies supplying components, sometimes accused for hold-up, regard it to a lesser degrees as a problem. Finally, almost one quarter of respondents were not able to give an assessment both for hold-up and hold-out underlining the difficulty in identifying the real extent of the problem, which has already been expressed in the interviews.

Closely related to the intertwined problems of hold-up and hold-out are the negotiations of the licensing agreements for standard-essential ICT patents (SEPs). Overall, this is rated higher as a challenge than hold-up and hold-out. However, the major opponents in these negotiations, the companies supplying components and the companies producing final consumer goods, agree at the lowest level to this challenge. The same is true for their assessment of large patent owners not joining pools of ICT patents.

Finally, the risk that many ICT patented technologies are not used or commercialized is particularly supported both by the independent software developers and by the semi-public and public research institutes. The latter are afraid that the technologies they are developing are eventually not commercialised. In contrast, companies supplying components consider this challenge – also among the other challenges – as one of the least relevant ones.

In summary, almost all challenges considered to be relevant are reflected by the level of agreement from the experts. However, the valuations are significantly lower by the patent owners and higher by the SMEs with a few exceptions. Furthermore, not only the use of patents and the company size, but also the various business models lead to different assessments. In general, the independent software developers have more serious concerns related to the challenges generated by ICT patents. The differentiation between various business models provides further insights and has policy implications.

Figure 7 Assessment of the challenges for ICT patents regarding patent enforcement and application ranging from totally disagree (1) to totally agree (5)

1. The cost/risk to enforce granted ICT patents is high
2. The likelihood of litigation (infringement) of ICT patents is high
3. The likelihood of courts granting an injunction to prevent infringement of ICT patents is high
4. Expected legal cost for resolution of conflicts regarding ICT patents are high
5. The legal uncertainty for companies creating or implementing ICT patents is high
6. Licensors are not willing to license ICT patents covering their technologies (hold-up)
7. Implementers of ICT patents are not willing to licensing in the third-party ICT patents covering their implemented technologies (hold-out)
8. Agreeing on licensing agreements for standard-essential ICT patents (SEPs) is challenging
9. Large patent owners not joining pools of ICT patents challenge the implementation of ICT-related technologies
10. ICT patents owned by Patent Assertion Entities (PAEs) increases legal uncertainty for implementers of ICT related technologies
11. Many technologies protected by ICT patents are not used or commercialised
12. Patents on computer-implemented inventions (CII) or software patents challenges innovation of ICT-related technologies
13. The use of ICT patents protected technology generate problems for the use of Open Source Software
14. The use of Open Source Software generates problems for the use and protection of ICT patents

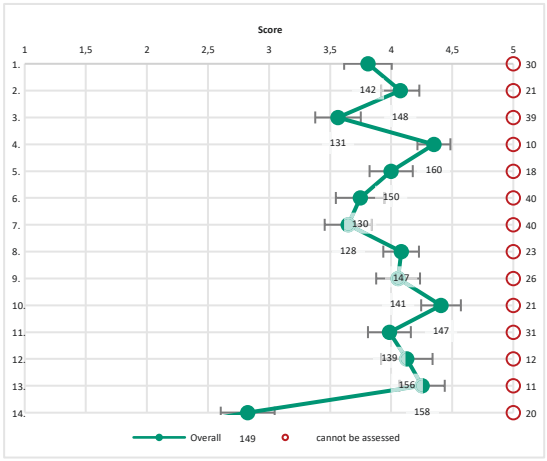


Figure 8 Assessment of the challenges for ICT patents regarding patent enforcement and application ranging from totally disagree (1) to totally agree (5) (patent owners (yes) vs non-patent owners (no))

1. The cost/risk to enforce granted ICT patents is high
2. The likelihood of litigation (infringement) of ICT patents is high
3. The likelihood of courts granting an injunction to prevent infringement of ICT patents is high
4. Expected legal cost for resolution of conflicts regarding ICT patents are high
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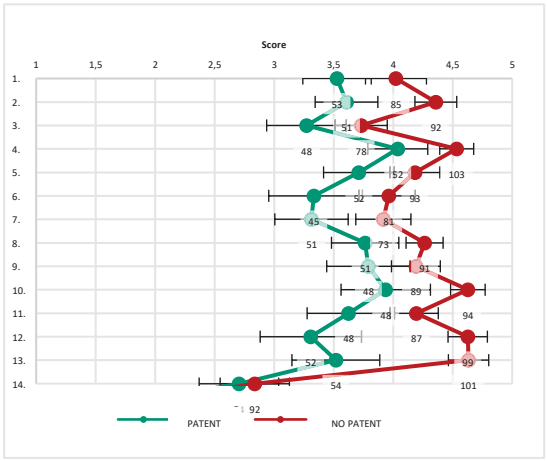
10. ICT patents owned by Patent Assertion Entities (PAEs) increases legal uncertainty for implementers of ICT related technologies
11. Many technologies protected by ICT patents are not used or commercialised
12. Patents on computer-implemented inventions (CII) or software patents challenges innovation of ICT-related technologies
13. The use of ICT patents protected technology generate problems for the use of Open Source Software
14. The use of Open Source Software generates problems for the use and protection of ICT patents



4.3.3 Solutions

Based on the review of the literature and the proposals mentioned in the interviews to improve the present framework for ICT patents (including options), which run counter to the current legal framework (internationally, within the European Union, or nationally), we developed a set of possible solutions. These are divided into those related to successful patent application on the one hand and the enforcement and implementation of patents on the other hand.

4.3.3.1 Solutions related to patent application and granting

In contrast to the high agreement to almost all proposed challenges for ICT patents, the effectiveness of some of the suggested approaches aimed at making the framework for ICT patents more conducive to innovation are questioned by the majority of the respondents. However, major new insight from the stakeholder survey is the high level of agreement to almost all proposed solutions between the patent owners and the other respondents despite the rather different assessment of the challenges.

However, we start with the most significant result. The vast majority of the respondents assess the exclusion of software from patenting "both for the program listing and the technical content underlying the software" as very effective. This extremely positive assessment is particularly driven by the valuations of the independent software developers and SMEs. However, the respondents representing the other business models also support this proposal. In line with the broad support of the exclusion of "software a such" from patenting, is the strong backing of the proposal of raising and specifying (e.g. related to technicality) the bar for patents on computer-implemented inventions by both patenting and non-patenting respondents, in particular active in SMEs. This proposal was already supported in the early days of the discussions about software patents (Blind et al. 2005). In contrast, but very consistent with the previous assessment is the strict denial of patents for "software as such", i.e. program listing is not patentable. Here, we observe even a greater homogeneity among all respondents. Although the sample is slightly different, there are interesting differences to the findings of Blind et al. (2005), who investigated the options on patenting software and computer-implemented inventions at the very beginning of the discussion about possible changes of the European Patent Convention. More than fifteen years later, the position of the independent software developers has not changed at all. However, we can observe that the representatives of both the software suppliers and of the non-patenting companies of the manufacturing sectors have recently started to follow closely the position of the independent software developers.

Besides the specific aspects of software patents, the other proposal rated as effective focuses on the quality of granted ICT patents, which is identified to be challenging. Whereas not all stakeholders consider raising the application and renewal fees as being effective, the patent scope as the most supported challenge should be narrowed. This proposal is especially endorsed by the non-patenting respondents, but questioned by the companies providing IPR services, because patent attorneys are interested in getting patents granted that have a large scope. This high level of correspondence between the most relevant challenge and the most effective solution confirms the consistency of the answers and therefore the selected approach in conducting an impact assessment. Besides narrowing the patent scope, the required degree of novelty and the required inventive step are evaluated as being effective in making the framework for ICT patents more conducive to innovation.

In contrast to these rather traditional proposals, the idea of crowd-sourced validity checks supporting patent offices and the requirement of implementing an invention before granting an ICT patent receives less support, in particular the latter by patenting respondents. They are also not in

favor of reducing the protection period for ICT patents to ten years, which is considered to be more effective by the independent software developers. However, the requirement to grant ICT patents within five years is supported by the patent-owning respondents, in particular by the network operators.

In summary, the proposals related to successful patent application are considered to be effective in restricting patenting for "software as such" by the majority of the respondents. In addition to this specific topic suggestions focusing on raising the quality of ICT patents are considered to be less effective both by patent owners and by non-patenting respondents. In particular, raising the costs for patent applications or renewals of granted patents are not perceived to be very effective nor speeding up the granting process of ICT patents or halving their protection period. In general, it will be challenging to effectively implement these proposals either due to legal restrictions set by TRIPS or limited resources for investing in patent examinations, e.g. to reduce the scope of patent applications.

Figure 9 Assessment of solutions for ICT patents promoting innovation regarding patent application and granting ranging from not effective (1) to very effective (4)

1. The application fees for ICT patents are raised
2. The quality of granted ICT patents is improved by raising the required degree of novelty
3. The quality of granted ICT patents is improved by raising the required inventive step
4. The quality of granted ICT patents is improved by narrowing their scope
5. Crowd-sourced validity checks support the patent validity checks by patent offices
6. Granting an ICT patent requires already the implementation of the invention
7. Raising and specifying (e.g. related to technicality) the bar for patents on computer-implemented inventions
8. Software is excluded from patenting both for the program listing and the technical content underlying the software
9. Patents for "Software as such" are granted, i.e. the program listing is patentable
10. ICT patents are granted within five years
11. The renewal fees for granted ICT patents are increased during all the protection period
12. The protection period for ICT patents is shortened to 10 years

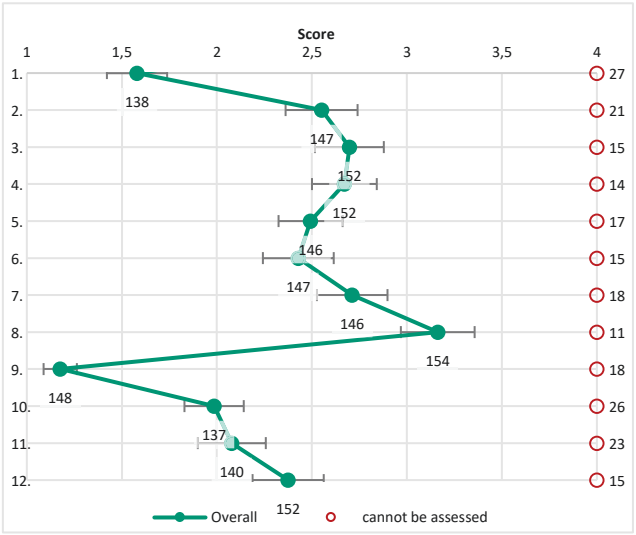


Figure 10 Assessment of solutions for ICT patents promoting innovation regarding patent application and granting ranging from not effective (1) to very effective (4) (patent owners (yes) vs non-patent owners (no))

1. The application fees for ICT patents are raised
2. The quality of granted ICT patents is improved by raising the required degree of novelty
3. The quality of granted ICT patents is improved by raising the required inventive step
4. The quality of granted ICT patents is improved by narrowing their scope
5. Crowd-sourced validity checks support the patent validity checks by patent offices
6. Granting an ICT patent requires already the implementation of the invention
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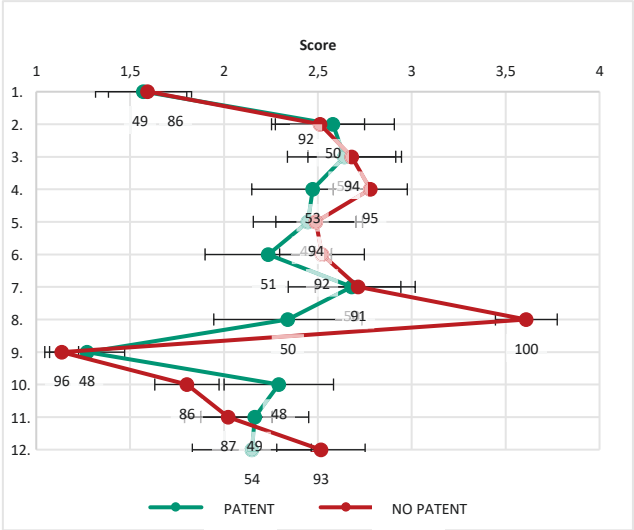

4.3.3.2 Solutions related to enforcing and implementing patents

In addition to the solutions related to applying and granting patents, even more proposals are being discussed in the literature and by the interviewed experts to improve the present framework for ICT patents related to enforcing and implementing patents in order to make the framework for ICT patents more conducive for innovation.

In the first part, we focus on solutions and institutions facilitating the licensing of patents. The second part deals with proposals to solve conflicts both within and outside courts easier.

Compared to the assessment of the relevance of the challenges the valuation of the effectiveness of the various proposals never reach on average the level "effective". The majority of the respondents consider the challenges as rather demanding, but on average, the proposed solutions are not expected to be effective. This general observation justifies research, including our project in this area to identify effective solutions, but even further research including both deepening the existing insights, but also applying further approaches to test the effectiveness of the most promising proposals in practice, e.g. via experiments.

Reflecting the high assessment of the relevance of threats generated by Patent Assertion Entities (PAEs), regulations restricting their activities are considered effective at least by the majority of patent-owning companies. The other intensively debated topic of licensing conditions for standard-essential patents (SEPs) is leading to at least a limited support to the proposal of incentivizing the publication of information including product specifications and licensing fees for Standard-Essential ICT patents. Surprisingly, both proposals receive slightly more support from the patent owners than from the non-patent owning organizations.

The suggestion that a declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.) is required to receive the maximum of twenty years of protection for ICT patents is only rated as ambivalent related to its effectiveness to promote innovation evaluated slightly higher, in particular by the patent-owning companies is, the idea of defining a set of well-known and trusted patent pledges, i.e. voluntary commitments by patent holders to give up some of

the rights associated to the patent (e.g. grant permission for commercial use without any direct compensation, no injunctions, FRAND, etc.). In contrast, the public support for technology exchange clearing houses to support bilateral licensing negotiations is considered as being the least effective measure for promoting ICT-related innovative technologies, which is consistent with the skeptical comments from several interviews.

Public policies supporting the formation and development of ICT patent pools, especially of SEPs, or of bilateral or joint licensing programs are also not positively rated regarding their effectiveness in promoting ICT innovations. However, the network operators, companies producing final consumer goods, component suppliers and companies providing IPR services endorse these solutions slightly more, whereas the SMEs are rather unconvinced. Defensive ICT patent aggregators, as a specific type of patent pools, receive slightly stronger support particularly, from the non-patenting respondents and the SMEs. Surprisingly based on the critical discussions in the interviews, the publication of the licensing terms of bilateral licensing agreements receives a stronger support, in particular from the non-patenting respondents and the SMEs. In addition, the network operators and the software developers are – at least partly – convinced about the effectiveness of this measure to promote innovation in ICT.

Finally, the development of compatible licensing solutions for Open Source Software and ICT patents is considered partly effective in promoting ICT innovations. Particularly, from the non-patenting respondents as well as from the network operators and public and semi-public research institutes. The proposal of integrating only Royalty-Free ICT patents into Open Source Software is less convincing, notably for the non-patenting respondents. Here, the concerns already raised in several interviews are confirmed.

Besides the – at least partly endorsed – suggested regulations related to PAEs and SEPs, the other two proposals related to the court system received a positive evaluation from the patent-owners regarding their effectiveness in promoting innovation. On the one hand, infringement and validity issues regarding ICT patents should be tried together before the same court, which is in particularly supported by companies providing IPR services. On the other hand, specialised courts instead of general courts should deal with ICT patent disputes. This is supported by the patent owners and especially, the network operators. This is consistent with their statements in the interviews.

The other proposed solutions related to ICT patents disputes in courts are evaluated with ambivalence. In addition to increasing the court fees for patent disputes, patent owners -in particular the companies supplying components- are more inclined to favour the losing parties being responsible for all legal costs and the restoration of the financial situation of the winning party before the court case. The other respondents, in particular the SMEs, are very skeptical regarding the efficiency of these ideas. The skepticisms among the patent owners even increases related to the proposal of introducing caps on ICT patent court case costs, which are recoverable by the winning party. The same is true for restricting plaintiffs by only challenging one ICT patent of one defendant in any given court case. In particular, companies providing IPR services and companies supplying components doubt the effectiveness of this restriction. However, the non-patenting respondents had even slightly better evaluate these two suggestions.

In order to avoid court cases, the support of mediation and arbitration processes to reach a mutually satisfactory settlement of ICT patent disputes is significantly more appreciated by patent owners and in particular by the network operators compared to the other respondents. It is very likely, that they have already had positive experience with arbitration and mediation, which is also reported by some interviewees. In contrast, they are not at all convinced about the effectiveness of publicly supported

insurances against ICT patent litigations, which are slightly more positively considered by the other respondents and the SMEs.

Finally, the influence of the European trade secret regulations on the incentives to file ICT patents is quite ambivalent and difficult to assess, as one third of the respondents were not able to provide an evaluation. However, the SMEs traditionally relying on this instrument are slightly more confident regarding the effectiveness of this instrument in promoting innovation in ICT.

In general, the proposed solutions derived from the literature, the interviews and partly from the statistical analysis of WP 2 were perceived by the majority of the respondents of the stakeholder survey not to be effective in promoting ICT innovation. This is contradictory to the high agreement on the relevance of most challenges. However, the assessment of the challenges differ depending on patent ownership and company size, because patent owners perceived less and SMEs more relevance of the challenges. In addition, even within organisations, management perceives the challenges more severely compared to legal or IT experts. However, these differences do not exist in their assessment of the effectiveness of almost all proposals. Therefore, the consequence of this comprehensive impact assessment covering all relevant challenges and all possible solutions is not to stick to the status quo, but rather to prioritize the most convincing solutions (especially from the perspective of those who do not own ICT patents as well as SMEs).

Not surprisingly, the respondents put the focus within the patent application and granting phase on the various approaches improving patent quality. The other more specific proposal being considered to be effective for promoting innovation is raising and specifying the bar for patents on computer-implemented inventions and excluding the patentability of “software as such”, which is in line with the current regulations of the European Patent Convention. Another observation, which supports the status quo of the existing regulation, is the skepticism towards the effectiveness of changing patent application, but also of renewal and even court fees. The impact of these cost components on the behavior of the various stakeholders is limited. Reducing the protection period and the time to grant ICT patents is though a slightly more convincing argument. However, the protection period is regulated by TRIPS and therefore difficult to change.

The option of the Agreement on a Unified Patent Court (UPC) allowing for the separation of infringement and validity issues to be treated in different courts, i.e. bifurcation, is perceived critically, especially by the patent owners. However, the specialized courts to be implemented within the UPC reflect the expressed needs of the stakeholders. Besides these institutional aspects, experts perceive the need to address the possible challenges caused by Patent Assertion Entities with regulations. However, based on the interviews, the details remain open as to how these regulations would be shaped in order to be effective. The second challenge is increasing the transparency of the licensing agreements related to Standard-Essential Patents (SEPs), which is assumed to be effectively achieved by providing more information, including product specifications and licensing fees.

The recently published EC Working Paper “Putting intellectual property at the service of SMEs to foster innovation and growth in the Single Market Strategy” (EC 2016) proposes some support measures focusing on start-ups and SMEs “…addressing sub-optimal use of IPR by them across the EU”. On the one hand, the results of our survey support the streamlining of European IPR awareness schemes for SMEs. This is attributed to SMEs responses often revealing that they are not able to assess both the relevance of the challenges and the effectiveness of the proposed measures. On the other hand, the support for developing an EU IPR mediation and arbitration network for SMEs has to be considered carefully as its effectiveness in promoting innovation has only been evaluated with ambivalence by the respondents to our survey. The same degree of skepticism exists for publicly

supported insurance schemes for litigation. However, SMEs are more positive. Therefore, the creation of European-level insurance schemes for litigation and IPR theft can be justified by the results of our survey, but the critical assessments raised by some interviewees should be taken into account. Finally, expanding the support of funding schemes to support IPR use by SMEs might be not so effective, because the application costs are no major challenge and changing costs structures are not considered to be very effective.

Figure 11 Assessment of solutions for ICT patents promoting innovation regarding enforcing and implementing patents ranging from not effective (1) to very effective (4)

1. A declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.) is required to receive the maximum of 20 years of protection for ICT patents
2. A set of well-known and trustable patent pledges, i.e. voluntary commitments by patent holders to give up some of the rights associated to the patent (e.g. grant permission for commercial use without any direct compensation, no injunctions, FRAND, etc.), is defined
3. Technology exchange clearing houses are publicly supported to support bilateral licensing negotiations
4. Regulations to restrict the activities for Patent Assertion Entities (PAEs) are established
5. Publication of information incl. product specifications and licensing fees for Standard-Essential ICT patents should be encouraged
6. Public policies support the formation and development of ICT patent pools, especially of SEPs, incl. providing incentives for organisations to join
7. Public policies support the formation and development of bilateral or joint licensing programs, incl. providing incentives for organisations to develop these
8. Compatible licensing solutions for Open Source Software and ICT patents are developed
9. Only Royalty-Free ICT patents shall be integrated into Open Source Software
10. Licensing terms of bilateral licensing agreements should be published
11. Defensive ICT patent aggregators are publicly supported
12. Insurances against ICT patent litigations are publicly supported (incl. provided by state insurance)
13. Trade secret regulations reduce the incentive to file ICT patents
14. Mediation and arbitration processes to reach a mutually satisfactory settlement of ICT patent disputes outside of court are further publicly supported
15. Court fees for ICT patent disputes are increased
16. Legal costs for ICT patent disputes in courts are covered by the losing party
17. Financial situation in an ICT patent dispute of the winning party before the court case is reasonably restored
18. Caps on ICT patent court case costs that are recoverable by the winning party are introduced
19. A plaintiff can only challenge one ICT patent of one defendant in any given court case
20. Infringement and validity issues regarding ICT patents are tried together before the same court
21. Specialised courts instead of general courts should deal with ICT patent disputes

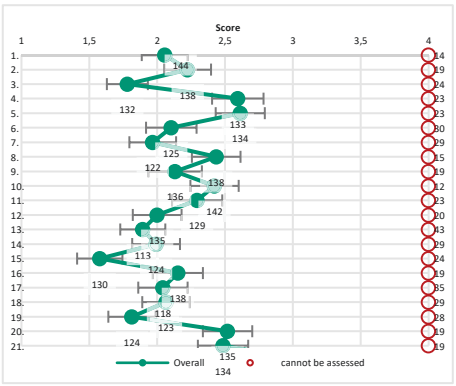

Figure 12 Assessment of solutions for ICT patents promoting innovation regarding enforcing and implementing patents ranging from not effective (1) to very effective (4) (patent owners (yes) vs non-patent owners (no))

1. A declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.) is required to receive the maximum of 20 years of protection for ICT patents
2. A set of well-known and trustable patent pledges, i.e. voluntary commitments by patent holders to give up some of the rights associated to the patent (e.g. grant permission for commercial use without any direct compensation, no injunctions, FRAND, etc.), is defined
3. Technology exchange clearing houses are publicly supported to support bilateral licensing negotiations
4. Regulations to restrict the activities for Patent Assertion Entities (PAEs) are established
5. Publication of information incl. product specifications and licensing fees for Standard-Essential ICT patents should be encouraged
6. Public policies support the formation and development of ICT patent pools, especially of SEPs, incl. providing incentives for organisations to join
7. Public policies support the formation and development of bilateral or joint licensing programs, incl. providing incentives for organisations to develop these
8. Compatible licensing solutions for Open Source Software and ICT patents are developed
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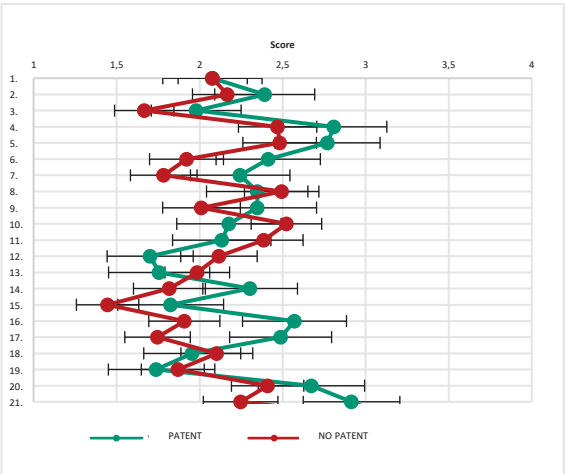
16. Legal costs for ICT patent disputes in courts are covered by the losing party
17. Financial situation in an ICT patent dispute of the winning party before the court case is reasonably restored
18. Caps on ICT patent court case costs that are recoverable by the winning party are introduced
19. A plaintiff can only challenge one ICT patent of one defendant in any given court case
20. Infringement and validity issues regarding ICT patents are tried together before the same court
21. Specialised courts instead of general courts should deal with ICT patent disputes



4.3.3.3 Correlation of the feasibility of solutions and their assessment

Although the feasibility of selected options will be discussed in the chapter about the impact assessment, we provide a general overview of the solutions targeting the application and granting of patents on the one hand and enforcing and implementing patents on the other hand. The following tables give an indication in whose responsibility the possible changes are, what specific steps have to be taken and how the likelihood of such changes might be.

Table 10 Proposed solutions related to application and granting of patents and assessment of their feasibility

Solutions	Responsible	Effort	Likelihood
The application fees for ICT patents are raised	National governments or European Patent Convention	Raising application fees	Feasible, but unlikely because of reduced revenues
The quality of granted ICT patents is improved by raising the required degree of novelty	Patent offices	Increasing effort in examination	Feasible, but unlikely because of higher costs and less revenues
The quality of granted ICT patents is improved by raising the required inventive step	Patent offices	Increasing effort in examination	Feasible, but unlikely because of higher costs and less revenues
The quality of granted ICT patents is improved by narrowing their scope	Patent offices	Increasing effort in examination	Feasible, but unlikely because of higher costs and less revenues
Crowd-sourced validity checks support the patent validity checks by patent offices	National governments or European Patent Convention; patent offices	Investment in crowd-sourcing tools and providing incentives	Feasible, but unlikely because of higher costs, less revenues and loss of reputation
Granting an ICT patent requires already the implementation of the invention	National governments or European Patent Convention; patent offices	Increasing effort in examination	Feasible, but unlikely because of higher costs and less revenues
Raising and specifying (e.g. related to technicality) the bar for patents on computer-implemented inventions	National governments or European Patent Convention; patent offices	Initially increasing effort in examination, in the long run in case of simplifications lower effort possible	Feasible, but unlikely because of higher costs and less revenues
Software is excluded from patenting both for the program listing and the technical content underlying the software	National governments or European Patent Convention; patent offices	Less effort in examination	Feasible, but unlikely because of barriers to change current practice
Patents for “Software as such” are granted, i.e. the program listing is patentable	National governments or European Patent Convention; patent offices	Less effort in examination	Feasible, but unlikely because of previous discussions and of barriers to change current practice
ICT patents are granted within five years	National governments or European Patent Convention; patent offices	Increasing effort in examination	Feasible, but unlikely because of higher costs and less revenues

The renewal fees for granted ICT patents are increased during all the protection period	National governments or European Patent Convention;	Raising application fees	Feasible, but unlikely because of uncertain impacts on revenues
The protection period for ICT patents is shortened to 10 years	WTO based on majority of national governments	No effort	Feasible, but very unlikely because of missing consensus to changes TRIPS and uncertain impacts on revenues

If we compare the feasibility to change the current framings in the application and granting phase of patenting with the assessment of their effectiveness to promote innovation by the stakeholders, it strikes that easy achievable, but disputable changes, like raising the patent applications fees or granting patents for "software as such" are perceived at least effective. In contrast, excluding software in general from patenting does not require specific financial efforts and only changes in the legal framework, but is evaluated a being quite effective by those stakeholders not owning patents, in particular the members of the OSS community. Furthermore, the solutions to raise patent quality need significant investments into the patent examination process, but no changes in the legal framework. They are evaluated just below "effective". In summary, the assessment of the effectiveness of proposed solutions by the stakeholders does not really correlate positively with the feasibility of their implementation, i.e. the more difficult the solutions to implement does not necessarily lead to a higher assessment of their effectiveness by the stakeholders.

Table 11 Proposed solutions regarding enforcing and implementing patents and assessment of their feasibility

Solutions	Responsible	Effort	Likelihood
A declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.) is required to receive the maximum of 20 years of protection for ICT patents	WTO based on majority of national governments	Change of Art. 33 of TRIPS Agreement	Feasible, but very unlikely because of missing consensus to changes TRIPS and uncertain impacts on revenues
A set of well-known and trustable patent pledges, i.e. voluntary commitments by patent holders to give up some of the rights associated to the patent (e.g. grant permission for commercial use without any direct compensation,	National governments or European Patent Convention		

no injunctions, FRAND, etc.), is defined			
Technology exchange clearing houses are publicly supported to support bilateral licensing negotiations	National governments or European Patent Convention	Investment in the establishment and maintenance of clearing houses	Feasible, but unlikely because of higher costs and missing incentives; demonstrator needed
Regulations to restrict the activities for Patent Assertion Entities (PAEs) are established	National governments or European Union	Effort to develop and implement national or European regulations	Feasible, but unlikely due to missing information about extent of damages caused and concrete solutions
Publication of information incl. product specifications and licensing fees for Standard-Essential ICT patents should be encouraged	Patent offices, standardization body, national governments or European Union	Effort to develop and maintain a scheme	Feasible, but unlikely because of unclear responsibilities and missing incentives
Public policies support the formation and development of ICT patent pools, especially of SEPs, incl. providing incentives for organizations to join	National governments or European Union	Effort to develop and maintain public policies	Feasible, but unlikely because of missing evidence about positive impacts and missing incentives
Public policies support the formation and development of bilateral or joint licensing programs, incl. providing incentives for organizations to develop these	National governments or European Union	Effort to develop and maintain public policies	Feasible, but unlikely because of missing evidence about positive impacts and missing incentives
Compatible licensing solutions for Open Source Software and ICT patents are developed	Industry and OSS community	Effort to develop and implement licensing solutions	Feasible, but unlikely because of missing evidence about positive impacts and missing incentives
Only Royalty-Free ICT patents shall be	Industry and OSS community	Little effort, because in general implemented	Very likely

integrated into Open Source Software			
Licensing terms of bilateral licensing agreements should be published	National governments or European Union	Effort to develop and implement national or European regulations	Feasible, but unlikely due to missing information about extent of benefit caused and options to circumvent such a regulation
Defensive ICT patent aggregators are publicly supported	National governments or European Union	Effort to develop and maintain public policies	Feasible, but unlikely because of missing evidence about positive impacts and missing incentives
Insurances against ICT patent litigations are publicly supported (incl. provided by state insurance)	National governments or European Union	Effort to develop and maintain public policies	Feasible, but unlikely because of missing evidence about positive impacts and missing incentives
Trade secret regulations reduce the incentive to file ICT patents	Trade Secret Directive has been adopted; Implementation by the EU Member States	Effort to implement the Trade Secret Directive by Member States	Very likely, but impact on ICT patents is unclear
Mediation and arbitration processes to reach a mutually satisfactory settlement of ICT patent disputes outside of court are further publicly supported	National governments or European Union or WIPO	Effort to develop and maintain public policies	Feasible, but unlikely because of missing evidence about positive impacts and missing incentives
Court fees for ICT patent disputes are increased	National governments	Little effort	Feasible, but unlikely because of missing incentives
Legal costs for ICT patent disputes in courts are covered by the losing party	National governments	Little effort	Already realized in patents laws of some countries
Financial situation in an ICT patent dispute of the winning party before the	National governments	Effort to perform analyses by the courts	Already realized in patents laws of some countries

court case is reasonably restored			
Caps on ICT patent court case costs that are recoverable by the winning party are introduced	National governments	Little effort	In some countries realized, but harmonized solution is unlikely
A plaintiff can only challenge one ICT patent of one defendant in any given court case	National governments	Little effort	In some countries realized, but harmonized solution is unlikely
Infringement and validity issues regarding ICT patents are tried together before the same court	National governments, European Patent Convention, Unified Patent Court	Significant changes required	In some countries realized, but harmonized solution is unlikely
Specialized courts instead of general courts should deal with ICT patent disputes	National governments, European Patent Convention, Unified Patent Court	Significant changes required	In some countries realized, but harmonized solution is unlikely

If we compare the feasibility to change the current framings regarding enforcing and implementing patents with the assessment of their effectiveness to promote innovation by the stakeholders, we observe different patterns. On the one hand, the establishment of specialized courts or the treatment of infringement and validity issues before the same court, which are quite challenging changes in general, but could be achieved within the current the implementation of the Unified Patent Court at the European level, are assessed to be between low and medium effective. One the other hand, the challenging solutions of establishing regulations for PAEs and the publication of licensing fees for Standard-Essential ICT patents reach the same level of assessment. Obviously, there is no linear correlation between the likelihood of implementing changes and the assessment of their effectiveness. However, the “easy” solution of just raising the court fees for ICT patent disputes is not convincing for the majority of the stakeholders. Overall, the more convincing solutions are obviously – despite some exceptions – more difficult to accomplish.

4.3.4 Assessment of RRI dimensions regarding ICT patents

In the last section of the survey, the respondents have been asked to assess the relevance of the five dimensions of implementing Responsible Research and Innovation (RRI) regarding ICT patents. According to the European Commission, "Responsible research and innovation (RRI) is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation." In practice, RRI is implemented as a package that includes diverse actors and public engagement in research and innovation, enabling easier access to scientific results, the integration of gender and ethics in the research and innovation content and process, and formal and informal science education (https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation).

Overall, the respondents assess the relevance of the five dimensions as only medium relevant. Furthermore, around one quarter of them indicate that they are not able to provide an assessment. Overall, this result reflects the limited awareness of the interviewed experts of the RRI dimensions and also their low evaluation of its relevance, which is confirmed by other studies, e.g. Stahl et al. (2017).

However, there are some particularities to be considered. Firstly, the facilitation of access to scientific results is considered the most relevant dimension of RRI, which corresponds to the insights from the interviews stressing – at least partly – the importance of open access. Second, multi-actor and public engagement in research and innovation still achieves a medium relevance by the assessment of the experts. This dimension has been marginally touched on in the interviews by referring to open innovation processes. Third, formal and informal science education is similarly evaluated, although almost never mentioned in the interviews. Fourth, the ethical dimension in research and innovation receives slightly lower support by the experts. In contrast to the discussions regarding the pharmaceutical and biotechnological industries, limited discussions about the ethics of ICT patents took place. This has been already been revealed by the literature review, but – as outlined above – also supported both by the statements and the constrained awareness of the interviewees, who are obviously not aware of the meanwhile broad discourse on the ethics of ICT (Rogerson 2011) or computer (Stahl et al. 2016). Finally, the gender issues of the research and innovation content and process are considered of low relevance for RRI. One third of the respondents are even not able to assess the relevance of this dimension. This result of the survey corresponds to the interviewees being aware of the gender bias in ICT, but seeing little necessity to intervene.

In general, the patent owner and the large companies attribute a slightly, but not significantly higher relevance to all five dimensions of RRI. However, the representatives of public and semi-public research institutes and the OSS community attribute even a high relevance in enabling an easier access to scientific results via ICT patents. However, most written comments in the open answer section are provided to this dimension. A majority of responses point to patents as hindering the easy access to scientific results – in contrast to scientific publications. Others consider them to be irrelevant and even a few stressing that patents can promote – in particular in comparison to trade secrets – the access to scientific results by the disclosure of the inventions. Although, multi-actor and public engagement in research and innovation is considered to be relevant for ICT patents, their proprietary character is perceived as being rather critical for involving other players. Finally, the independent software developers attribute almost a medium relevance to the gender dimension related to ICT patents in contrast to the representatives of all other business models.

Figure 13 Assessment of relevance of RRI dimensions regarding ICT patents ranging from very low (1) to very high (5)

1. Multi-actor and public engagement in research and innovation
2. Enabling easier access to scientific results
3. Gender issues in the research and innovation content and process
4. Ethics in the research and innovation content and process:
5. Formal and informal science education

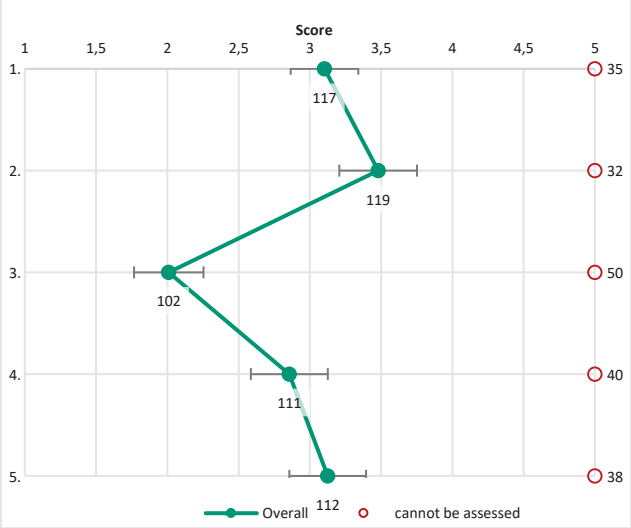
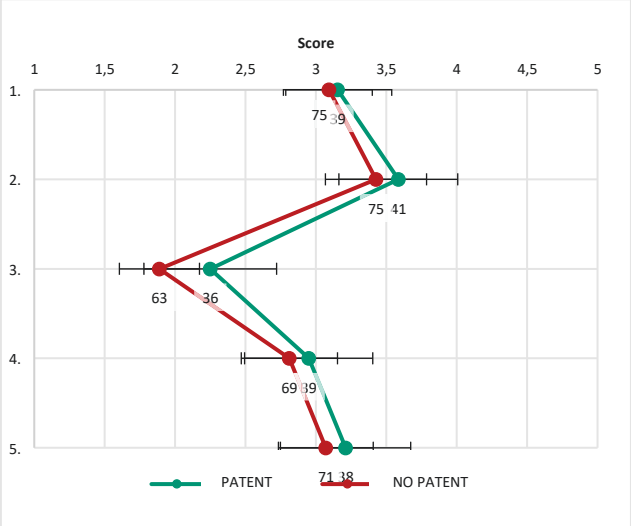


Figure 14 Assessment of RRI dimensions regarding ICT patents from very low (1) to very high (5) (patent owners (yes) vs non-patent owners (no))

1. Multi-actor and public engagement in research and innovation
2. Enabling easier access to scientific results
3. Gender issues in the research and innovation content and process
4. Ethics in the research and innovation content and process:
5. Formal and informal science education



5 IMPACT ASSESSMENT

5.1 METHODOLOGY

In contrast to traditional impact assessments, which focus on one specific problem (e.g. EC 2010) or a set of closely linked problems (EC 2011), our literature review and consultation of stakeholders has revealed a broad set of problems ranging from patent application over licensing to litigation. Consequently, we deviate from the Impact Assessment guideline of the European Commission (EC 2009) and concentrate our impact assessment on several topics of high relevance. The problem description is based on the literature, including the ethics of ICT, reviewed in WP 2, the empirical analysis of ICT patents in WP3 and the insights from the interviews and the stakeholder consultation. The selection of the options, which are not necessarily focused on the EU and can be implemented – in contrast to traditional impact assessments – in parallel, as well as the assessment of their impact on innovation in general, ethical issues and open access within the context of responsible research and innovation in particular, and further evaluation criteria are based on the review of the literature, but especially on the assessment of the stakeholders. Due to the focus on three very generic topics, we are not able to perform a quantitative impact assessment, like in the case of the translation of patents (EC 2010), but rely on already available empirical evidence and scientific studies. Wright (2011) proposes ethical impact assessments for ICT not only for specific areas of ICT, but also for policy-makers and regulatory authorities when they are considering a new ICT-related policy or regulation. However, changes in the patent regime are so generic that no specific ethical implications can be derived confirming the need for context-specific analysis argued by Stahl et al. (2017). Therefore, we consider the ethical dimensions on a rather generic level within the impact assessment focusing on innovation.

The presented policy options are chosen to solve the identified problems without prejudice to their legal feasibility. The policy options are discussed and measured against the following pre-defined criteria:

Effectiveness related to innovation in general: The extent to which the measure fulfils the objective of promoting innovation in general.

Effectiveness related to ethics within responsible research and innovation: The extent to which the measure fulfils the objective of considering ethical aspects in the context of promoting responsible research and innovation.

Effectiveness related to open access within responsible research and innovation: The extent to which the measure fulfils the objective of promoting open access as one dimension of responsible research and innovation.

Cost reduction: The estimated cost reduction for the users of the patent system, in particular, the level of potential cost savings per patent and, more generally, for the whole patent system.

Simplification: The extent of foreseeable simplification of the legal and administrative complexity of the current patent system.

Legally security: The proposed measure arrangements must ensure or at least increase legal certainty related to patenting and patents.

Political feasibility: The possibility to reach an agreement on each of the options must be assessed. If numerous attempts to address the problems identified have already taken place in the past, the

assessment of the past failures and in particular the reasons for these failures will take into account in evaluating the political feasibility of each option.

5.2 Major Problems, Options and Impacts

Based on the insights of the literature, the empirical analysis and the stakeholder consultation, we have identified and selected three topics to focus on, i.e. patent quality, the patent protection period and litigation, for conducting the impact assessment. The selection is based on the relevance of the problem, but considers also the options governments have to change the system. Therefore, approaches crucially depending on industry initiatives and support are not selected. Furthermore, the definition of the problems is a broader compared to the specific challenges discussed in the interviews and addressed in the survey, because this allows to match each problem with several possible options.

5.2.1 Patent quality

5.2.1.1 Problem description

One of the main challenges addressed in many publications is achieving a satisfactory level of patent quality. The patent quality which is defined as "the degree to which a patent satisfies the statutory patentability requirements, leaves little doubt as to its breadth and discloses information that enables a person skilled in the art to implement that protected invention" (EPO 2012, p. 8). Patent offices around the world have been focusing on quality. One example is the so-called EPO "Raising the bar on patent quality" programme (EPO 2007) aiming to achieve better patent applications from the very beginning. In detail, the EPO increased its fees and required applicants to restrict the scope of subject matter considered in prior art search and examination. Consequently, in patents granted by the EPO, the number and length of claims started to decline, when new claims fees became effective (Harhoff 2016). In addition, the grant rate, which started to decline in the 1990s (Frietsch et al. 2010), remained below 50% (EPO 2017).

However, the majority of the respondents to the survey complains about the low level of quality of granted patents, in particular their rather large scope. In addition, the empirical analysis of WP2 revealed the decreasing number of forward citations as one indicator of patent quality, although citations being questioned as good quality indicator, e.g. by Bessen (2008).

In particular, the quality of patents on computer-implemented inventions (CII) or software patents are perceived by the majority of the stakeholders to challenge innovation of ICT-related technologies. In particular, the OSS community complains that the use of ICT patents protected technology generates problems for the use of Open Source Software. Consequently, this challenge has to be tackled by an effective solution. The relevance of this challenge might increase, because the number of patent applications on IT methods for management has more than doubled in the last ten years (EPO 2017), although the number of granted patents remained below one hundred per year.

5.2.1.2 Option 1: Baseline scenario

Under this scenario, the current patent system in Europe would work in the same way as in the past. In detail, we would observe an increasing number of patent applications in ICT assuming an extrapolation of previous trends. Related to patent quality, we can also assume a continuation of sticking to the objective of keeping the grant rate below 50%. However, in absolute terms we have then to expect an increasing number of granted patents. In addition, patents on CII accounted according to Frietsch et al. (2015) for around one third of all applications at the EPO since the year 2000. This share can be assumed to be stable or even increasing. However, due to general increase in patent applications, the absolute number of patents on CII is expected to increase.

Under this option, the identified challenges of the current European patent system would not be addressed and the costs and the complexity of the current system would stay unchanged or even increase. Based on the assessment of the stakeholders, the exploitation of the full innovation potential in Europe would be hindered. Therefore, this solution is not effective for promoting innovation. In terms of cost reduction and simplification, the expected increase in litigation would not be stopped and the complexity of the patent landscape will tend to increase. Therefore, this option would provide no additional benefit to the active and passive users of the patent system. However, the costs would increase for the applicants due to the increasing number of patents applied by the other applicants. Finally, this option is also not in line with the political engagement of the Commission in promoting RRI.

5.2.1.3 Option 2: Raising application fees

Under this option, the patent offices would raise the application fees significantly.However, it remains ambivalent whether the objective to promote innovation would be achieved. De Rassenfosse and van Pottelsberghe de la Potterie (2012) show that the reduction of fees by the EPO in the late 1990s increased the demand for patents, i.e. patent applications in Europe. The interviewees, but also the majority of the stakeholders responding to the survey consider raising the application fees as being not effective to reduce the applications, in particular of patents of low quality. In addition, the negative impact on SMEs is mentioned. This is in line with the another survey (EC 2015b). Here, the respondents indicated that the cost of patents was a relevant factor, but also the relevance of many other factors, that impact on innovative behaviour.

Although according to some interviewees, higher application fees would distract patents of low quality, the majority of the experts perceive this instrument as not being effective in raising patent quality, because other costs associated with attorneys are much more relevant. In contrast, higher applications fees would generate higher costs especially for SMEs, whereas for large companies they do not matter so severely. Overall, this instrument would further disadvantage SMEs. Therefore, some experts propose to reduce the application fees for this type of applicant. However, it was suggested that the increased revenues are could be used by the patent offices to increase their efforts in the examination processes and eventually patent quality.

Whereas the patenting entities of the patent system incur higher costs, which might be negative for their investment in innovation, the innovators not using patents might benefit because they are confronted with a lower number of patent applications and less patent thickets. According to Cockburn and MacGarvie (2011) and Hall et al. (2017), patent thickets reduce entry into new technologies and markets.

Overall, the innovators in ICT, including the OSS, not using patents may benefit from higher application fees for patents and consequently less patent applications, whereas the applicants might reduce their patent applications and eventually research and innovation efforts. Although the latter are fewer actors in numbers, their R&D investments are significant for the whole ICT sector. Therefore, the overall impact on innovation is ambivalent.

5.2.1.4 Option 3: Raising patent quality

Patent quality can be raised by appropriate examination procedure of the patent offices to discourage trivial, insufficient or unelaborated patent applications (EC JRC 2015a). The measures to be taken in order to improve patent quality should be cost efficient and should not extend the patent granting process (EC 2015a).

In contrast to the limited effectiveness of raising the application fees, the quality of ICT patents can more effectively be increased by raising the required degree of novelty. Here, this requirement is – according to the majority of the interviewees active in patenting – satisfactory fulfilled by the European Patent Office. However, the representatives of the OSS community suggest significantly increasing the novelty requirements.

Raising the required inventive step is certainly another option. However, the proof of the inventive steps is rather challenging. Therefore, most of the interviewees did not comment on this measure. However, the representatives of the OSS suggest that patent offices require more information from the applicants to make better decisions regarding the inventive steps eventually, leading to a much lower number of granted patents.

Narrowing the scope of patents is another measue to raise their quality. However, the majority of the interviewees either is satisfied with the current scope of patents or sees no possibility to narrow it further without utilizing heavy investments. Obviously, the new policies introduced by the EPO in 2008 have been effective. However, the respondents to the survey not owning patents are more convinced about this approach.

Crowd-sourced validity checks could support the patent validity checks by patent offices, but several initiatives initiated in the past failed. Therefore, this approach is not supported.

Raising the patent quality would certainly contribute to the objective of promoting innovation. First, the grant rate is expected to be reduced further. Consequently, applicants of patents will invest more in the quality of their patents, which requires higher investment into R&D. Second, a higher quality of the patents will reduce the risk of patents to become invalid, i.e. legal insecurity will be lower for both patent owner and patent implementers. Third, a higher quality of patents will also increase their value as a source of information for non-patenting actors. Overall, we observe several innovation-driving forces of a higher patent quality, especially for the innovators without patents.

5.2.1.5 Option 4: Specifying the criteria for patents on CII

A specific dimension of raising the patent quality is related to patents on computer-implemented inventions. Since the statutory patentability standards for ICT patents (e.g. technicality, etc.) differ among patent offices, the specification of the criteria for patents on CII seems to be an adequate solution also by the majority patent owners. The other extreme option of granting “Software as such”, i.e. the program listing is patentable, is completely denied by all responding stakeholders, i.e. also by the patent holders. Although the exclusion of software from patenting both for the program listing and the technical content underlying the software is endorsed by the majority of the non-patenting organisations, it is not accepted by the patent owners. Furthermore, Frietsch et al. (2015) show that around one third of the patent applications at the European Patent Office is already related to CII and might be difficult to abolish. Consequently, specifying the criteria for patents on CII is the proposed feasible option.

The impact on the patent applicants will be positive, because the transparency regarding the patentability of CII will be increased and the risk in the granting process reduced. Overall, the specification of the criteria also addressing the inventive step (http://www.ipwatchdog.com/2017/09/12/grant-philpott-patenting-computer-implemented-inventions-europe/id=87865/) is expected to reduce the number of granted patents on CII. Consequently, the impact of the innovators without patents, including the OSS, is expected to be positive, as already identified via a survey among German software companies during the discussions of an opening of the EPC to software patents (Blind et al. 2005). In contrast, Eberhardt et

al. (2016) report a positive impact of a proposed broadening of patent eligibility to include software, but for software companies active in India.

5.2.1.6 Comparing the options

Overall, the patent quality related option is expected to have a positive impact on innovation in ICT, but specifying the criteria for patents on CII is even more positive for innovation.

Table 10 Expected impact of options on innovation

Policy Option	Patenting entities (Overall)	Patenting entities (SMEs)	Innovators in general without patents
Baseline scenario Option 1	0	0	0
Option 2: Raising application fees	-	--	+
Option 3: Raising patent quality	+	+	++
Option 4: Specifying the criteria for patents on CII	++	++	++
"0": no change "+": positive impact "-": negative impact			

In a second step, we also look at the impact of the options on the other five criteria of the impact assessment. Regarding responsible research and innovation, we explicitly differentiate between the dimension of ethical concerns and open access to research results and even research data. The ethics of ICT has already been focused in the literature review and addressed in the interviews.

Raising the application fees has a two-sided effect on the open access to research results. On the one hand, the expected reduction of patent applications reduces the access to scientific results, if the inventions are eventually kept secret. On the other hand, avoiding trivial patents reduces the search costs and ICT patents with possible negative ethicalimplications. If raising the patent quality includes also the consideration of ethical aspects, then this will have certainly a positive impact on RRI, whereas open access is not influenced because of the publication of the patent application. Finally, specifying the criteria for patents on CII does not address specific ethical issues, but would satisfy the expressed needs of the Open Source communities, if this specification facilitates the open access to scientific results.

Whereas raising the application fees certainly increases the cost for the applicants at least in the short term, raising the patent quality might even create further costs, because the likelihood of granting patents will decrease, which requires higher investments for the applicants in patent quality, i.e. not only in the application, but also in research and innovation. The further specification of the criteria for patents on CII should create no significant additional costs.

Raising patent application fees and patent quality might contribute indirectly to the simplification of the patent system by reducing the number of applications and grants. However, if specifying the criteria for patents on CII is successful, it will have the highest immediate impact on simplifying the ICT patent system.

Legal security is certainly increased by raising the patent quality, because litigations might be reduced. This could be even the case, if raising the application fees will reduce the number of patent applications. However, specifying the criteria for patents on CII will certainly contribute most to legal

security, because it will have an impact both on patent applications, because the applicant has more transparency about the requirements for an application on CII, and the examination process, because the examiner has a clearer guideline for his decision making process. Finally, all other stakeholders influenced by patents on CII also benefit regarding legal security.

The feasibility of the baseline scenario is high, because the feasibility of the other three option is low. First, after the successful reduction of application fees in Europe in order to promote the competitiveness of the European industry, an abolishment of this approach is almost unfeasible. Second, raising the patent quality is asked for by all stakeholders. However, further heavy investments in patent examination is necessary, which is – taking into account the budget restrictions – rather unlikely. Third, specifying the criteria for patents on CII is not costly. However, the willingness to change Article 52 EPC after the intensive debates at the beginning of the century is certainly not high. Overall, changes related to patent quality cannot be expected despite the positive impacts to be expected in various dimensions.

Table 11 Comparing the impacts of the options

Policy Option	Effective-ness rela-ted to inno-vation in general	Effective-ness related to ethical issues within RRI	Effective-ness related to open access within RRI	Cost reduction	Simplification	Legal security	Feasibility
Baseline scenario Option 1	0	0	0	0	0	0	High
Option 2: Raising application fees	0	+	0	-	+	0	Low
Option 3: Raising patent quality	+	+	0	--	+	+	Low
Option 4: Specifying the criteria for patents on CII	++	0	++	0	++	++	Low
	"0": no change "+": positive impact "-": negative impact						

5.2.2 Patent protection period

5.2.2.1 Problem description

Despite the higher dynamics in the ICT technologies and markets, patents are still a very attractive instrument for companies. This is not only supported by the high and still increasing number of patent applications, but also by the fact that many of them are renewed to the maximum protection period and even further prolonged via follow-up patents. However, critical voices question the effectiveness of patents if they are valid for only a few years due to very dynamic technological progress. In practice, patent protection is only asked for around 10 years on average (Frietsch et al. 2010), i.e. the de facto protection period is already only half of the maximum of 20 years. Therefore,

the concerns raised related to the lengthy decision processes in the patent offices becoming even more relevant, i.e. the increase from first application to granting a patent identified in WP2 is a severe problem. Consequently, the majority of the respondents to our survey – in particular the independent software developers – agrees that 20 years of protection are long

Therefore, we consider two options to tackle the problem. On the one hand raising the renewal fees will make keeping patents valid to the maximum of the protection period more expensive. On the other hand, we consider the reduction of the maximum protection period to 10 years. Speeding up the granting process to a maximum of five years would have been a third option, but here the behavior of the applicants, e.g. asking for amendments, has to be considered influential on achieving this objective. Therefore, we focus just on two options in addition the baseline scenario.

5.2.2.2 Option 1: Baseline scenario

Under this scenario, the current patent system in Europe would work in the same way as in the past. The observed trend of an increasing number of patent applications in ICT would continue and the renewal decisions will not change. However, Frietsch et al. (2010) observe in the 1990s a reduced average protection period compared to the 1980s. Extrapolating this trend would mean that the patent owners will keep their patents not as long as in the past. However, recent empirical evidence is missing.

5.2.2.3 Option 2: Raising renewal fees

In contrast to the ineffectiveness of raising the application fees for patents, higher renewal fees towards the end of the protection period are perceived as being effective by a significant share of the experts. The current structure of the renewal fees allows even SMEs to enter the patent system and in case of success provides them with the resources to pay the higher fees in later periods. However, some experts also argue that the commercial exploitation of patents takes – even in ICT – time. Therefore, higher renewal fees might lead companies to give up patents, which turn out to be valuable only later. However, this false decision of the patent owner is benefitting all other innovators.

Overall, raising renewal fees will not harm the innovation activities of patenting companies, except to a limit extend SMEs, but will make more originally patented technologies available to all other innovators in the market, which is promoting innovation in general. The increased revenues for the patent offices might allow them to invest in improving the patent quality by hiring more and better trained examiners.

5.2.2.4 Option 3: Reducing maximum protection period

The more drastic intervention would be the reduction of the maximum protection to ten instead of twenty years. Overall, the respondents perceive this option as more effective as raising the renewal fees. In particular, the representatives of the OSS would favor a drastic reduction of the protection period for ICT patents corresponding to the lifecycle of technologies and markets in ICT, because they perceive granted patents as long-lasting barriers for innovation. Representatives of patent owning and commercializing organizations argue even for a longer protection period due to the extended time needed from research to the final commercialization, especially of hardware-based technologies.

The impact of such a drastic change on the innovation activities of patenting companies might be negative especially for valuable hardware based technologies, because their patent owners are not able to exploit the full innovation rent. In contrast, the reduction will benefit all other innovators,

because patented technology will be available earlier and cannot be serve as a barrier for their innovation activities.

5.2.2.5 Comparing the options

If we compare the options, we expect that the reduction of the maximum protection period will benefit technological companies relying on third party inventions in general most, but will be negative for the patenting entities of the patent system. The net impact cannot be determined. In the short run, it might be positive; in the end, the reduced incentives to invest in research and innovation might lead to a negative impact. Raising the renewal fees is only increasing the price of patents probably leading to a positive selection effect that only the commercially valuable invention will be patented and less patents just used for blocking competitors.

Table 12 Expected impact of options on innovation

Policy Option	Patenting entities (Overall)	Patenting entities (SMEs)	Innovators in general without patents
Baseline scenario Option 1	0	0	0
Option 2: Raising renewal fees	0	-	+
Option 3: Reducing maximum protection period	-	-	++
"0": no change "+": positive impact "-": negative impact			

Looking at the impact of the options on the other fivecriteria, we would expect – in contrast to raising the application fees – a positive impact on open access as one dimension of responsible research and innovation, because the access, in the sense of usage to patented scientific results will be available earlier in case of the reduction of the protection period. If raising the renewal fees leads to a de facto reduction of patent protection period of technologies, which are for the patentees not commercially interesting anymore, the other innovators might be able to use these technologies for their innovation activities. Ethical issues are also affected, if the earlier disposable patent protected technologies have implications on the well-being of human beings in general and on the digital divides in particular. The other dimensions of RRI are not influenced.

Whereas raising the renewal fees certainly increases the cost for the patent owners, the revenues for the patent offices could be used for further decreasing the application costs or even better for improving the patent quality. Overall, we might even expect a cost reduction for the patent offices due to the higher payments of the patent owners. The shortage of the protection period will reduce the revenues of the patent offices, which have to be compensated by higher application or renewal fees. However, these income sources might not sufficient, which requires higher costs for the governments. Overall, both option are likely to increase the costs for the patenting entities.

Raising renewal fees and reducing patent protection might contribute indirectly to the simplification of the patent system by reducing the number of valid patents, which might reduce e.g. the patent thickets for all other innovators.

Legal security is certainly increased by raising the renewal fees and reducing the protection period, because litigation risk will be reduced. In particular, PAEs are litigating other producing companies, when patents are more than ten years old, whereas producing companies start litigating from the very beginning (Love 2013).

The continuation of the baseline scenario is high, because the feasibility of the raising the renewal fees is low and the reduction of the protection period even very low. The competition between the patent offices will make – like in the case of raising the application fees – the increase of the renewal fees unlikely. Finally, it will be almost impossible to restrict the patent protection period to ten years due to the long tradition of the twenty years as maximum period and the requirement to change TRIPS.

Table 13 Comparing the impacts of the options

Policy Option	Effectiveness related to innovation in general	Effective-ness related to ethical issues within RRI	Effective-ness related to open access within RRI	Cost re-duction	Simplificat-ion	Legal security	Feasibility
Baseline scenario Option 1	0	0	0	0	0	0	High
Option 2: Raising renewal fees	0	+	+	-	+	+	Low
Option 3: Reducing maximum protec-tion period	-	++	++	-	+	++	Very low
	"0": no change "+": positive impact "-": negative impact						

5.2.3 Litigation

5.2.3.1 Problem description

The last, but probably most important problem we address in our impact assessment is litigation. Both the interviews, but also the stakeholder survey reveal that both the likelihood of litigation (infringement) of ICT patents, but also the expected legal cost for resolution of conflicts are high. These subjective perceptions are confirmed by the recent study of Marco et al. (2017), which reveals a significant increase, i.e. almost a doubling, of patent litigation at US courts after 2010. The increasing trend of litigations is confirmed for SEPs, which overall are stagnating (Pohlmann and Blind 2016). Finally, PWC (2016) report also a stagnation of granted patents, but an increase of litigation. They find in particular an increasing role of Non-Practicing Entities (NPEs), which are comparable to PAEs. This fits to the high relevance of an increased legal uncertainty generated by ICT patents owned by Patent Assertion Entities (PAEs) expressed by the majority of the respondents to our survey. In addition to the number of litigation cases, Bessen et al. (2015) report an increase of litigation costs from the year 2000 to around 40 billion $ in 2010. This trend is going to continue according to PWC (2016). Again, both Bessen et al. (2015) and PWC (2016) reveal the increasing relevance of PAEs to the rise of litigation costs. In addition to the costs, the risk of litigation has to be mentioned. PWC (2016) reveals that NPEs have only a success rate of 25% compared to 35% of practicing entities, but the damages awards for NPEs almost three times greater than practicing entities. In summary, litigations involving NPEs or PAEs are characterized by a high level of risk compared to practicing entities. The high risk is confirmed for Europe by a recent Darts-IP report –

'The Rise of Non-practising Entity Cases Outside the United States' (Darts-IP 2017), showing the increasing number of litigation cases initiated by NPEs (see also Lemley and Feldman 2016 and Patent Dispute Report 2016). The win rate of NPE plaintiffs are far above 50% in China and Germany and therefore even higher than in the United States. Finally and very important for our focus on ICT patents, telecommunication, digital communication and computer technology dominate are responsible for the majority of the cases initiated by NPEs or PAEs (FTC 2016). Lemley and Melamed (2017) explain this phenomenon in particular in ICT by an overabundance of patents that are interpreted too broadly, a legal system that allows patent holders to obtain excessive settlements, and an important royalty-stacking problem.

Regarding the impact of litigations in information technology, we cannot assume a zero-sum-game between the plaintiff and the defendants, because Raghu et al. (2008) find that patent litigation has a significant negative impact on the defendants, whereas the effect is significantly positive for plaintiffs leading to a negative-sum-game. According to Bessen et al. (2011), non-practicing entities may have caused a loss of half a trillion dollars in market value between 1990 and 2008 reducing R&D incentives and eventually in social welfare.

5.2.3.2 Option 1: Baseline scenario

Under this scenario, the current patent system in Europe is unlikely to work in the same way as in the past. The observed trend of an increasing number of litigations in ICT would continue and the NPEs or PAEs activities are expected to increase due to their high likelihood of winning the cases. Consequently, the whole system, but especially the defendants, i.e. the practicing entities are expected to suffer. Therefore, the investments in research and innovation might decline, leading to a reduced competitiveness and growth in the future.

5.2.3.3 Option 2: Support of Alternative Dispute Resolution (ADR)

The first option is trying to avoid litigation in general by supporting alternative dispute resolution (ADR) methods as already provided by the WIPO Arbitration and Mediation Center. However, the limited number of collaboration with its member states Intellectual Property Offices in order to raise awareness among users of the services provided of the advantages of ADR methods to prevent and resolve intellectual property and technology disputes provides evidence that there is further effort needed. This assessment is also shared by the insights of the interviews and the survey, because only a small fraction of the actors are aware of these options and even fewer has used them. Therefore, both patent owners, in particular SMEs, and the implementers of patents would benefits by ADR in case of conflicts, because solving of conflicts via litigation is not a zero-sum-game, but a negative-sum-game. However, in addition of raising awareness possibilities to share also the outcome of ADR have to be investigated to convince possible users about their benefits in comparison to litigation.

5.2.3.4 Option 3: Specialised courts dealing with infringement and validity

Since ADR methods are certainly not sufficient, changes within the court system have to be considered. The survey has revealed that the most effective measures endorsed by a broad majority of the expert asking for specialised courts dealing both with infringement and validity issues. Cremers et al. (2016) show that bifurcation, where claims of infringement and validity of a patent are decided independently of each other in separate court proceedings at different courts, creates situations in which a patent is held infringed that is subsequently invalidated. In Germany, for example, the patent owner files an infringement lawsuit before a district court. In order to challenge the validity of the patent, the alleged infringer has to file a nullity action before the Bundespatentgericht. If the district court judge finds infringement without considering validity, the patent owner is usually granted an injunction even before the decision on validity is rendered.

Consequently, the establishment of specialised courts unifying the decisions about validity and infringement is certainly beneficial for the implementers of technology and innovation. Large patent owners have less resource problems, but for SMEs, this is a significant reduction of costs.

5.2.3.5 Option 4: Regulation of PAEs

ICT patents owned by Patent Assertion Entities (PAEs) increase the legal uncertainty for implementers of ICT related technologies in such a way, that this challenge is the most agreed upon among all other challenges by the respondents to our survey. Furthermore, the above mentioned trends towards more and more costly litigations driven by NPEs or PAEs is endorsing the individual perception of the respondents to the surveys and of many interviewees. Consequently, regulations to restrict the activities for PAEs is considered to be one of the most effective solutions among all the proposed ideas.

Restricting PAEs might benefit both all other patent owners and all the other innovators without patents. The justification of PAEs by their role in facilitating innovation and bringing new technology from inventors to those who can implement it cannot be supported by the survey of Feldman and Lemley (2015) finding that very few patent license demands actually lead to innovation. Therefore, the restriction of their activities is contributing to innovation of both patent owners and implementers without patents.

5.2.3.6 Comparing the options

If we compare the options, we expect that the restriction of PAEs will benefit all innovators most. However, specialised courts are also very positive. In addition, there improved capacities might also restrict the strategic opportunities for PAEs. The expected impact of supporting ADR on innovation is in general positive, but less compared to the other two options.

Table 14 Expected impact of options on innovation

Policy Option	Patenting entities (Overall)	Patenting entities (SMEs)	Innovators in general without patents
Baseline scenario Option 1	-	--	--
Option 2: Support of Alternative Dispute Resolution (ADR)	+	+	+
Option 3: Specialised courts dealing with infringement and validity	+	++	++
Option 4: Regulation of PAEs	++	++	++
"0": no change "+": positive impact "-": negative impact			

Looking at the impact of the options on the other five criteria, we would expect no real impact on responsible research and innovation.. However, the options may have ethical implications, if they promote an earlier implementation of the disputed patent protected technologies, which may have implications on the well-being of human beings in general or aspects of inclusiveness. The same line of argument applies to open access to scientific results, i.e. if the implementation of the options lead to an earlier settlement of the disputes and therefore the usage of the contained knowledge and related technologies. The other dimensions of RRI are not influenced,.

Whereas further support of ADR certainly increases the costs for the governments, the costs for the patenting entities and alleged infringers will be reduced, because the cost they incur in courts cases will be higher. Specialized courts instead of the bifurcation system reduce the costs both for the government and those involved in courts cases also argued by Cremers et al. (2016). The regulation of PAEs will generate significant costs in the development phase, because an internationally coordinated approach is necessary. Even more cost will be required for the effective implementation of the regulation. However, an effective regulation of PAEs will reduce the cost for all other actors in the patent system.

ADR will not necessarily reduce the complexity, but the establishment of specialized courts dealing both with infringement and validity issues is certainly a simplification. Whether the regulation of PAEs will lead to simplifications remains open, because identifying illegal activities and effectively enforcing the regulations is certainly a complex task.

Legal security is certainly increased by raising the establishment of specialized courts, as Cremers et al (2016) argue that the uncertainty over the scope and validity of patents may be higher under a bifurcated system, which may lead to a higher litigation intensity. If the activities of PAEs are effectively restricted, their contribution to the massive increase in litigation will be reduced leading to higher legal security.

The continuation of the baseline scenario is medium, because during the implementation of the Agreement of a Unified Patent Court the establishment of specialised patent courts in Europe is indeed feasible and is not contradicting TRIPS. The limited success of ADR by WIPO is an indication that a further support is rather unlikely. Although needed and positive for innovation, the feasibility of a regulation of PAEs is limited due to the need of an international agreement, because national, but also European initiatives are uneffective.

Table 15 Comparing the impacts of the options

Policy Option	Effectiveness related to innovation in general	Effective-ness related to ethical issues within RRI	Effective-ness related to open access within RRI	Cost reduc-tion	Simplification	Legal security	Feasibility
Baseline scenario Option 1	-	-	-	-	0	-	Medium
Option 2: Support of Alternative Dispute Resolution (ADR)	+	0	+	+	0	0	Low
Option 3: Specialised courts dealing with infringe-ment and validity	++	0	+	++	+	++	Medium

Option 4: Regula-tion of PAEs	++	+	+	++	0	++	Low
	"0": no change "+": positive impact "-": negative impact						

5.3 SUMMARY

The assessment of the impacts of the various options to address the three problems of patent quality, a long patent protection period and litigation revealed that the majority of them have potentially high impacts to promote innovation in general and especially related to the accessibility of scientific results in the context of RRI. The ethical implications of the proposed changes are in general rather vague. However, if they promote the accessibility and diffusion of patented technologies, which foster the well-being of humans, then they have also strong ethical implications. Consequently, the open accessibility to scientific results as one dimension of RRI has also an explicit ethical dimension, because it might eventually influence ethical issues, like digital divide in particular (e.g. Stahl et al. 2014) or inclusion in general (e.g. Rogerson 2011). However, the link between the dimension of open access within the five dimension of RRI and the ethical dimensions has not explicitly addressed in previous studies, e.g. by Stahl et al. (2017) or De Keersmaecker (2017). Here, the study about challenges for ICT patents and possible solutions mainly within the current legal framework and of incremental character considering the various dimensions of RRI has revealed some new and interesting links, which should be investigated further in improving the RRI framework. Due to the rather comprehensive relevance of ethics for ICT for society (Rogerson 2011, Stahl et al. 2014), it should be further considered to integrate components of an ethical impact assessment for ICT (Wright 2011) into the guidelines for performing impact assessments (EC 2009), which contain so far only an explicit link to "(bio) ethical issues".

Some of the options, like specifying the criteria for patents on CII, would also generate no or little costs for the patenting entities, but also not for the system as a whole. However, the feasibility of almost all of the options is low, because it is difficult to change the status quo. The implementation of the Agreement on a UPC provides some opportunity to realize in particular the option of specialized courts, which would also beneficial for addressing the challenging increase in litigation.

6 CONCLUSIVE REMARKS

The objective of this report was the identification of current challenges for patents in ICT related technologies in a first step and finding solutions to tackle them in a second step. Based on the insights of the literature review and the empirical analysis performed in WP2, we identified the existing impact and future studies also dealing with future challenges and possible solutions.

These already existing insights were the basis for guiding us through interviews with stakeholders, which cover the whole value chain in ICT from research, over software developers to producers of consumer products, but also experts of organizations setting the regulatory framework. Due to the broad coverage of stakeholders, a huge variety of challenges and proposals for solutions could be identified. The specific focus on Responsible Research and Innovation revealed that the majority of the experts were not aware of RRI. Consequently, only a few links to patents in ICT related technologies could be identified in contrast to the intensive ethical debate in bio- and pharmaceutical technologies.

Despite the broad variety of challenges and solutions discussed with the experts, an online questionnaire was developed, intensively tested and widely distributed to all stakeholder groups. The feedback was quite positive in the sense to be interested in identifying the most relevant problems and the solutions most likely to be effective. However, the received responses also allowed recognizing the differences between the stakeholders, e.g. the patenting entities and the organizations not owning patents or large and small companies. Overall, the assessment of the challenges varies significantly between these groups, but in general, they tend to agree more on effectiveness of the solutions, which is a first promising result. Finally, the responses on the relevance of the dimensions of RRI for ICT patents confirm the limited awareness already revealed in the interviews. However, the closest link exists obviously related to the access to scientific results, but ethical issues are also relevant. Overall, there is a high consistency between the insights from the interviews and the results of the survey. The comparison between the assessed effectiveness of the solutions and the requirements to make the necessary changes in the framework including an evaluation of their likelihood did not necessarily reveal a clear correlation. However, obviously easy changes, like changing fees and cost, are perceived not be very effective.

In a final step, the most relevant problems, which can potentially solved by interventions of the government, were used to perform an impact assessment of the available options to solve the problems. In detail, we addressed the problem of patent quality, the patent protection period and litigation and possible solutions. Although, most options would promote innovation in general, but also the specific aspects of open access and ethics as two dimensions of RRI in particular, their feasibility is limited. This is alarming, because some problems are rather urgent, e.g. the increasing number of litigations, in particular initiated by PAEs, despite a stagnating number of patents, at least in the Western world.

From a methodological perspective, this first impact assessment focusing on the patent system including the aspect of RRI should be seen as a starting point to consider and elaborate RRI, in particular the ethical issues, not only of ICT, in future impact assessments.

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ANNEX 1: RELEVANT PROBLEMS AND POTENTIAL SOLUTIONS IDENTIFIED IN THE LITERATURE

Table 6 Overview of relevant problems identified from literature

	EPO (2007), SCENARIOS OF THE FUTURE: HOW MIGHT IPR REGIMES EVOLVE BY 2025? WHAT GLOBAL LEGITIMACY MIGHT SUCH REGIMES HAVE?	EPO AND OHIM (2013), INTELLECTUAL PROPERTY RIGHTS INTENSIVE INDUSTRIES: CONTRIBUTION TO ECONOMIC PERFORMANCE AND EMPLOYMENT IN THE EUROPEAN UNION.	EC JRC (2014A), INTERNATIONAL PROTECTION OF ICT INTELLECTUAL PROPERTY AND THE INTERNATIONALIZATION OF ICT R&D	ECSIP (2014), PATENTS AND STANDARDS: A MODERN FRAMEWORK FOR IPR-BASED STANDARDIZATION	EC (2015), REPORT OF THE EXPERT GROUP ON PATENT AGGREGATION	EC JRC (2015A), INNOVATION IN THE EUROPEAN DIGITAL SINGLE MARKET: THE ROLE OF PATENTS	EC JRC (2015B), INTELLECTUAL PROPERTY AND INNOVATION IN INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)	EPO AND EUIPO (2016), INTELLECTUAL PROPERTY RIGHTS INTENSIVE INDUSTRIES AND ECONOMIC PERFORMANCE IN THE EUROPEAN UNION INDUSTRY-LEVEL ANALYSIS REPORT	DG GROW (2016), MODERNISING THE ENFORCEMENT OF INTELLECTUAL PROPERTY RIGHTS	EC JRC (2016), PATENT ASSERTION ENTITIES IN EUROPE	FTC (2016), PATENT ASSERTION ENTITIES ACTIVITY	EC (2016), PUTTING INTELLECTUAL PROPERTY AT THE SERVICE OF SMES TO FOSTER INNOVATION AND GROWTH {COM(2016) 733 FINAL}	AVANCI (2016), ACCELERATING IOT CONNECTIVITY - REPORT	CRA (2016), TRANSPARENCY, PREDICTABILITY AND EFFICIENCY OF SSO-BASED STANDARDIZATION AND SEP LICENSING	EARTO (2017), FOR GLOBALLY COMPETITIVE STANDARDIZATION IN THE DIGITAL SINGLE MARKET: EARTO VOTING RECOMMENDATIONS TO SUPPORT INNOVATION IN EUROPE
PATENT APPLICATION AND GRANTING															
BACKLOG OF PATENT OFFICES REDUCED PRODUCT CYCLE	X									X					
FRAGMENTATION OF PATENTS							X								
ICT INDUSTRIES USE IPRS INTENSIVELY							X			X					
LOW QUALITY OF PATENTS (E.G. DUE DIFFICULTIES ON PATENT EXAMINATION; LOW QUALITY APPLICATIONS)	X			X	X	X	X			X	X				

SHORT PRODUCT CYCLES IN ICT FOR CURRENT PATENT LENGTH	X													
TECHNOLOGICAL COMPLEXITY / MULTIDISCIPLINARY	X				X	X	X							
THE INCREASED NUMBER OF SOURCES GENERATING IPR (VARIETY OF TECHNOLOGIES)	X													
LARGE AMOUNT OF PATENT APPLICATIONS (HIGH VOLUMES LEAD TO BACKLOGS, CREATES UNCERTAINTY, AND INCREASE PROBABILITY OF GRANT)	X	X			X			X						
INCREASE OF THE TIME-TO-MARKET (THE TIME IT TAKES TO DETERMINE THE FATE OF AN APPLICATION)	X			X										
THE ASSESSMENT OF THE INVENTIVE MERIT OF AN APPLICATION	X													
THE PATENTABILITY OF NEW FIELDS, NOTABLY SOFTWARE, BUSINESS METHODS AND BIOTECHNOLOGY.	X					X								
LIMITED ACCESS PATENT INFORMATION		X			X	X	X	X		X				
LACK OF MARKET TRANSPARENCY					X	X	X		X	X	X			X
SOFTWARE AND THE INTERPLAY OF IPR WITH OPEN INNOVATION						X	X							
CAPITALIZING GLOBALLY ON INNOVATION REQUIRES ITS GLOBAL PROTECTION			X											
SMALL AND MEDIUM SIZED ENTERPRISES (SMES) FIND	X				X	X						X		

THAT PROCEDURES ARE TOO COSTLY															
SMES MAY LACK OF AWARENESS ABOUT THE BENEFITS OF PATENTS					X							X			
SMES LACK THE NECESSARY EXPERTISE	X				X							X			
HIGH TRANSACTION COSTS	X			X	X				X					X	
A LACK OF FINANCE FOR LEGALLY PROTECTING THEIR IPR					X										
INTERPLAY BETWEEN IPRS AND OPEN INNOVATION MODELS						X	X								
PATENTS IN THE FACTO STANDARDS															X
UNCLEAR ROLE OF IPRS IN CUMULATIVENESS INNOVATION							X								
ENFORCING AND IMPLEMENTING PATENTS															
HIGH LITIGATION RATES							X		X						
PATENT HOLD-UP	X			X		X								X	
ICT SECURITY RISKS, PROTECTIONISM, DUA USE (E.G. BIOTERRORISM)	X														
INCREASE PATENT PROPENSITY	X														
PATENT PROSECUTION COSTS	X														
LANGUAGE PROFUSION, DATA VOLUMES, INFORMATION COMPLEXITY	X				X										

DISRUPTIVE OR LITIGIOUS ACTIVITIES OF PATENT ASSERTION ENTITIES (PAE) (LITIGATIONS, PORTFOLIOS, TARGETS)						X	X			X	X			
PATENT TROLLS	X			X										
TRUE OWNERS ARE NOT EASILY IDENTIFIABLE DURING THE DISCOVERY PROCESS DUE TO THE PRACTICE OF ESTABLISHING SHELL PAE COMPANIES IN DIFFERENT JURISDICTIONS.										X				
LICENSE STACKING OR HOLD-UP (INTEROPERABILITY TECHNICAL STANDARDIZATION)	X													
NO COMMERCIALIZATION, NO DIFFUSION	X				X									
PATENT THICKETS (INCREASE, WITH COMPLEXITY OF TECHNOLOGIES)	X						X			X				
RESTRICTIONS ON RESEARCH EXCEPTION, PATENT BLOCKAGE OF RESEARCH TOOLS, SOCIETAL FEARS / NOVEL RISKS	X													
SHORT PRODUCT CYCLES IN ICT FOR CURRENT PATENT LENGTH	X													
STRATEGIC PATENTING	X													
PATENT AMBUSH OR PATENT BLOCKING				X										
ROYALTY STACKING (TOO HIGH CUMULATIVE LICENSING FEES)	X			X		X				X				X
PATENT BUNDLES							X							
DIFFICULTY FOR PATENT HOLDERS IN GETTING				X										

IMPLEMENTERS TO LICENSE THEIR SEPS						
UNTRUTHFUL DECLARATIONS (PARTIES DECLARE PATENTS AS SEPS WHILE THEY KNOW – OR SHOULD HAVE KNOWN THAT THESE ARE NOT)	X					
BLANKET DISCLOSURES	X					
OVER-DISCLOSURE	X					
GROWING NUMBER OF STANDARD ESSENTIAL PATENTS (SEP)	X	X	X			
LACK OF TRANSPARENCY REGARDING SEPS (E.G. UNCERTAINTY ABOUT SEP OWNERSHIP)	X		X			X
UNCLEAR DEFINITION OF SEP	X		X			
LACK OF AVAILABILITY OF LICENSES FOR (SEPS)	X					
FRAND CONDITIONS NOT CLEAR; TRANSFER OF FRAND CONDITIONS (FROM OLD TO NEW SEP OWNER)	X		X	X		
DISCRIMINATION BETWEEN IMPLEMENTERS (PATENT OWNERS ARE FREE TO DISCRIMINATE BETWEEN LICENSEES)	X					
PROBLEMS DUE TO PATENT OWNERS' TECHNOLOGY BEING INCOMPLETE OR "IMMATURE"		X				
DIFFICULTIES IN PATENT VALUATION		X				
DIFFICULTIES IN ENFORCING PATENTS		X				

Table 7 Overview of potential solutions identified in literature

	EPO (2007), SCENARIOS OF THE FUTURE: HOW MIGHT IP REGIMES EVOLVE BY 2025? WHAT GLOBAL LEGITIMACY MIGHT SUCH REGIMES HAVE?	ECSIP (2014), PATENTS AND STANDARDS: A MODERN FRAMEWORK FOR IPR-BASED STANDARDIZATION	EC (2015), REPORT OF THE EXPERT GROUP ON PATENT AGGREGATION	EC JRC (2015A), INNOVATION IN THE EUROPEAN DIGITAL SINGLE MARKET: THE ROLE OF PATENTS	DG GROW (2016), MODERNISING THE ENFORCEMENT OF INTELLECTUAL PROPERTY RIGHTS	EC JRC (2016), PATENT ASSERTION ENTITIES IN EUROPE	FTC (2016), PATENT ASSERTION ENTITIES ACTIVITY	EC (2016), PUTTING INTELLECTUAL PROPERTY AT THE SERVICE OF SMES TO FOSTER INNOVATION AND GROWTH {COM(2016) 733 FINAL}	AVANCI (2016), ACCELERATING IOT CONNECTIVITY - REPORT	CRA (2016), TRANSPARENCY, PREDICTABILITY AND EFFICIENCY OF SSO-BASED STANDARDIZATION AND SEP LICENSING	EARTO (2017), FOR GLOBALLY COMPETITIVE STANDARDIZATION IN THE DIGITAL SINGLE MARKET: EARTO VOTING RECOMMENDATIONS TO SUPPORT INNOVATION IN EUROPE
PATENT APPLICATION AND GRANTING											
IMPROVEMENT OF QUALITY OF PATENTS (E.G. TO LIMIT LARGE-SCALE ASSERTION OF LOW QUALITY PATENTS TO ENSURE THAT THE STANDARDS MAINTAINED IN PATENT GRANTING PROCEDURES ARE ALSO OF THE HIGHEST QUALITY)	X	X	X	X		X	X				
IMPROVEMENT ON THE TRANSPARENCY OF PATENT AVAILABILITY AND OWNERSHIP	X	X	X	X	X	X	X				
EU-LEVEL MEASURES TO SUPPORT THE USE OF IPR BY START-UPS AND SMES (IMPROVING AWARENESS; CREATION OF EUROPEAN-LEVEL INSURANCE SCHEMES FOR LITIGATION AND IPR THEFT; IMPROVING COORDINATION OF IPR SUPPORT FUNDING SCHEMES; INCLUDE PATENTS IN SMES BUSINESS STRATEGIES)				X				X			
			X								
AUGMENTED DATABASE		X									
CROWD-SOURCED VALIDITY CHECK		X									

ENFORCING AND IMPLEMENTING PATENTS							
REDUCTION OF TRANSACTION COSTS AND BARRIERS TO ENTRY							X
NON-PROFIT INTERMEDIARY POOLS, OPEN ACCESS CLEARING HOUSE		X					
PATENT POOLS AND COLLABORATIVE PRACTICES		X	X	X			X
CLEARINGHOUSE		X		X			
PATENT SUPERMARKET		X					
OPEN SOURCE/OPEN SCIENCE	X						
SECRECY	X						
CREATION OF A DATABASE OF ROYALTY RATES (ANONYMOUS) FOR BENCHMARKING PURPOSES.		X					
PROMOTING OR MANDATING COORDINATION MECHANISMS BETWEEN LICENSORS, SUCH AS EX-ANTE DISCLOSURE OF THE HIGHEST ROYALTY RATES OR OTHER MECHANISMS THAT MODERATE CUMULATIVE DEMAND.		X					
DEFINE OR STRENGTHEN SSO RULES THAT BIND FUTURE OWNERS OF SEPS TO EXISTING COMMITMENTS		X	X				
IMPROVEMENTS TO THE PATENT DECLARATION SYSTEM FOR SEP		X					
CONCRETE LICENSING PRACTICES OF SEPS					X		

EFFICIENT DISPUTE RESOLUTION MECHANISMS FOR SEP				X						
IMPROVEMENT OF THE GUIDANCE ON THE INCLUSION OF PATENTED TECHNOLOGIES			X			X				
SETTING RULES ON NOTIFICATION OF TRANSFER OF ENCUMBERED PATENTS ('RECORDATION')			X							
STANDARD UPDATES AND COLLABORATION WITH PATENT OFFICES										X
EX ANTE AND EX POST DISCLOSURE				X		X		X		X
(E.G. SSO PARTICIPANTS SHOULD BE REQUIRED TO MAKE AN EX ANTE DECLARATION OF THEIR PATENTS AND PATENT APPLICATIONS, WITH THE UNDERSTANDING THAT ALL IPRS WHICH ARE NOT SINGLED OUT FOR EXCEPTION ARE AVAILABLE ON FRAND TERMS)										
ROYALTIES RATES ARE DIFFERENTIATED FOR DIFFERENT APPLICATIONS (TO ENSURE FAIRNESS)									X	
ROYALTY CAPS COMMITMENTS			X							X
PORTFOLIO LICENSING										X
LICENSE OF RIGHTS (LIABILITY REGIMES)	X		X						X	
PATENT TRANSFER RULES										X
CONFLICT RESOLUTION RULES										X
DEVELOP DISPUTE RESOLUTION MECHANISMS OR ARBITRATION (E.G. IN SSOS) AS A POTENTIAL ATTRACTIVE ALTERNATIVE TO COURTS.			X							
FRAND LICENSING TERMS AND THE OPAQUENESS OF THE						X		X		

STANDARDIZATION PROCESS										
INCREASE SUPPORT TO FRAND LICENSING										X
SSO-BASED FRAND POLICIES									X	
CLARIFY FRAND CONDITIONS BY DEVELOPING PRINCIPLES ON THE DETERMINATION OF THE ROYALTY RATE AND ROYALTY	X		X							
		X								
CLARIFY THE SCOPE OF THE RECIPROCITY ELEMENT OF FRAND.	X	X	X		X				X	
POLICY COULD BE DIRECTED TOWARDS MINIMIZING LEGAL UNCERTAINTY, AT THE SAME TIME, THE BEHAVIOR OF SOME PAES THAT EXPLOIT THIS EXACT TYPE OF UNCERTAINTY WOULD BE REDUCED.					X					
PAE LITIGATION ASYMMETRIES SHOULD BE ADDRESSED BY POLICYMAKERS THROUGH PROCEDURAL AND SUBSTANTIVE REFORM						X				
TO MINIMIZE PAES QUESTIONABLE ACTIVITIES (E.G. TO MINIMIZE LEGAL UNCERTAINTY IN THE SYSTEM)		X	X		X	X				

ANNEX 2: INTERVIEW GUIDELINE

Horizon 2020 Project CIFRA: Challenging the ICT Patent Framework for Responsible Innovation

Abstract

The aim of the project is to provide a structured review of the role of the Patent System on the innovation process and how it impacts the social development with specific focus on the particularities of ICT research and innovation. The project will identify and thoroughly characterize the imperfections of the current system and propose alternatives that provide better alignment between ICT Research & Innovation, human needs and societal expectations.

Therefore the project will propose alternative framings that result in a more effective and efficient tool for collaborative innovation and real technical and social development. These alternative framings may comprise suggestions to adapt existing tools (such as the patent system), or defining new mechanisms (such as new innovative licensing schemes).

An specific area of study will be the open source software model, which currently seems to work well for software development, to assess its pros and cons as a collaborative innovation scheme and to what extent the advantages of the open source 'philosophy' could be extrapolated to the patent system. The analysis and outcomes of the project will not just be theoretical but, whenever applicable, it will be based on a thorough data analysis of the patent landscape in the ICT sector.

Interview Questions

1. Arguments for the Patent System for ICT

2. Critique of the Patent System for ICT

3. Possible Solutions /Alternative Framings in General (e.g. Open Source)

4. Possible Solutions /Alternative Framings in Particular

5. Facilitating the Access to Scientific Results via Patents in General and ICT in Particular

6. Major Aspects of Responsible Research and Innovation: Ethical Dimension of Patents in General and ICT in Particular

7. Other Aspects of Responsible Research and Innovation: engaging society (public engagement), gender dimension, promoting (in)formal science education

ANNEX 3: SURVEY QUESTIONNAIRE

CIFRA: Challenging the ICT Patent Framework for Responsible Innovation

Stakeholder Consultation on ICT Patents

Grant Agreement No.731940
Research and Innovation Action
Call: H2020-ICT-35-2016

The importance of patents for the promotion of responsible innovation in ICT is in general acknowledged. This survey is conducted within the framework of CIFRA: Challenging the ICT Patent Framework for Responsible Innovation, a project within Horizon 2020 of the European Commission.

We are aware of the various business models of the stakeholders involved in the development and commercialisation of ICT-related technologies and the different role ICT patents and other intellectual property rights play. Consequently, there is no single first best solution available. It is further acknowledged that the patent system is an integral legal framework which is respectful of IPR meeting the requirements of both 'innovative step' and 'novelty' – regardless of the technology, industry or sector.

The objective of this study is to review the issues and possible improvements related to current framework for ICT patents to promote responsible innovation. This questionnaire is based on the review of the literature and interviews with stakeholders from various backgrounds. It aims to collect the opinions and attitudes of stakeholders involved in or with the ICT sector towards the current patent regime framework relevant for responsible innovation. Your answers to the questions of the survey, which we interpret as your personal opinion and not necessarily your organisation's official position, will be treated with absolute confidentiality. We will only analyse data on an aggregated level and include them in the final report of this project to be published on the project webpage http://cifra-h2020.eu/ (http://cifra-h2020.eu/).

We know about your time constraints, but would deeply appreciate your co-operation and your opinions in order to support the further development of an innovation-friendly patent regime for ICT in the European Union.

If you wish, you can download the questionnaire for your information as PDF (/upload/surveys/228186/files/cifra_questionnaire.pdf).

In case of questions, please contact:

Prof. Dr. Knut Blind

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(mailto:knut.blind@fokus.fraunhofer.de?subject=CIFRA%20questionnaire)

Disclaimer:

This survey is conducted within the framework of the European Horizon 2020 project, entitled 'Challenging the ICT-related Patent Framework for Responsible Innovation' (the CIFRA project), including this questionnaire, should not be reported as representing the individual or collective views of the CIFRA consortium partners, being the Fraunhofer-Gesellschaft, Telefonica Investigacion y Desarrollo SA, Universita Commerciale Luigi Bocconi or Universidad Carlos III de Madrid. The design, implementation, conclusions, and recommendations of the CIFRA project are those of the authors only. This document as well as any propositions included herein are without prejudice to the recognized state of the law and binding international and intergovernmental treaties and norms.

Section A: Definitions:

A1. **We have a very broad understanding of ICT patents following the OECD STI working paper on ICT-related technologies including both traditional telecommunication and Internet related technologies, such as the Internet of Things (IoT) and their various applications, e.g. electronic payment systems, imaging and sound technologies, and gaming, and also in vertical industries, incl. automotive or energy. Furthermore, we also consider patents on computer-implemented inventions (CII), being aware that under the European Patent Convention "programs for computers" are not regarded as inventions for the purpose of granting European patents.**

http://www.oecd-ilibrary.org/science-and-technology/ict-a-new-taxonomy-based-on-the-international-patent-classification_ab16c396-en?crawler=true

According to the European Commission, "Responsible research and innovation (RRI) is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation." In practice, RRI is implemented as a package that includes multi-actor and public engagement in research and innovation, enabling easier access to scientific results, the take up of gender and ethics in the research and innovation content and process, and formal and informal science education.

https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation

I understand ☐

Section B: Position of the person answering the questionnaire

B1. Please indicate your position or responsibility in your organisation.

- ☐ Chief Executive Officer (top management)
- ☐ Member of Legal/Patent Department
- ☐ Member of Research and Development Department
- ☐ Member of IT/Software Department
- ☐ Independent Software Developer
- ☐ Other

Other

Section C: Basic economic information about your organisation

C1. What is your organisation's core business or primary sector of activity?

C2. What is your organisation's core business model?

- ☐ Company producing final consumer products
- ☐ Company supplying components
- ☐ Network operator
- ☐ Software supplier
- ☐ Independent Open Source Developer
- ☐ Research institute (Private)
- ☐ Research institute (Semi-Public and Public)
- ☐ Service company
- ☐ Company providing IP services

Other

Other

C3. Basic economic information about your organisation

Total turnover market sales of goods and services including export and taxes (in €) in 2016:

Number of employees (full-time) in 2016:

Year of foundation:

Expenditure for internal and external research and development (in % of total turnover):

Section D: Type of innovation activities

D1. During the period 2014-2016 did your organisation introduce successfully any type of the following innovation, i.e. a product incl. service, a process (technology), marketing or organisational method, that is new or significantly improved?

	No	Yes
Product innovation	☐	☐
Process innovation	☐	☐
Marketing innovation	☐	☐
Organisational innovation	☐	☐

Section E: Use of Intellectual Property Rights

E1. Did your organisation apply for, register or claim the following intellectual property rights between 2014 and 2016?

	No	Yes
Application for patents	☐	☐
Application for utility models	☐	☐
Registration for industrial designs	☐	☐
Registration for trademarks	☐	☐
Claiming of copyright (e.g. by proof of the creation date or the © symbol)	☐	☐

	No	Yes
Others, please specify	☐	☐

E2. Please provide an approximate number:

Application for patents	
Application for utility models	
Registration for industrial designs	
Registration for trademarks	
Claiming of copyright (e.g. by proof of the creation date or the © symbol)	

E3. Please name it and provide an approximate number:

Name:

Others, please specify	

Approx. Number:

Others, please specify	

E4. Did your organisation (cross-) license out or sell own patents, and/or (cross-) license in or purchase patents of third parties?

	No	Yes
Own patents rights licensed out or sold to third parties	☐	☐
Patents of third parties licensed in or bought (excl. standard software)	☐	☐
Others, please specify (e.g. cross-licensing)	☐	☐

E5. Please provide an approximate number:

Own patents rights licensed out or sold to third parties	
Patents of third parties licensed in or bought (excl. standard software)	

E6. Please name it and provide an approximate number:

Name:

Others, please specify	

Approx. Number:

Others, please specify	

Section F: Assessing the effectiveness of ICT patents from your organisation's perspective

F1. Please assess the effectiveness of ICT patents for achieving the following objectives from the perspective of your organisation.

	very low	low	medium	high	very high	cannot be assessed
Preventing imitation of inventions, e.g. for securing the means to obtain a return on the R&D investment	☐	☐	☐	☐	☐	☐
Securing own freedom to operate by disclosing prior art (e.g. to prevent legal conflicts)	☐	☐	☐	☐	☐	☐
Blocking competitors	☐	☐	☐	☐	☐	☐
Using the coordination function in research processes and collaborations incl. open innovation	☐	☐	☐	☐	☐	☐
Using as asset in negotiations (incl. cross licensing)	☐	☐	☐	☐	☐	☐
Generating licensing revenues	☐	☐	☐	☐	☐	☐
Enhancing reputation	☐	☐	☐	☐	☐	☐
Measuring performance of research and development	☐	☐	☐	☐	☐	☐
Rewarding employees	☐	☐	☐	☐	☐	☐
Other objectives (optional), please specify below	☐	☐	☐	☐	☐	☐

F2. Other objectives, please specify:

Section G: Assessment of the challenges for ICT patents related to innovation in your organisation (1/2)

G1. Based on the review of the literature and interviews with experts we have identified the following challenges related to the objectives of ICT patents. Please indicate the extent to which you agree or disagree to the following statements regarding patent application and granting to promote effectively innovation including research and development in ICT.

	totally disagree	disagree	ambivalent	agree	totally agree	cannot be assessed
Due to the technological dynamics in the ICT sector, patents are not effective to protect innovation	☐	☐	☐	☐	☐	☐
Due to technological convergence and fragmentation in the ICT sector, patents are not effective to protect innovation	☐	☐	☐	☐	☐	☐
Patent examination practices do not adequately consider relevant existing prior art	☐	☐	☐	☐	☐	☐
The cost for applying for ICT patents is too high	☐	☐	☐	☐	☐	☐

	totally disagree	disagree	ambivalent	agree	totally agree	cannot be assessed
The granting process for ICT patents is too slow	☐	☐	☐	☐	☐	☐
The language of ICT patents is too complicated to qualify as a good source of information	☐	☐	☐	☐	☐	☐
The quality of ICT patents granted is low	☐	☐	☐	☐	☐	☐
The statutory patentability standards for ICT patents (e.g. technicality, etc.) differ among patent offices	☐	☐	☐	☐	☐	☐
The maximum protection period of 20 years is long for ICT patents	☐	☐	☐	☐	☐	☐
The scope of granted ICT patents is too broad	☐	☐	☐	☐	☐	☐
Implementations cannot be effectively protected by patents because they include code under an Open Source license that includes patent licenses	☐	☐	☐	☐	☐	☐
Others (optional), please specify below	☐	☐	☐	☐	☐	☐

G2. Other challenge for innovation regarding patent application and granting (optional), please specify:

Section H: Assessment of the challenges for ICT patents related to innovation in your organisation (2/2)

H1. Based on the review of the literature and interviews with experts we have identified the following challenges related to the objectives of ICT patents. Please indicate the extent to which you agree or disagree to the following statements regarding enforcing and implementing patents to promote effectively innovation including research and development in ICT.

	totally disagree	disagree	ambivalent	agree	totally agree	cannot be assessed
The cost/risk to enforce granted ICT patents is high	☐	☐	☐	☐	☐	☐
The likelihood of litigation (infringement) of ICT patents is high	☐	☐	☐	☐	☐	☐
The likelihood of courts granting an injunction to prevent infringement of ICT patents is high	☐	☐	☐	☐	☐	☐
Expected legal cost for resolution of conflicts regarding ICT patents are high	☐	☐	☐	☐	☐	☐
The legal uncertainty for companies creating or implementing ICT patents is high	☐	☐	☐	☐	☐	☐
Licensors are not willing to license ICT patents covering their technologies (hold-up)	☐	☐	☐	☐	☐	☐
Implementers of ICT patents are not willing to licensing in the third-party ICT patents covering their implemented technologies (hold-out)	☐	☐	☐	☐	☐	☐

	totally disagree	disagree	ambivalent	agree	totally agree	cannot be assessed
Agreeing on licensing agreements for standard-essential ICT patents (SEPs) is challenging	☐	☐	☐	☐	☐	☐
Large patent owners not joining pools of ICT patents challenge the implementation of ICT-related technologies	☐	☐	☐	☐	☐	☐
ICT patents owned by Patent Assertion Entities (PAEs) increases legal uncertainty for implementers of ICT-related technologies	☐	☐	☐	☐	☐	☐
Many technologies protected by ICT patents are not used or commercialised	☐	☐	☐	☐	☐	☐
Patents on computer-implemented inventions (CII) or software patents challenges innovation of ICT-related technologies	☐	☐	☐	☐	☐	☐
The use of ICT patents protected technology generate problems for the use of Open Source Software	☐	☐	☐	☐	☐	☐
The use of Open Source Software generates problems for the use and protection of ICT patents	☐	☐	☐	☐	☐	☐
Other challenges (optional), please specify below	☐	☐	☐	☐	☐	☐

H2. Other challenge for innovation regarding enforcing and implementing patents (optional), please specify:

Section I: Assessment of solutions for ICT patents promoting innovation (1/2)

I1. Several solutions are being discussed in the literature and by experts to improve the present framework for ICT patents, including options which are counter to the current legal framework (internationally, within the European Union, or nationally). Please assess the effectiveness of the following approaches to patent application and granting, with the aim of making the framework for ICT patents more conducive to innovation.

	not effective	ambivalent	effective	very effective	cannot be assessed
The application fees for ICT patents are raised	☐	☐	☐	☐	☐
The quality of granted ICT patents is improved by raising the required degree of novelty	☐	☐	☐	☐	☐
The quality of granted ICT patents is improved by raising the required inventive step	☐	☐	☐	☐	☐
The quality of granted ICT patents is improved by narrowing their scope	☐	☐	☐	☐	☐
Crowd-sourced validity checks support the patent validity checks by patent offices	☐	☐	☐	☐	☐
Granting an ICT patent requires already the implementation of the invention	☐	☐	☐	☐	☐
Raising and specifying (e.g. related to technicality) the bar for patents on computer-implemented inventions	☐	☐	☐	☐	☐

	not effective	ambivalent	effective	very effective	cannot be assessed
Software is excluded from patenting both for the program listing and the technical content underlying the software	☐	☐	☐	☐	☐
Patents for "Software as such" are granted, i.e. the program listing is patentable	☐	☐	☐	☐	☐
ICT patents are granted within five years	☐	☐	☐	☐	☐
The renewal fees for granted ICT patents are increased during all the protection period	☐	☐	☐	☐	☐
The protection period for ICT patents is shortened to 10 years	☐	☐	☐	☐	☐
Others (optional), please specify below	☐	☐	☐	☐	☐

I2. Other possible solution regarding patent application and granting (optional), please specify:

Section J: Assessment of solutions for ICT patents promoting innovation (2/2)

J1. Several solutions are being discussed in the literature and by experts to improve the present framework relevant for ICT patents including options with do not comply with the current legal framework within the European Union. Please assess the effectiveness of the following approaches related to enforcing and implementing patents to make the framework for ICT patents more conducive to innovation.

	not effective	ambivalent	effective	very effective	cannot be assessed
A declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.) is required to receive the maximum of 20 years of protection for ICT patents	☐	☐	☐	☐	☐
A set of well-known and trustable patent pledges, i.e. voluntary commitments by patent holders to give up some of the rights associated to the patent (e.g. grant permission for commercial use without any direct compensation, no injunctions, FRAND, etc.), is defined	☐	☐	☐	☐	☐
Technology exchange clearing houses are publicly supported to support bilateral licensing negotiations	☐	☐	☐	☐	☐
Regulations to restrict the activities for Patent Assertion Entities (PAEs) are established	☐	☐	☐	☐	☐
Publication of information incl. product specifications and licensing fees for Standard-Essential ICT patents should be encouraged	☐	☐	☐	☐	☐
Public policies support the formation and development of ICT patent pools, especially of SEPs, incl. providing incentives for organisations to join	☐	☐	☐	☐	☐
Public policies support the formation and development of bilateral or joint licensing programs, incl. providing incentives for organisations to develop these	☐	☐	☐	☐	☐

	not effective	ambivalent	effective	very effective	cannot be assessed
Compatible licensing solutions for Open Source Software and ICT patents are developed	☐	☐	☐	☐	☐
Only Royalty-Free ICT patents shall be integrated into Open Source Software	☐	☐	☐	☐	☐
Licensing terms of bilateral licensing agreements should be published	☐	☐	☐	☐	☐
Defensive ICT patent aggregators are publicly supported	☐	☐	☐	☐	☐
Insurances against ICT patent litigations are publicly supported (incl. provided by state insurance)	☐	☐	☐	☐	☐
Trade secret regulations reduce the incentive to file ICT patents	☐	☐	☐	☐	☐
Mediation and arbitration processes to reach a mutually satisfactory settlement of ICT patent disputes outside of court are further publicly supported	☐	☐	☐	☐	☐
Court fees for ICT patent disputes are increased	☐	☐	☐	☐	☐
Legal costs for ICT patent disputes in courts are covered by the losing party	☐	☐	☐	☐	☐
Financial situation in an ICT patent dispute of the winning party before the court case is reasonably restored	☐	☐	☐	☐	☐
Caps on ICT patent court case costs that are recoverable by the winning party are introduced	☐	☐	☐	☐	☐
A plaintiff can only challenge one ICT patent of one defendant in any given court case	☐	☐	☐	☐	☐
Infringement and validity issues regarding ICT patents are tried together before the same court	☐	☐	☐	☐	☐
Specialised courts instead of general courts should deal with ICT patent disputes	☐	☐	☐	☐	☐
Others (optional), please specify below	☐	☐	☐	☐	☐

J2. Other possible solution regarding enforcing and implementing patents (optional), please specify:

Section K: Assessment of RRI dimensions regarding ICT patents

K1. Please assess the relevance of the five dimensions of implementing Responsible Research and Innovation (RRI) regarding ICT patents and their relevance.

	very low	low	medium	high	very high	cannot be assessed
Multi-actor and public engagement in research and innovation:	☐	☐	☐	☐	☐	☐
Enabling easier access to scientific results:	☐	☐	☐	☐	☐	☐

	very low	low	medium	high	very high	cannot be assessed
Gender issues the research and innovation content and process:	☐	☐	☐	☐	☐	☐
Ethics in the research and innovation content and process:	☐	☐	☐	☐	☐	☐
Formal and informal science education:	☐	☐	☐	☐	☐	☐

K2. Please specify the role of ICT patents related to the five dimensions of implement-ing Responsible Research and Innovation (RRI).

Section L: Contact Data

L1. Please provide us with some information (confidentiality is guaranteed), which allow us to send you the summary of the results.

Email address	
Name of organisation	
Country	

Thank you for your co-operation!

Please contact in case of questions:

Prof. Dr. Knut Blind Fraunhofer Institute for Open Communication Systems Tel.: +49 (0)30-314-76638 E-Mail: knut.blind@fokus.fraunhofer.de

ANNEX 4: ADDITIONAL ANALYSIS OF STAKEHOLDER SURVEY

ANALYSIS DIFFERENTIATING BETWEEN CEO AND OTHER POSITIONS

Figure A1 Effectiveness of ICT patents ranging from very low (1) to very high (5) (CEO vs other positions)

1. Preventing imitation of inventions, e.g. for securing the means to obtain a return on the R&D investment
2. Securing own freedom to operate by disclosing prior art (e.g. to prevent legal conflicts)
3. Blocking competitors
4. Using the coordination function in research processes and collaborations incl. open innovation
5. Using as asset in negotiations (incl. cross licensing)
6. Generating licensing revenues
7. Enhancing reputation
8. Measuring performance of research and development
9. Rewarding employees

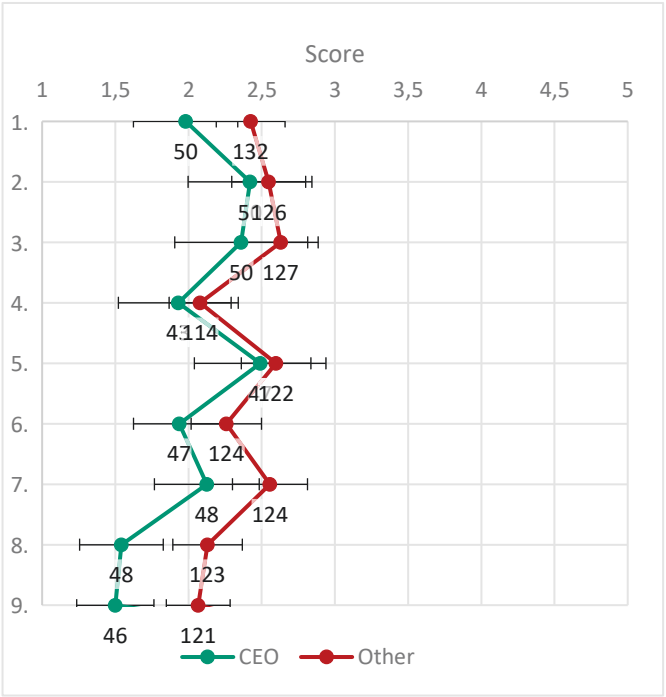


Figure A2 Assessment of the challenges for ICT patents regarding patent application and granting ranging from totally disagree (1) to totally agree (5) (CEO vs other positions)

1. Due to the technological dynamics in the ICT sector, patents are not effective to protect innovation
2. Due to technological convergence and fragmentation in the ICT sector, patents are not effective to protect innovation
3. Patent examination practices do not adequately consider relevant existing prior art
4. The cost for applying for ICT patents is too high
5. The granting process for ICT patents is too slow
6. The language of ICT patents is too complicated to qualify as a good source of information
7. The quality of ICT patents granted is low
8. The statutory patentability standards for ICT patents (e.g. technicality, etc.) differ among patent offices
9. The maximum protection period of 20 years is long for ICT patents
10. The scope of granted ICT patents is too broad
11. Implementations cannot be effectively protected by patents because they include code under an Open Source license that includes patent licenses

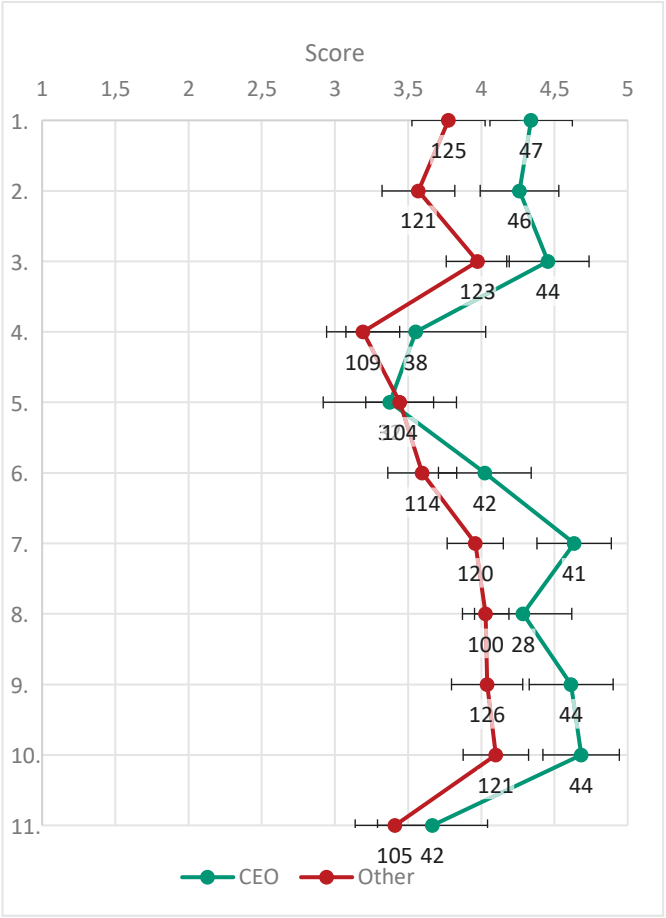


Figure A3 Assessment of the challenges for ICT patents regarding patent enforcement and application ranging from totally disagree (1) to totally agree (5) (CEO vs other positions)

1. The cost/risk to enforce granted ICT patents is high
2. The likelihood of litigation (infringement) of ICT patents is high
3. The likelihood of courts granting an injunction to prevent infringement of ICT patents is high
4. Expected legal cost for resolution of conflicts regarding ICT patents are high
5. The legal uncertainty for companies creating or implementing ICT patents is high
6. Licensors are not willing to license ICT patents covering their technologies (hold-up)
7. Implementers of ICT patents are not willing to licensing in the third-party ICT patents covering their implemented technologies (hold-out)
8. Agreeing on licensing agreements for standard-essential ICT patents (SEPs) is challenging
9. Large patent owners not joining pools of ICT patents challenge the implementation of ICT-related technologies
10. ICT patents owned by Patent Assertion Entities (PAEs) increases legal uncertainty for implementers of ICT related technologies
11. Many technologies protected by ICT patents are not used or commercialised
12. Patents on computer-implemented inventions (CII) or software patents challenges innovation of ICT-related technologies
13. The use of ICT patents protected technology generate problems for the use of Open Source Software
14. The use of Open Source Software generates problems for the use and protection of ICT patents

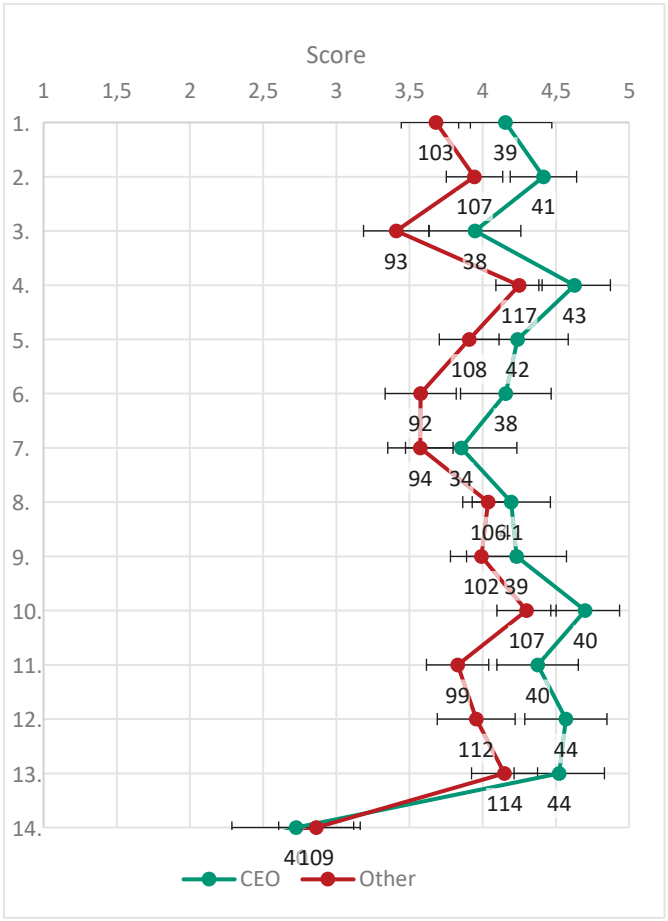


Figure A4 Assessment of solutions for ICT patents promoting innovation regarding patent application and granting ranging from not effective (1) to very effective (4) (CEO vs other positions)

1. The application fees for ICT patents are raised
2. The quality of granted ICT patents is improved by raising the required degree of novelty
3. The quality of granted ICT patents is improved by raising the required inventive step
4. The quality of granted ICT patents is improved by narrowing their scope
5. Crowd-sourced validity checks support the patent validity checks by patent offices
6. Granting an ICT patent requires already the implementation of the invention
7. Raising and specifying (e.g. related to technicality) the bar for patents on computer-implemented inventions
8. Software is excluded from patenting both for the program listing and the technical content underlying the software
9. Patents for "Software as such" are granted, i.e. the program listing is patentable
10. ICT patents are granted within five years
11. The renewal fees for granted ICT patents are increased during all the protection period
12. The protection period for ICT patents is shortened to 10 years

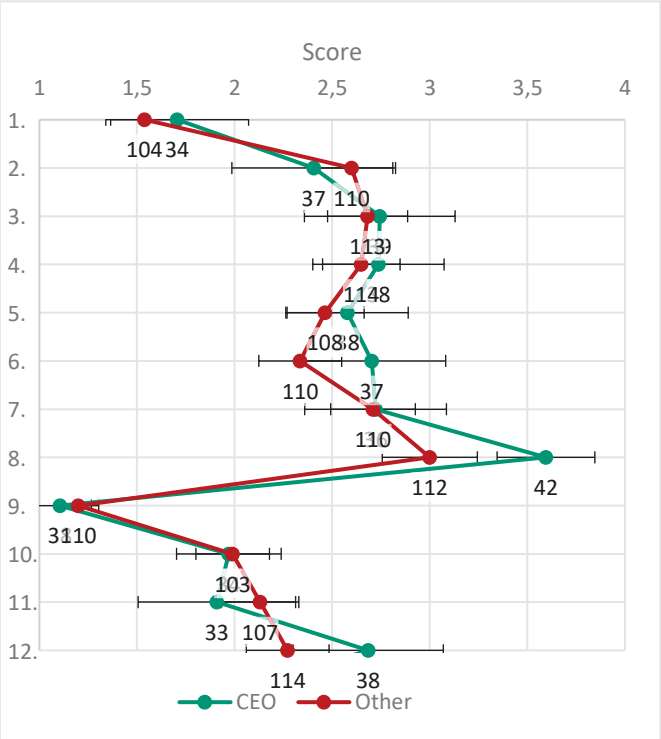


Figure A5 Assessment of solutions for ICT patents promoting innovation regarding enforcing and implementing patents ranging from not effective (1) to very effective (4) (CEO vs other positions)

1. A declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.) is required to receive the maximum of 20 years of protection for ICT patents
2. A set of well-known and trustable patent pledges, i.e. voluntary commitments by patent holders to give up some of the rights associated to the patent (e.g. grant permission for commercial use without any direct compensation, no injunctions, FRAND, etc.), is defined
3. Technology exchange clearing houses are publicly supported to support bilateral licensing negotiations
4. Regulations to restrict the activities for Patent Assertion Entities (PAEs) are established
5. Publication of information incl. product specifications and licensing fees for Standard-Essential ICT patents should be encouraged
6. Public policies support the formation and development of ICT patent pools, especially of SEPs, incl. providing incentives for organisations to join
7. Public policies support the formation and development of bilateral or joint licensing programs, incl. providing incentives for organisations to develop these
8. Compatible licensing solutions for Open Source Software and ICT patents are developed
9. Only Royalty-Free ICT patents shall be integrated into Open Source Software
10. Licensing terms of bilateral licensing agreements should be published
11. Defensive ICT patent aggregators are publicly supported
12. Insurances against ICT patent litigations are publicly supported (incl. provided by state insurance)
13. Trade secret regulations reduce the incentive to file ICT patents
14. Mediation and arbitration processes to reach a mutually satisfactory settlement of ICT patent disputes outside of court are further publicly supported
15. Court fees for ICT patent disputes are increased
16. Legal costs for ICT patent disputes in courts are covered by the losing party
17. Financial situation in an ICT patent dispute of the winning party before the court case is reasonably restored
18. Caps on ICT patent court case costs that are recoverable by the winning party are introduced
19. A plaintiff can only challenge one ICT patent of one defendant in any given court case
20. Infringement and validity issues regarding ICT patents are tried together before the same court
21. Specialised courts instead of general courts should deal with ICT patent disputes

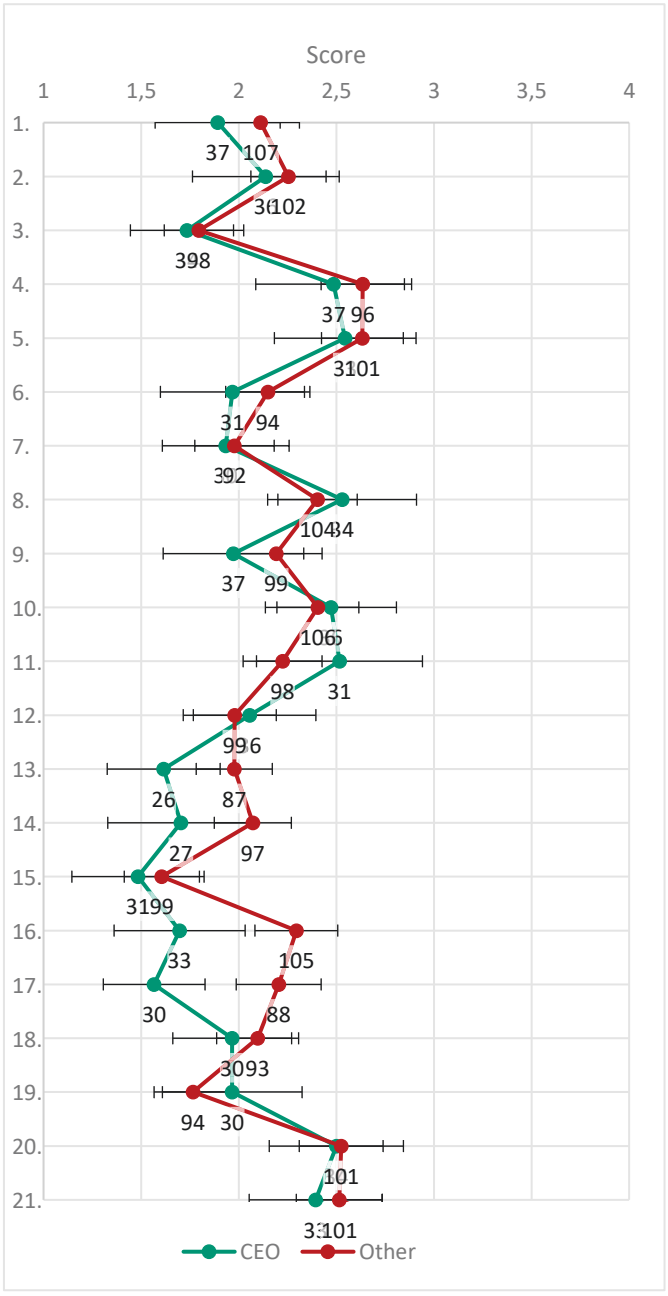
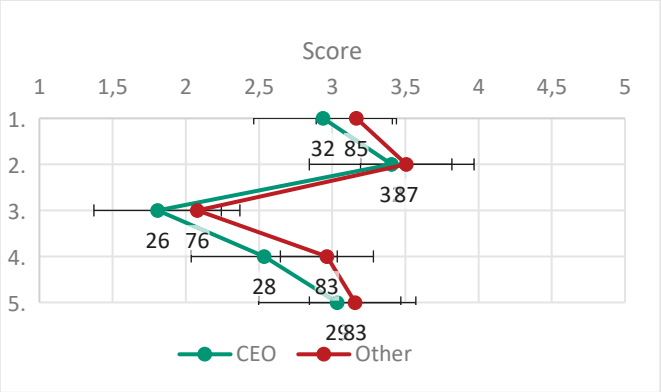


Figure A6 Assessment of RRI dimensions regarding ICT patents from very low (1) to very high (5) (CEO vs other positions)

1. Multi-actor and public engagement in research and innovation
2. Enabling easier access to scientific results
3. Gender issues in the research and innovation content and process
4. Ethics in the research and innovation content and process:
5. Formal and informal science education



ANALYSIS DIFFERENTIATING BETWEEN SMALL AND LARGE COMPANIES

Figure A7 Effectiveness of ICT patents ranging from very low (1) to very high (5) (large companies vs SMEs)

1. Preventing imitation of inventions, e.g. for securing the means to obtain a return on the R&D investment
2. Securing own freedom to operate by disclosing prior art (e.g. to prevent legal conflicts)
3. Blocking competitors
4. Using the coordination function in research processes and collaborations incl. open innovation
5. Using as asset in negotiations (incl. cross licensing)
6. Generating licensing revenues
7. Enhancing reputation
8. Measuring performance of research and development
9. Rewarding employees

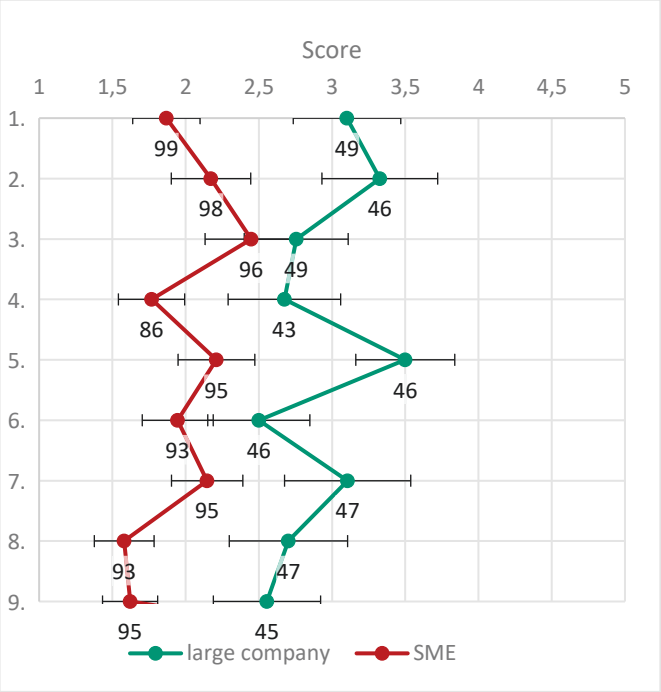


Figure A8 Assessment of the challenges for ICT patents regarding patent application and granting ranging from totally disagree (1) to totally agree (5) (large company vs SME)

1. Due to the technological dynamics in the ICT sector, patents are not effective to protect innovation
2. Due to technological convergence and fragmentation in the ICT sector, patents are not effective to protect innovation
3. Patent examination practices do not adequately consider relevant existing prior art
4. The cost for applying for ICT patents is too high
5. The granting process for ICT patents is too slow
6. The language of ICT patents is too complicated to qualify as a good source of information
7. The quality of ICT patents granted is low
8. The statutory patentability standards for ICT patents (e.g. technicality, etc.) differ among patent offices
9. The maximum protection period of 20 years is long for ICT patents
10. The scope of granted ICT patents is too broad
11. Implementations cannot be effectively protected by patents because they include code under an Open Source license that includes patent licenses

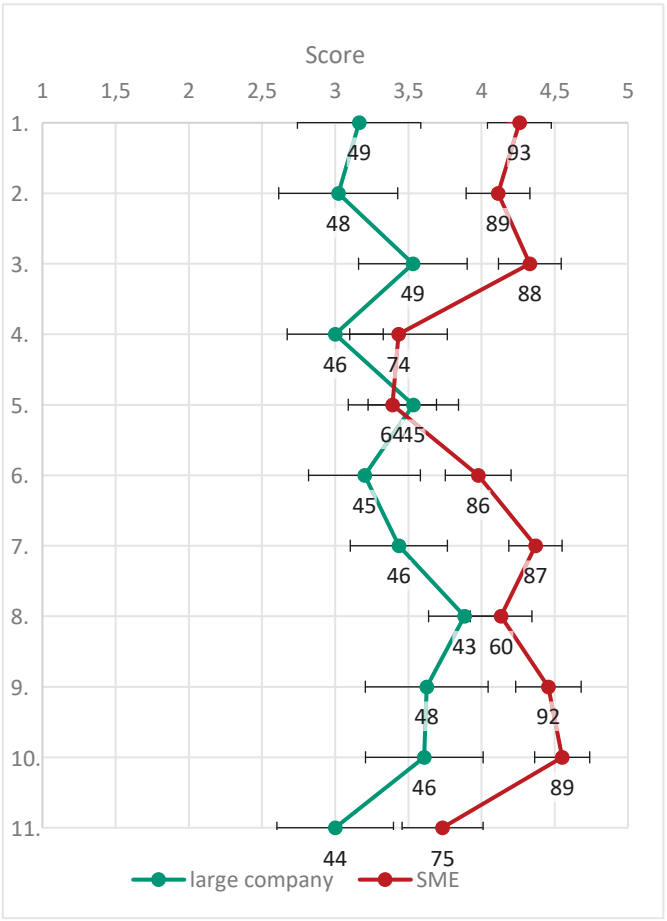


Figure A9 Assessment of the challenges for ICT patents regarding patent enforcement and application ranging from totally disagree (1) to totally agree (5) (large company vs SME)

1. The cost/risk to enforce granted ICT patents is high
2. The likelihood of litigation (infringement) of ICT patents is high
3. The likelihood of courts granting an injunction to prevent infringement of ICT patents is high
4. Expected legal cost for resolution of conflicts regarding ICT patents are high
5. The legal uncertainty for companies creating or implementing ICT patents is high
6. Licensors are not willing to license ICT patents covering their technologies (hold-up)
7. Implementers of ICT patents are not willing to licensing in the third-party ICT patents covering their implemented technologies (hold-out)
8. Agreeing on licensing agreements for standard-essential ICT patents (SEPs) is challenging
9. Large patent owners not joining pools of ICT patents challenge the implementation of ICT-related technologies
10. ICT patents owned by Patent Assertion Entities (PAEs) increases legal uncertainty for implementers of ICT related technologies
11. Many technologies protected by ICT patents are not used or commercialised
12. Patents on computer-implemented inventions (CII) or software patents challenges innovation of ICT-related technologies
13. The use of ICT patents protected technology generate problems for the use of Open Source Software
14. The use of Open Source Software generates problems for the use and protection of ICT patents

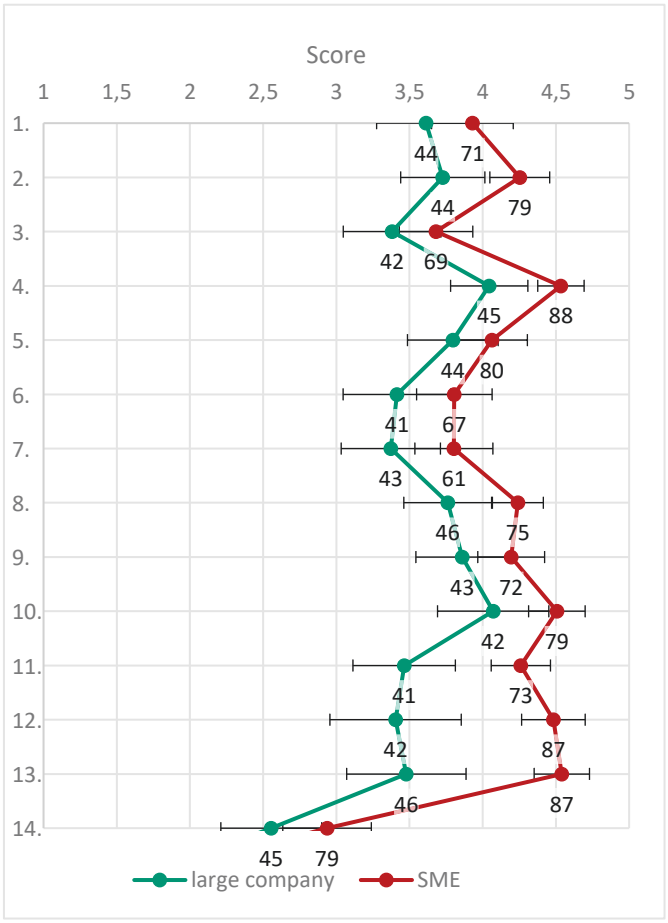


Figure A10 Assessment of solutions for ICT patents promoting innovation regarding patent application and granting ranging from not effective (1) to very effective (4) (large company vs SME)

1. The application fees for ICT patents are raised
2. The quality of granted ICT patents is improved by raising the required degree of novelty
3. The quality of granted ICT patents is improved by raising the required inventive step
4. The quality of granted ICT patents is improved by narrowing their scope
5. Crowd-sourced validity checks support the patent validity checks by patent offices
6. Granting an ICT patent requires already the implementation of the invention
7. Raising and specifying (e.g. related to technicality) the bar for patents on computer-implemented inventions
8. Software is excluded from patenting both for the program listing and the technical content underlying the software
9. Patents for "Software as such" are granted, i.e. the program listing is patentable
10. ICT patents are granted within five years
11. The renewal fees for granted ICT patents are increased during all the protection period
12. The protection period for ICT patents is shortened to 10 years

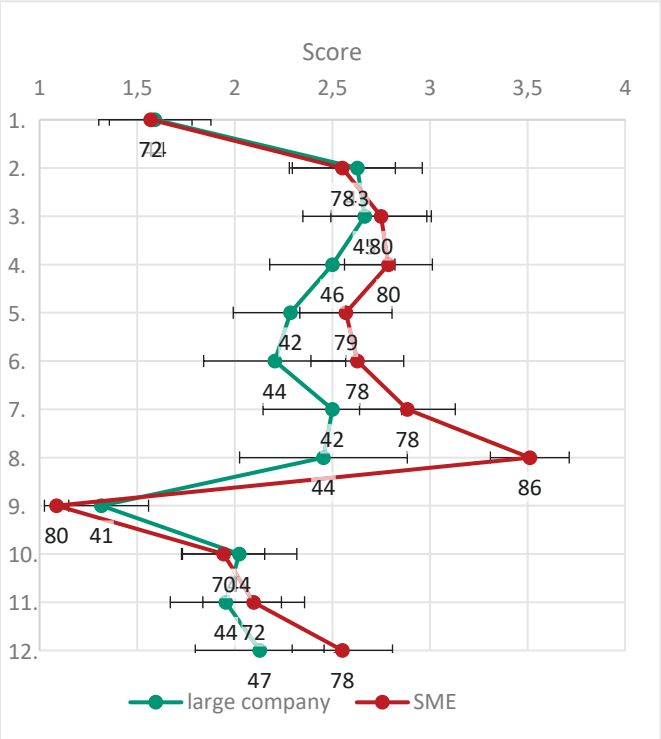


Figure A11 Assessment of solutions for ICT patents promoting innovation regarding enforcing and implementing patents ranging from not effective (1) to very effective (4) (large company vs SME)

1. A declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.) is required to receive the maximum of 20 years of protection for ICT patents
2. A set of well-known and trustable patent pledges, i.e. voluntary commitments by patent holders to give up some of the rights associated to the patent (e.g. grant permission for commercial use without any direct compensation, no injunctions, FRAND, etc.), is defined
3. Technology exchange clearing houses are publicly supported to support bilateral licensing negotiations
4. Regulations to restrict the activities for Patent Assertion Entities (PAEs) are established
5. Publication of information incl. product specifications and licensing fees for Standard-Essential ICT patents should be encouraged
6. Public policies support the formation and development of ICT patent pools, especially of SEPs, incl. providing incentives for organisations to join
7. Public policies support the formation and development of bilateral or joint licensing programs, incl. providing incentives for organisations to develop these
8. Compatible licensing solutions for Open Source Software and ICT patents are developed
9. Only Royalty-Free ICT patents shall be integrated into Open Source Software
10. Licensing terms of bilateral licensing agreements should be published
11. Defensive ICT patent aggregators are publicly supported
12. Insurances against ICT patent litigations are publicly supported (incl. provided by state insurance)
13. Trade secret regulations reduce the incentive to file ICT patents
14. Mediation and arbitration processes to reach a mutually satisfactory settlement of ICT patent disputes outside of court are further publicly supported
15. Court fees for ICT patent disputes are increased
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18. Caps on ICT patent court case costs that are recoverable by the winning party are introduced
19. A plaintiff can only challenge one ICT patent of one defendant in any given court case
20. Infringement and validity issues regarding ICT patents are tried together before the same court
21. Specialised courts instead of general courts should deal with ICT patent disputes

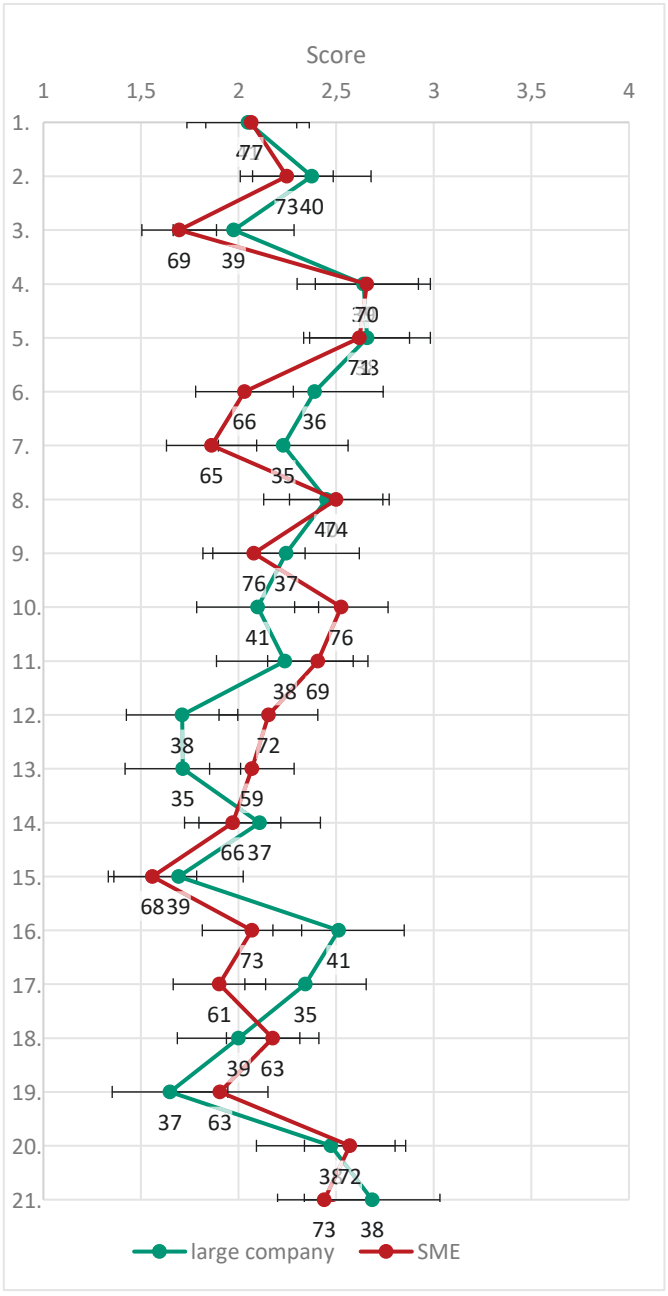
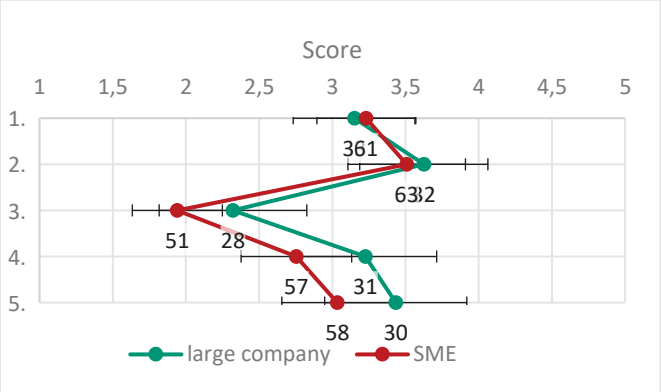


Figure A12 Assessment of RRI dimensions regarding ICT patents from very low (1) to very high (5) (large company vs SME)

1. Multi-actor and public engagement in research and innovation
2. Enabling easier access to scientific results
3. Gender issues in the research and innovation content and process
4. Ethics in the research and innovation content and process:
5. Formal and informal science education



ANALYSIS DIFFERENTIATING BETWEEN BUSINESS MODELS

Figure A13 Effectiveness of ICT patents ranging from very low (1) to very high (5) (different business models)

1. Preventing imitation of inventions, e.g. for securing the means to obtain a return on the R&D investment; **2**. Securing own freedom to operate by disclosing prior art (e.g. to prevent legal conflicts); **3**. Blocking competitors; **4**. Using the coordination function in research processes and collaborations incl. open innovation; **5**. Using as asset in negotiations (incl. cross licensing); **6**. Generating licensing revenues **7**. Enhancing reputation; **8**. Measuring performance of research and development; **9**. Rewarding employees

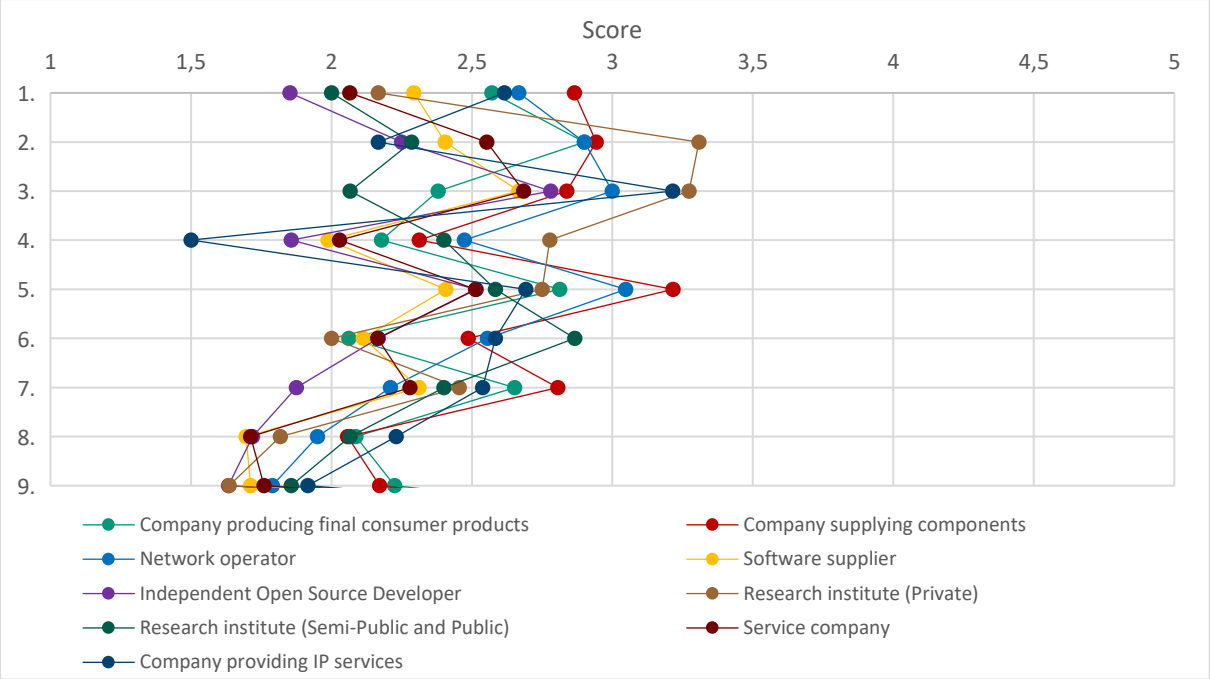


Figure A14 Assessment of the challenges for ICT patents regarding patent application and granting ranging from totally disagree (1) to totally agree (5) (different business models)

1. Due to the technological dynamics in the ICT sector, patents are not effective to protect innovation; **2**. Due to technological convergence and fragmentation in the ICT sector, patents are not effective to protect innovation; **3**. Patent examination practices do not adequately consider relevant existing prior art; **4**. The cost for applying for ICT patents is too high; **5**. The granting process for ICT patents is too slow; **6**. The language of ICT patents is too complicated to qualify as a good source of information; **7**. The quality of ICT patents granted is low; **8**. The statutory patentability standards for ICT patents (e.g. technicality, etc.) differ among patent offices; **9**. The maximum protection period of 20 years is long for ICT patents; **10**. The scope of granted ICT patents is too broad; **11**. Implementations cannot be effectively protected by patents because they include code under an Open Source license that includes patent licenses

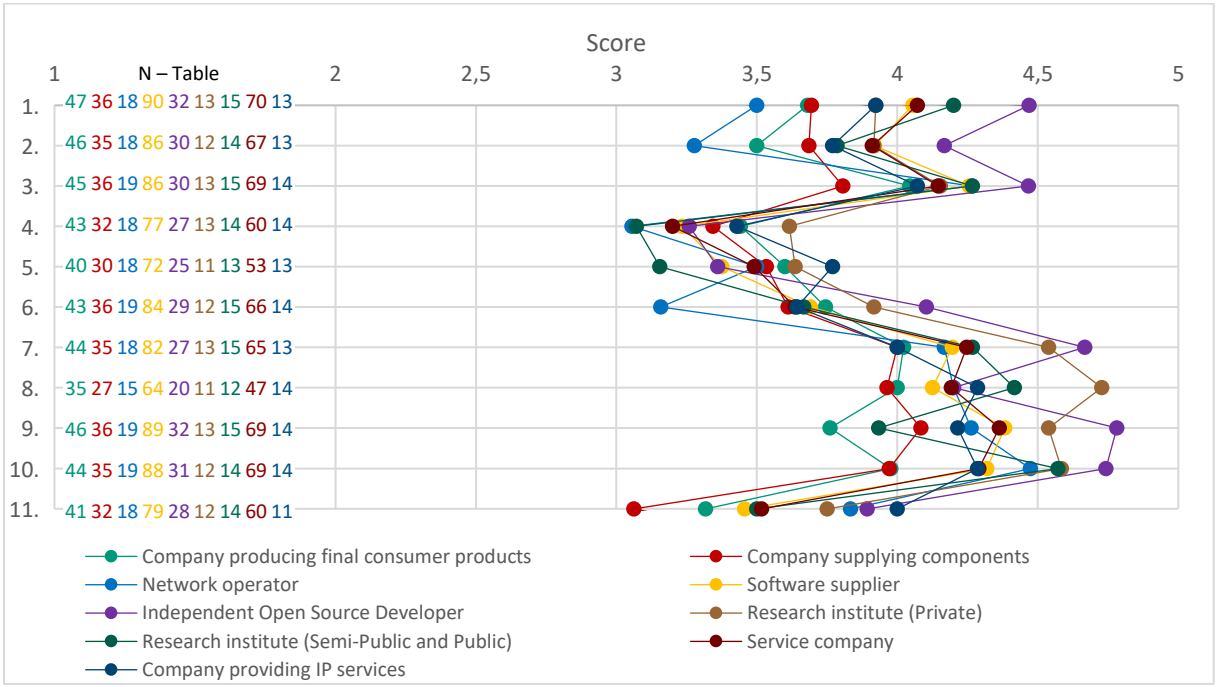


Figure A15 Assessment of the challenges for ICT patents regarding patent enforcement and application ranging from totally disagree (1) to totally agree (5) (different business models)

1. The cost/risk to enforce granted ICT patents is high; **2**. The likelihood of litigation (infringement) of ICT patents is high; **3**. The likelihood of courts granting an injunction to prevent infringement of ICT patents is high; **4**. Expected legal cost for resolution of conflicts regarding ICT patents are high; **5**. The legal uncertainty for companies creating or implementing ICT patents is high; **6**. Licensors are not willing to license ICT patents covering their technologies (hold-up); **7**. Implementers of ICT patents are not willing to licensing in the third-party ICT patents covering their implemented technologies (hold-out); **8**. Agreeing on licensing agreements for standard-essential ICT patents (SEPs) is challenging; **9**. Large patent owners not joining pools of ICT patents challenge the implementation of ICT-related technologies; **10**. ICT patents owned by Patent Assertion Entities (PAEs) increases legal uncertainty for implementers of ICT related technologies; **11**. Many technologies protected by ICT patents are not used or commercialised; **12**. Patents on computer-implemented inventions (CII) or software patents challenges innovation of ICT-related technologies; **13**. The use of ICT patents protected technology generate problems for the use of Open Source Software; **14**. The use of Open Source Software generates problems for the use and protection of ICT patents

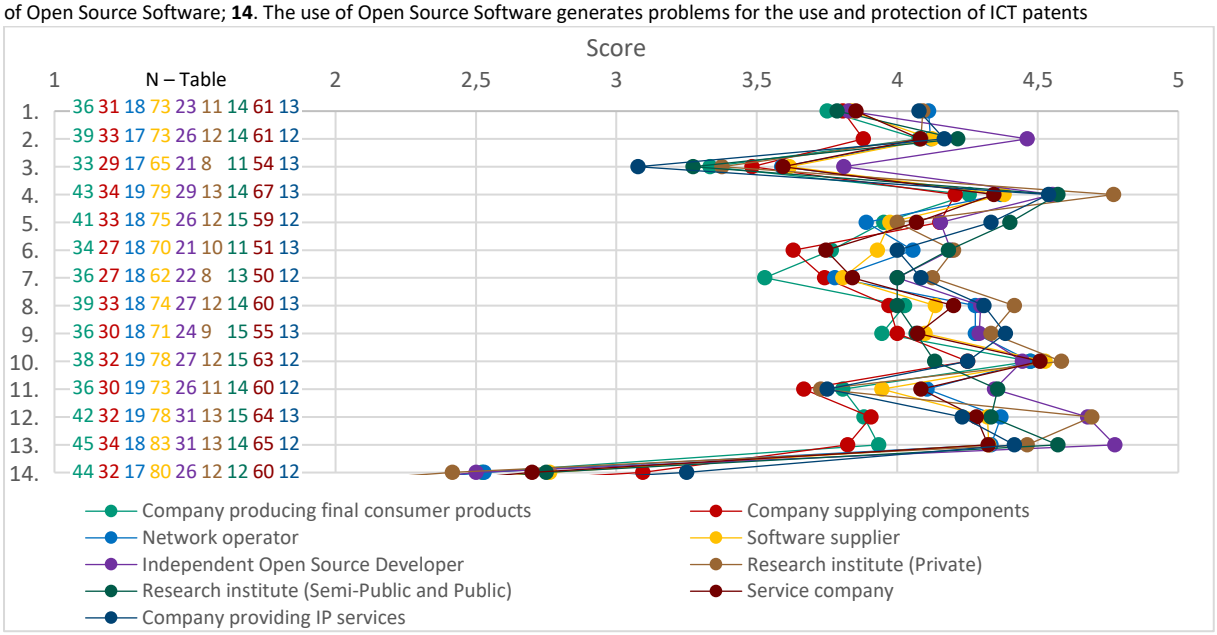


Figure A16 Assessment of solutions for ICT patents promoting innovation regarding patent application and granting ranging from not effective (1) to very effective (4) (different business models)

1. The application fees for ICT patents are raised; **2**. The quality of granted ICT patents is improved by raising the required degree of novelty; **3**. The quality of granted ICT patents is improved by raising the required inventive step; **4**. The quality of granted ICT patents is improved by narrowing their scope; **5**. Crowd-sourced validity checks support the patent validity checks by patent offices; **6**. Granting an ICT patent requires already the implementation of the invention; **7**. Raising and specifying (e.g. related to technicality) the bar for patents on computer-implemented inventions; **8**. Software is excluded from patenting both for the program listing and the technical content underlying the software; **9**. Patents for "Software as such" are granted, i.e. the program listing is patentable; **10**. ICT patents are granted within five years; **11**. The renewal fees for granted ICT patents are increased during all the protection period; **12**. The protection period for ICT patents is shortened to 10 years

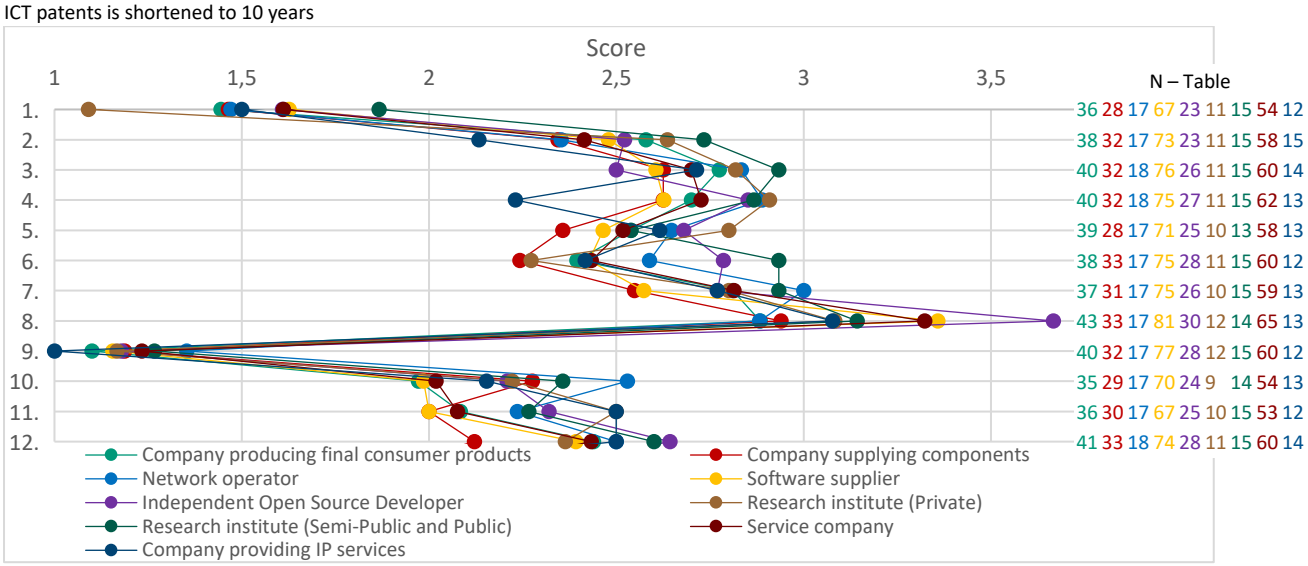


Figure A17 Assessment of solutions for ICT patents promoting innovation regarding enforcing and implementing patents ranging from not effective (1) to very effective (4) (different business models)

1. A declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.) is required to receive the maximum of 20 years of protection for ICT patents; **2**. A set of well-known and trustable patent pledges, i.e. voluntary commitments by patent holders to give up some of the rights associated to the patent (e.g. grant permission for commercial use without any direct compensation, no injunctions, FRAND, etc.), is defined; **3**. Technology exchange clearing houses are publicly supported to support bilateral licensing negotiations; **4**. Regulations to restrict the activities for Patent Assertion Entities (PAEs) are established; **5**. Publication of information incl. product specifications and licensing fees for Standard-Essential ICT patents should be encouraged; **6**. Public policies support the formation and development of ICT patent pools, especially of SEPs, incl. providing incentives for organisations to join; **7**. Public policies support the formation and development of bilateral or joint licensing programs, incl. providing incentives for organisations to develop these; **8**. Compatible licensing solutions for Open Source Software and ICT patents are developed; **9**. Only Royalty-Free ICT patents shall be integrated into Open Source Software; **10**. Licensing terms of bilateral licensing agreements should be published; **11**. Defensive ICT patent aggregators are publicly supported; **12**. Insurances against ICT patent litigations are publicly supported (incl. provided by state insurance); **13**. Trade secret regulations reduce the incentive to file ICT patents; **14**. Mediation and arbitration processes to reach a mutually satisfactory settlement of ICT patent disputes outside of court are further publicly supported; **15**. Court fees for ICT patent disputes are increased; **16**. Legal costs for ICT patent disputes in courts are covered by the losing party; **17**. Financial situation in an ICT patent dispute of the winning party before the court case is reasonably restored; **18**. Caps on ICT patent court case costs that are recoverable by the winning party are introduced; **19**. A plaintiff can only challenge one ICT patent of one defendant in any given court case; **20**. Infringement and validity issues regarding ICT patents are tried together before the same court; **21**. Specialised courts instead of general courts should deal with ICT patent disputes

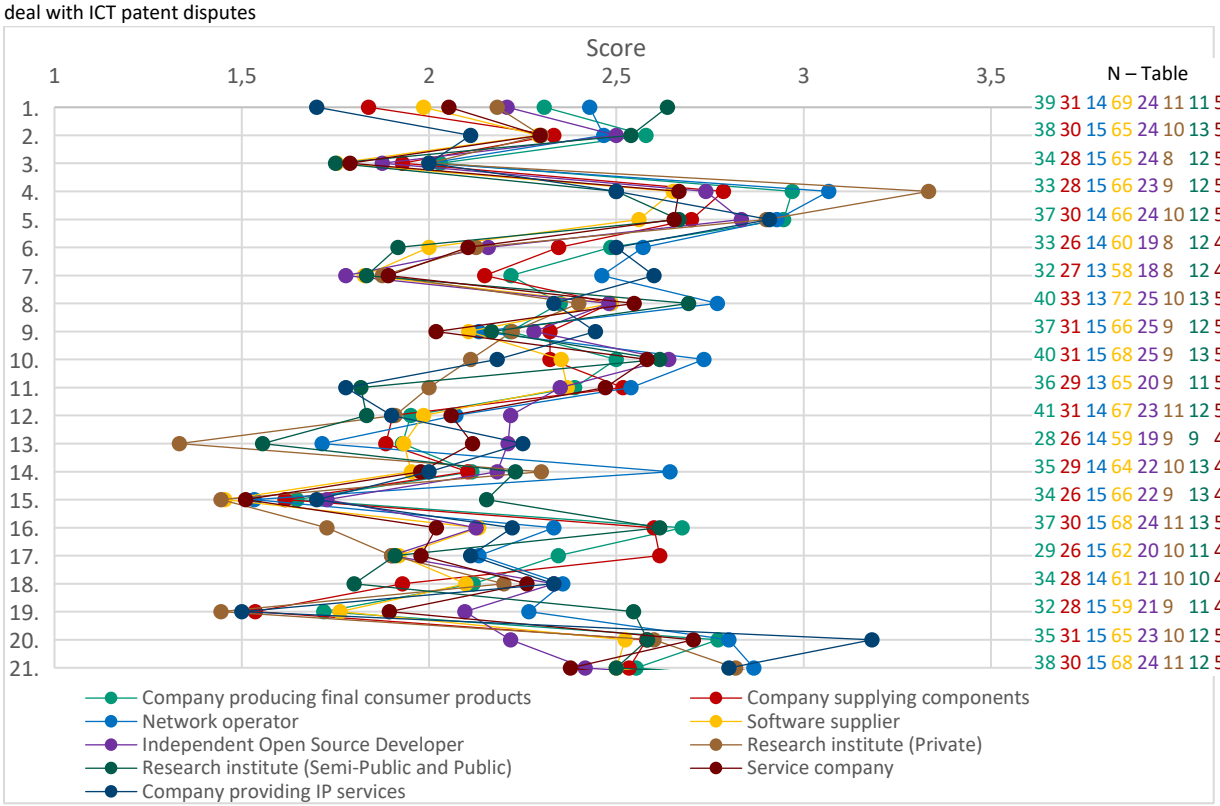
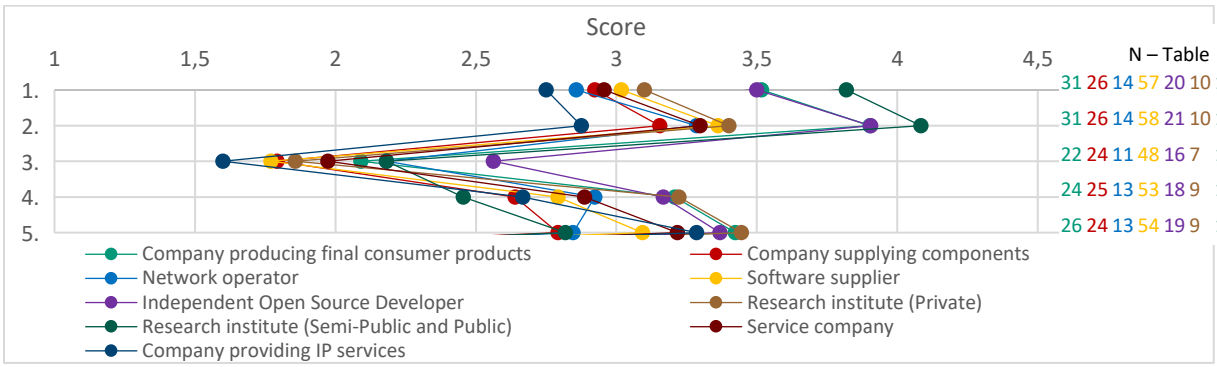


Figure A18 Assessment of RRI dimensions regarding ICT patents from very low (1) to very high (5) (different business models)

1. Multi-actor and public engagement in research and innovation; **2**. Enabling easier access to scientific results; **3**. Gender issues in the research and innovation content and process; **4**. Ethics in the research and innovation content and process; **5**. Formal and informal science education



ANALYSIS DIFFERENTIATING BETWEEN GERMANY AND OTHER COUNTRIES

Figure A19 Effectiveness of ICT patents ranging from very low (1) to very high (5) (Germany vs other Countries (other))

1. Preventing imitation of inventions, e.g. for securing the means to obtain a return on the R&D investment
2. Securing own freedom to operate by disclosing prior art (e.g. to prevent legal conflicts)
3. Blocking competitors
4. Using the coordination function in research processes and collaborations incl. open innovation
5. Using as asset in negotiations (incl. cross licensing)
6. Generating licensing revenues
7. Enhancing reputation
8. Measuring performance of research and development
9. Rewarding employees

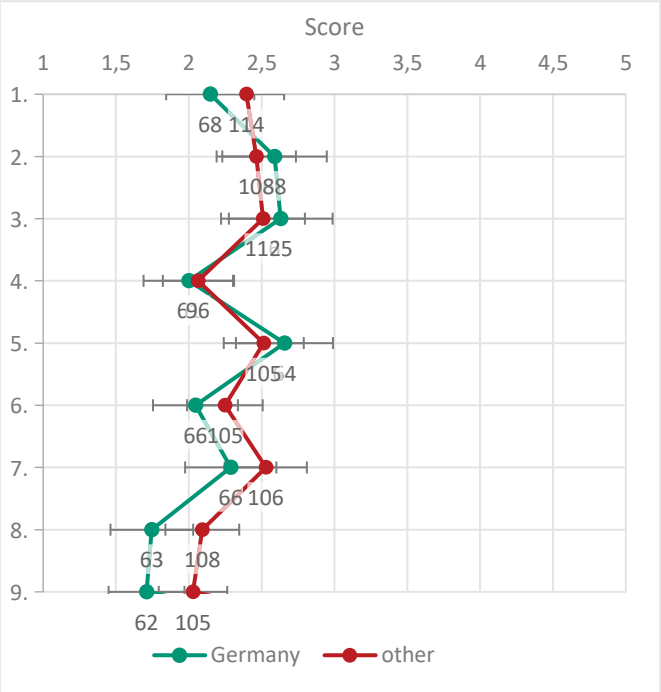


Figure A20 Assessment of the challenges for ICT patents regarding patent application and granting ranging from totally disagree (1) to totally agree (5) (Germany vs other Countries (other))

1. Due to the technological dynamics in the ICT sector, patents are not effective to protect innovation
2. Due to technological convergence and fragmentation in the ICT sector, patents are not effective to protect innovation
3. Patent examination practices do not adequately consider relevant existing prior art
4. The cost for applying for ICT patents is too high
5. The granting process for ICT patents is too slow
6. The language of ICT patents is too complicated to qualify as a good source of information
7. The quality of ICT patents granted is low
8. The statutory patentability standards for ICT patents (e.g. technicality, etc.) differ among patent offices
9. The maximum protection period of 20 years is long for ICT patents
10. The scope of granted ICT patents is too broad
11. Implementations cannot be effectively protected by patents because they include code under an Open Source license that includes patent licenses

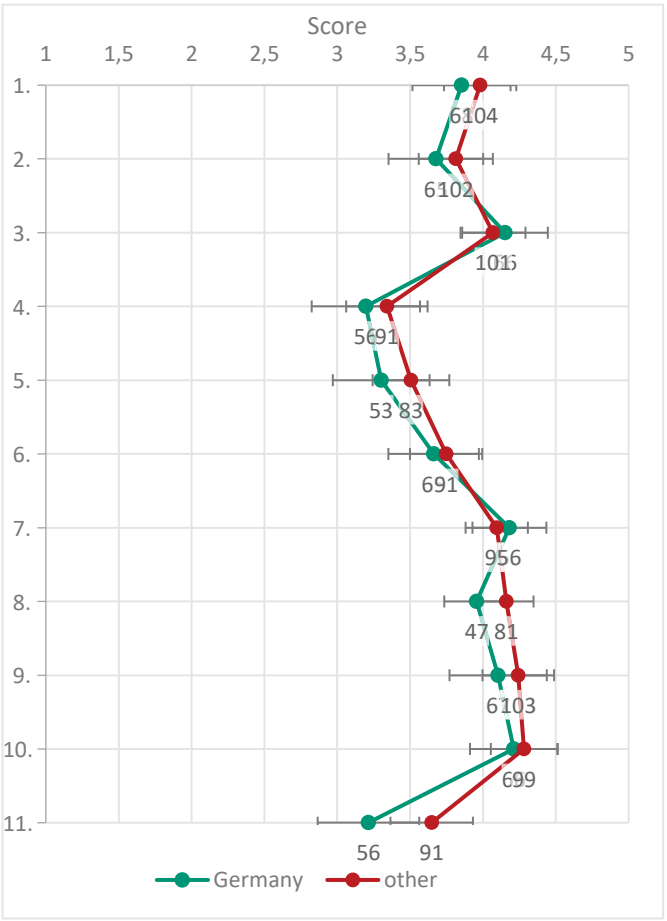


Figure A21 Assessment of the challenges for ICT patents regarding patent enforcement and application ranging from totally disagree (1) to totally agree (5) (Germany vs other Countries (other))

1. The cost/risk to enforce granted ICT patents is high
2. The likelihood of litigation (infringement) of ICT patents is high
3. The likelihood of courts granting an injunction to prevent infringement of ICT patents is high
4. Expected legal cost for resolution of conflicts regarding ICT patents are high
5. The legal uncertainty for companies creating or implementing ICT patents is high
6. Licensors are not willing to license ICT patents covering their technologies (hold-up)
7. Implementers of ICT patents are not willing to licensing in the third-party ICT patents covering their implemented technologies (hold-out)
8. Agreeing on licensing agreements for standard-essential ICT patents (SEPs) is challenging
9. Large patent owners not joining pools of ICT patents challenge the implementation of ICT-related technologies
10. ICT patents owned by Patent Assertion Entities (PAEs) increases legal uncertainty for implementers of ICT related technologies
11. Many technologies protected by ICT patents are not used or commercialised
12. Patents on computer-implemented inventions (CII) or software patents challenges innovation of ICT-related technologies
13. The use of ICT patents protected technology generate problems for the use of Open Source Software
14. The use of Open Source Software generates problems for the use and protection of ICT patents

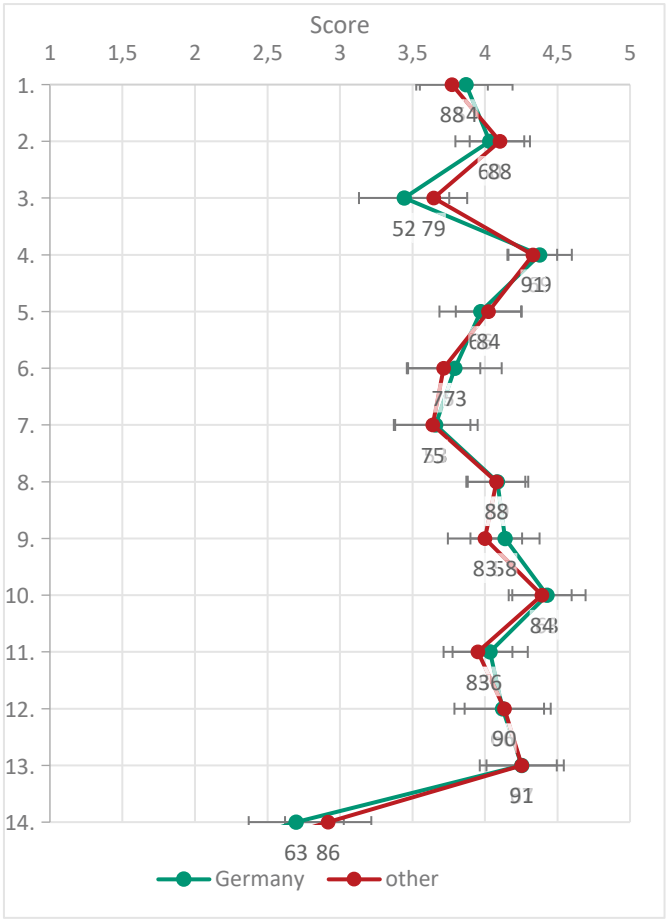


Figure A22 Assessment of solutions for ICT patents promoting innovation regarding patent application and granting ranging from not effective (1) to very effective (4) (Germany vs other Countries (other))

1. The application fees for ICT patents are raised
2. The quality of granted ICT patents is improved by raising the required degree of novelty
3. The quality of granted ICT patents is improved by raising the required inventive step
4. The quality of granted ICT patents is improved by narrowing their scope
5. Crowd-sourced validity checks support the patent validity checks by patent offices
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8. Software is excluded from patenting both for the program listing and the technical content underlying the software
9. Patents for "Software as such" are granted, i.e. the program listing is patentable
10. ICT patents are granted within five years
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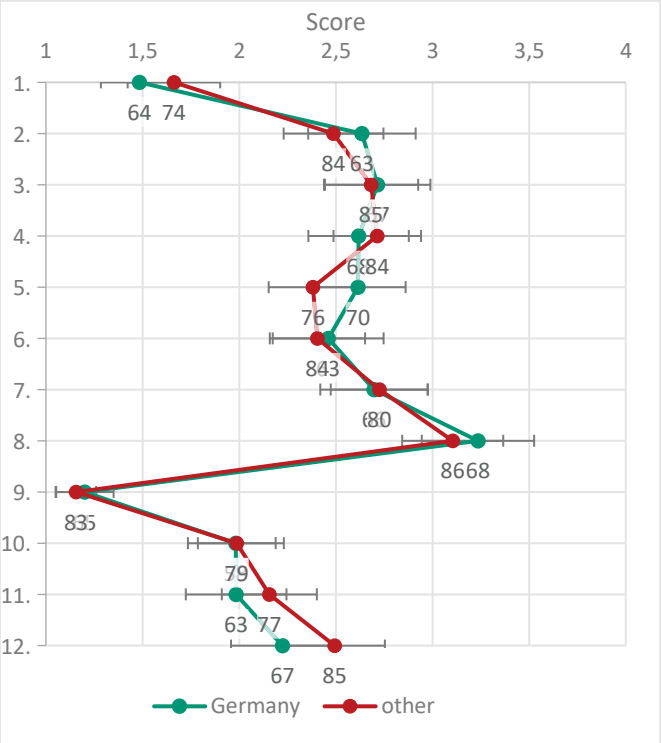

Figure A23 Assessment of solutions for ICT patents promoting innovation regarding enforcing and implementing patents ranging from not effective (1) to very effective (4) (Germany vs other Countries (other))

1. A declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.) is required to receive the maximum of 20 years of protection for ICT patents
2. A set of well-known and trustable patent pledges, i.e. voluntary commitments by patent holders to give up some of the rights associated to the patent (e.g. grant permission for commercial use without any direct compensation, no injunctions, FRAND, etc.), is defined
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7. Public policies support the formation and development of bilateral or joint licensing programs, incl. providing incentives for organisations to develop these
8. Compatible licensing solutions for Open Source Software and ICT patents are developed
9. Only Royalty-Free ICT patents shall be integrated into Open Source Software
10. Licensing terms of bilateral licensing agreements should be published
11. Defensive ICT patent aggregators are publicly supported
12. Insurances against ICT patent litigations are publicly supported (incl. provided by state insurance)
13. Trade secret regulations reduce the incentive to file ICT patents
14. Mediation and arbitration processes to reach a mutually satisfactory settlement of ICT patent disputes outside of court are further publicly supported
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20. Infringement and validity issues regarding ICT patents are tried together before the same court
21. Specialised courts instead of general courts should deal with ICT patent disputes

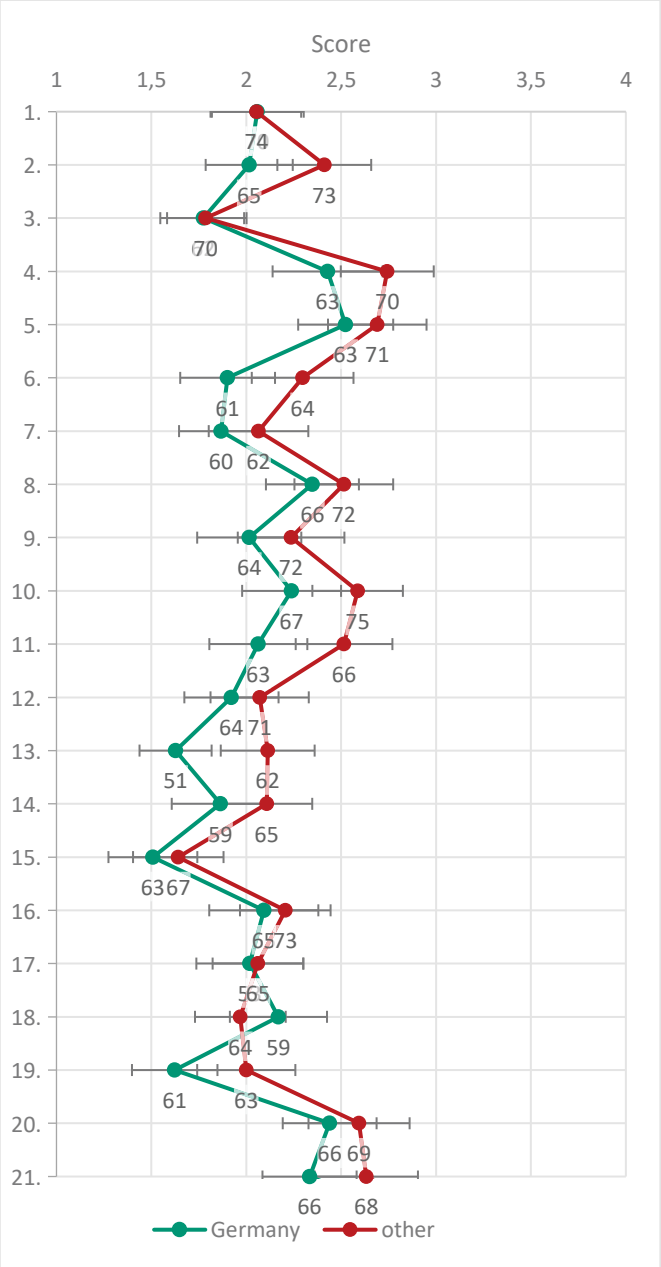
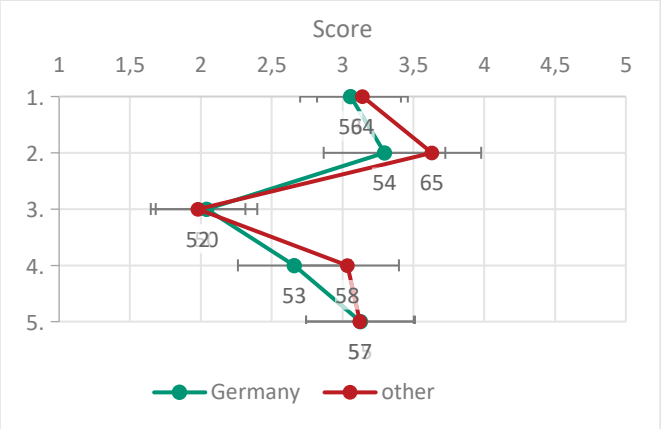


Figure A24 Assessment of RRI dimensions regarding ICT patents from very low (1) to very high (5) (Germany vs other Countries (other))

1. Multi-actor and public engagement in research and innovation
2. Enabling easier access to scientific results
3. Gender issues in the research and innovation content and process
4. Ethics in the research and innovation content and process:
5. Formal and informal science education



ANALYSIS DIFFERENTIATING BETWEEN GERMANY AND OTHER COUNTRIES AND BETWEEN PATENT OWNERS AND NON-PATENT OWNERS

Figure A25 Effectiveness of ICT patents ranging from very low (1) to very high (5) (patent owners Germany (Ger - Patent) vs non-patent owners Germany (Ger - No patent) vs patent owners other Countries (Oth – Patent) vs non-patent owners other Countries (Oth – No patent))

1. Preventing imitation of inventions, e.g. for securing the means to obtain a return on the R&D investment
2. Securing own freedom to operate by disclosing prior art (e.g. to prevent legal conflicts)
3. Blocking competitors
4. Using the coordination function in research processes and collaborations incl. open innovation
5. Using as asset in negotiations (incl. cross licensing)
6. Generating licensing revenues
7. Enhancing reputation
8. Measuring performance of research and development
9. Rewarding employees

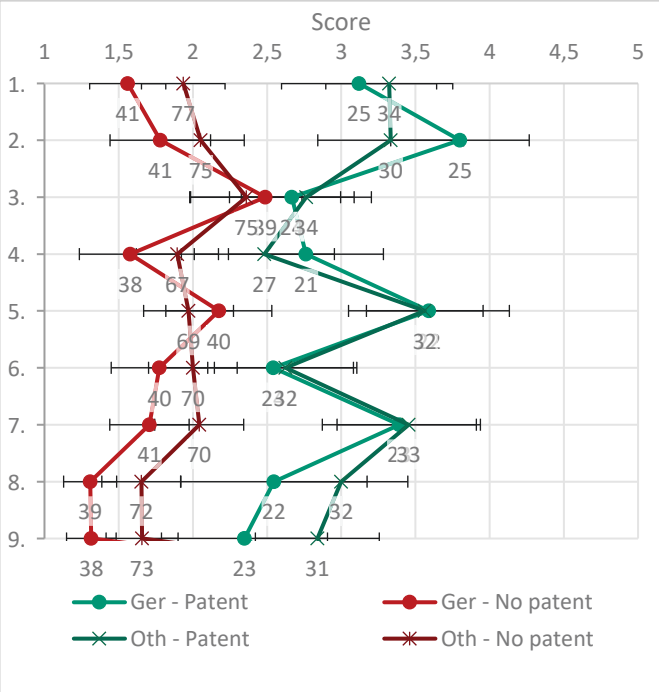


Figure A26 Assessment of the challenges for ICT patents regarding patent application and granting ranging from totally disagree (1) to totally agree (5) (patent owners Germany (Ger - Patent) vs non-patent owners Germany (Ger - No patent) vs patent owners other Countries (Oth – Patent) vs non-patent owners other Countries (Oth – No patent))

1. Due to the technological dynamics in the ICT sector, patents are not effective to protect innovation
2. Due to technological convergence and fragmentation in the ICT sector, patents are not effective to protect innovation
3. Patent examination practices do not adequately consider relevant existing prior art
4. The cost for applying for ICT patents is too high
5. The granting process for ICT patents is too slow
6. The language of ICT patents is too complicated to qualify as a good source of information
7. The quality of ICT patents granted is low
8. The statutory patentability standards for ICT patents (e.g. technicality, etc.) differ among patent offices
9. The maximum protection period of 20 years is long for ICT patents
10. The scope of granted ICT patents is too broad
11. Implementations cannot be effectively protected by patents because they include code under an Open Source license that includes patent licenses

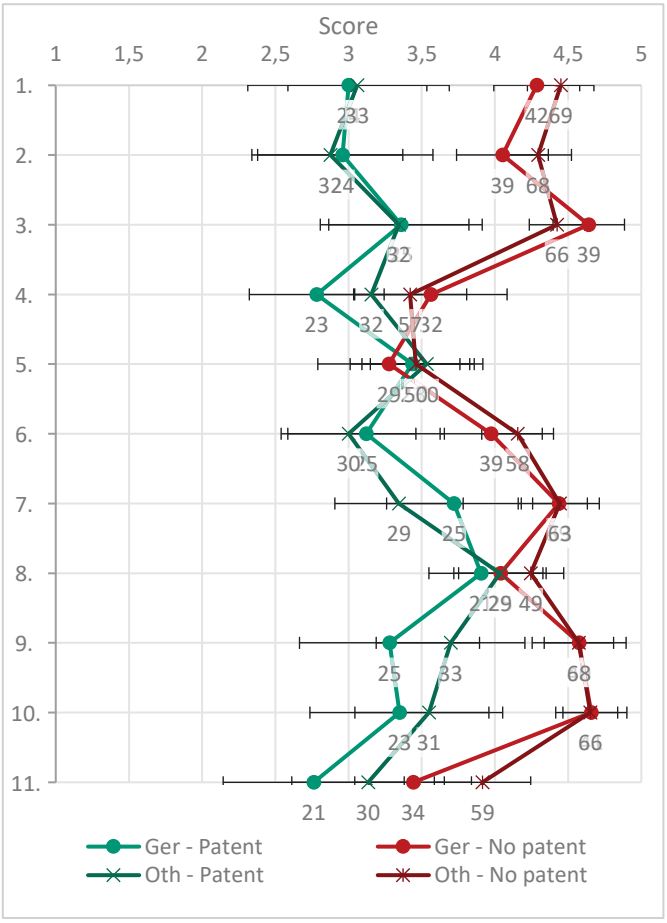


Figure A27 Assessment of the challenges for ICT patents regarding patent enforcement and application ranging from totally disagree (1) to totally agree (5) (patent owners Germany (Ger - Patent) vs non-patent owners Germany (Ger - No patent) vs patent owners other Countries (Oth – Patent) vs non-patent owners other Countries (Oth – No patent))

1. The cost/risk to enforce granted ICT patents is high
2. The likelihood of litigation (infringement) of ICT patents is high
3. The likelihood of courts granting an injunction to prevent infringement of ICT patents is high
4. Expected legal cost for resolution of conflicts regarding ICT patents are high
5. The legal uncertainty for companies creating or implementing ICT patents is high
6. Licensors are not willing to license ICT patents covering their technologies (hold-up)
7. Implementers of ICT patents are not willing to licensing in the third-party ICT patents covering their implemented technologies (hold-out)
8. Agreeing on licensing agreements for standard-essential ICT patents (SEPs) is challenging
9. Large patent owners not joining pools of ICT patents challenge the implementation of ICT-related technologies
10. ICT patents owned by Patent Assertion Entities (PAEs) increases legal uncertainty for implementers of ICT related technologies
11. Many technologies protected by ICT patents are not used or commercialised
12. Patents on computer-implemented inventions (CII) or software patents challenges innovation of ICT-related technologies
13. The use of ICT patents protected technology generate problems for the use of Open Source Software
14. The use of Open Source Software generates problems for the use and protection of ICT patents

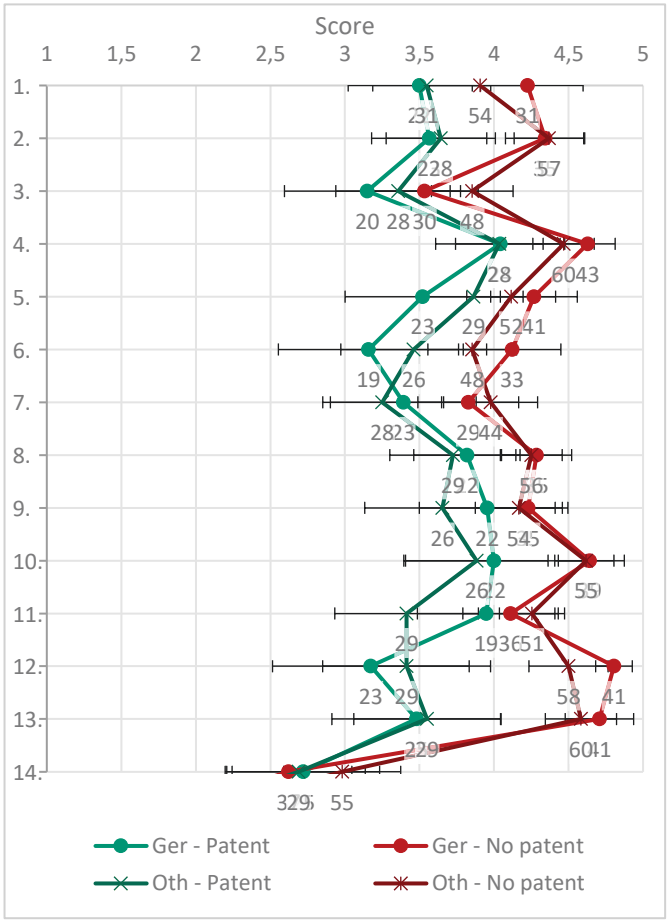


Figure A28 Assessment of solutions for ICT patents promoting innovation regarding patent application and granting ranging from not effective (1) to very effective (4) (patent owners Germany (Ger - Patent) vs non-patent owners Germany (Ger - No patent) vs patent owners other Countries (Oth – Patent) vs non-patent owners other Countries (Oth – No patent))

1. The application fees for ICT patents are raised
2. The quality of granted ICT patents is improved by raising the required degree of novelty
3. The quality of granted ICT patents is improved by raising the required inventive step
4. The quality of granted ICT patents is improved by narrowing their scope
5. Crowd-sourced validity checks support the patent validity checks by patent offices
6. Granting an ICT patent requires already the implementation of the invention
7. Raising and specifying (e.g. related to technicality) the bar for patents on computer-implemented inventions
8. Software is excluded from patenting both for the program listing and the technical content underlying the software
9. Patents for "Software as such" are granted, i.e. the program listing is patentable
10. ICT patents are granted within five years
11. The renewal fees for granted ICT patents are increased during all the protection period
12. The protection period for ICT patents is shortened to 10 years

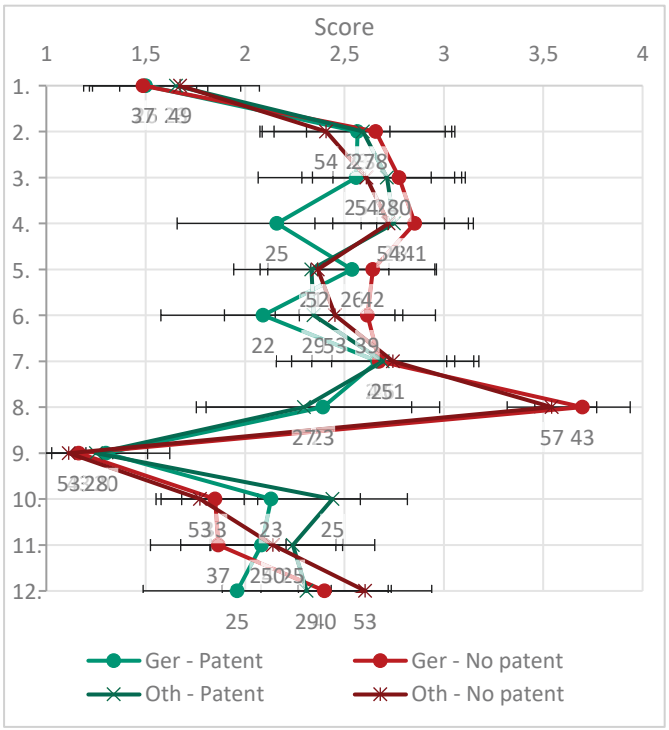


Figure A29 Assessment of solutions for ICT patents promoting innovation regarding enforcing and implementing patents ranging from not effective (1) to very effective (4) (patent owners Germany (Ger - Patent) vs non-patent owners Germany (Ger - No patent) vs patent owners other Countries (Oth – Patent) vs non-patent owners other Countries (Oth – No patent))

1. A declaration of willingness to grant a license for commercial use to anyone (license of right L.O.R.) is required to receive the maximum of 20 years of protection for ICT patents
2. A set of well-known and trustable patent pledges, i.e. voluntary commitments by patent holders to give up some of the rights associated to the patent (e.g. grant permission for commercial use without any direct compensation, no injunctions, FRAND, etc.), is defined
3. Technology exchange clearing houses are publicly supported to support bilateral licensing negotiations
4. Regulations to restrict the activities for Patent Assertion Entities (PAEs) are established
5. Publication of information incl. product specifications and licensing fees for Standard-Essential ICT patents should be encouraged
6. Public policies support the formation and development of ICT patent pools, especially of SEPs, incl. providing incentives for organisations to join
7. Public policies support the formation and development of bilateral or joint licensing programs, incl. providing incentives for organisations to develop these
8. Compatible licensing solutions for Open Source Software and ICT patents are developed
9. Only Royalty-Free ICT patents shall be integrated into Open Source Software
10. Licensing terms of bilateral licensing agreements should be published
11. Defensive ICT patent aggregators are publicly supported
12. Insurances against ICT patent litigations are publicly supported (incl. provided by state insurance)
13. Trade secret regulations reduce the incentive to file ICT patents
14. Mediation and arbitration processes to reach a mutually satisfactory settlement of ICT patent disputes outside of court are further publicly supported
15. Court fees for ICT patent disputes are increased
16. Legal costs for ICT patent disputes in courts are covered by the losing party
17. Financial situation in an ICT patent dispute of the winning party before the court case is reasonably restored
18. Caps on ICT patent court case costs that are recoverable by the winning party are introduced
19. A plaintiff can only challenge one ICT patent of one defendant in any given court case
20. Infringement and validity issues regarding ICT patents are tried together before the same court
21. Specialised courts instead of general courts should deal with ICT patent disputes

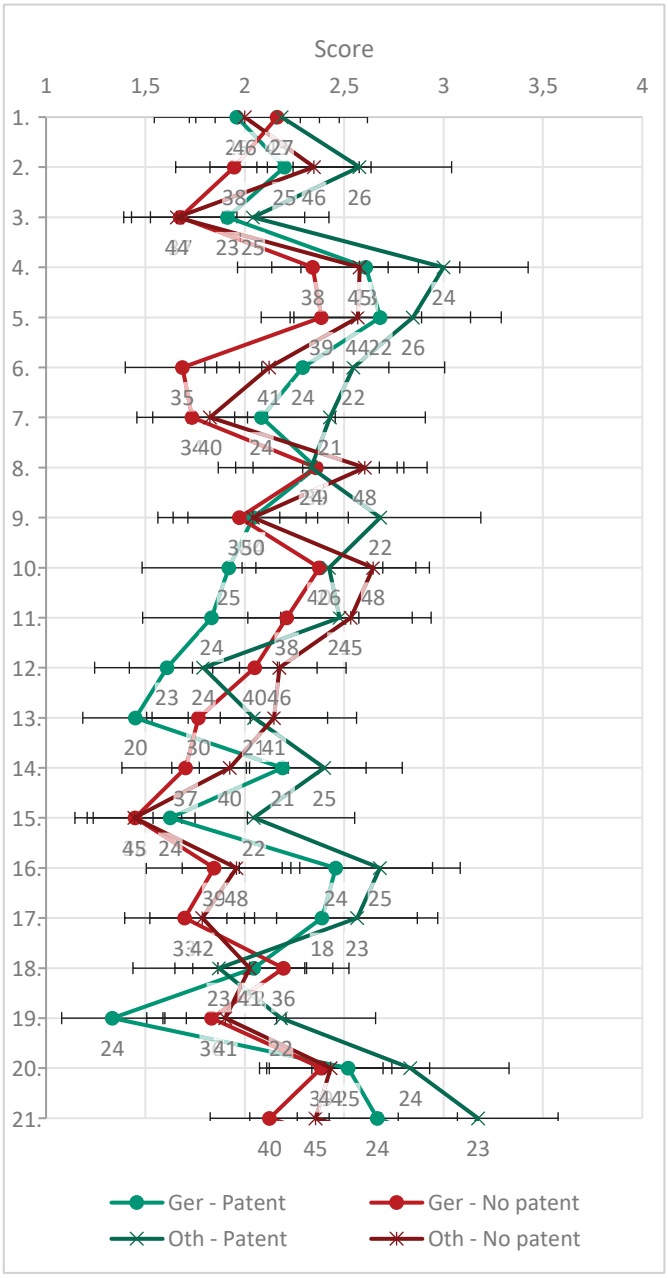


Figure A30 Assessment of RRI dimensions regarding ICT patents from very low (1) to very high (5) (patent owners Germany (Ger - Patent) vs non-patent owners Germany (Ger - No patent) vs patent owners other Countries (Oth – Patent) vs non-patent owners other Countries (Oth – No patent))

1. Multi-actor and public engagement in research and innovation
2. Enabling easier access to scientific results
3. Gender issues in the research and innovation content and process
4. Ethics in the research and innovation content and process:
5. Formal and informal science education