EUROPEAN COMMISSION

Expert Group Report on Strategic Use and Adaptation of Intellectual Property Rights Systems in Information and Communications Technologies-based Research

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and
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FOREWORD

This expert group on "**IPR Aspects of Integrated Internet Collaborations**" was organised by the Research DG of the European Commission, in the context of a series of workshops supporting the European Research Area (ERA) activities.

A group of external experts was invited to meet and discuss this topic, and to provide a summary of the background, problem areas, current situation, and guidelines and options for action by the Commission and policy makers and organisations in Member States.

The "Terms of Reference" were provided before the expert group began work.

The expert group was also attended by members of the Commission services, who provided background information on relevant activities.

This expert group report was written and assembled by the Rapporteur with the aid of the Commission services and the officer responsible.

DISCLAIMER: Although members of the Commission services participated in this expert group and provided assistance in assembling this report, the views expressed both individually and collectively in this report are those of the external experts, and may not in any circumstances be regarded as stating an official position of the European Commission.

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EXECUTIVE SUMMARY

The rapid changes in technologies that are used for R&D have created new opportunities and needs for strategic management of IPRs and knowledge, especially when used in a collaborative context. The use of new ICT technologies is fundamentally altering the way R&D is done. This is leading to a new research and innovation paradigm, which we will simply refer to as “e-Research”. As with contemporary R&D in general, knowledge flows and usage are increasingly influenced by the strategic use of IPR. ICTs, however, could also be used in conjunction with IPRs to privatise results of “e-Research” more efficiently. ICTs could also be used more efficiently for public dissemination. To optimise the use and possibilities of this new research paradigm, the expert group makes the following recommendations:

RECOMMENDATIONS

Legal recommendations

1. For the effective management of knowledge flows one should evaluate all types of technical knowledge both protected/protectable through IPRs or unprotectable. Possible avenues of exploitation for such knowledge need to be explored including in-house, licensing and joint ventures.
2. Considering that the IPR and knowledge needs are very diverse depending on the nature of targeted results, the players to be involved, and the sectors of activity, an approach to protecting knowledge differentiated by type of collaboration and IPRs should be adopted within research programmes.
3. Legislators should make sure that “a one size fits all” approach is not forced upon all types of rights. For example, copyright measures tailored for the film industry should not be forced upon completely different types of copyrighted material. Neither should patent standards be defined so generically that they can no longer be adapted to specific entities or concerns.
4. If the purpose of a R&D collaboration is the generation of standards, the IPR regime should enable maximal dissemination of the end product. IPRs should be well defined, enforceable and functional to allow cross-licensing and technology markets to work smoothly. If, however, IPRs create high transaction costs and entry barriers to usage, off-setting royalties under conditions for e.g. use, development and re-distribution, may be appropriate, e.g. on a subsidised or compulsory basis. This includes royalty-free licensing, or "open" licensing schemes as for generic or platform software and technologies. The open source model should be looked upon positively as an efficiency-inducing management model for ICT-based R&D collaborations under certain conditions, not limited only to the software area.
5. A critical assessment of the effect of the database directive on the increase of database production, and access to data, needs to be made.
6. In order to ensure interoperability in the infrastructure of ICT-based R&D collaborations, the proposed software patent directive should include a clause on

reverse engineering incorporating the liberties provided by Directive 91/250/EEC on the legal protection of computer programs.

7. Changes to IPR legislation should provide possibilities for *sui generis* protection rights to combat market failure, e.g. in software, taking into account the economic rather than technical rationales of protection and the needs for rights harmonisation.
8. Clearer guidance from the Commission would be welcome on how it sees competition law applying in situations when industry standards require the use of a technology that is IP-protected, and when access to research tools that are IP-protected is denied, or granted only at unreasonable rates.

Policy recommendations

9. Competition authorities should be sensitive to the peculiar features of ICT-based collaborative R&D.
10. To guarantee access and preservation of digital sources, agreements should carry the obligation to adhere to certain standards. At present, many electronic applications are so-called tailor made or are just "tools" to join different idiosyncratic parts of the electronic commonwealth. The key feature of an electronic environment should be that interchange and multiple use is possible, independent of time and place, demands strict rules of conduct. Close attention for the ongoing work in the field of digital preservation is needed for collaborative new research endeavours, for instance: The EU Information Society Technologies Programme (IST) (www.codis.lu/ist) in particular the Digital Heritage and Cultural Content programme http://www.cordis.lu/ist/ka3/digicult/home.html A good example is the Electronic Resource Preservation and Access Network www.erpanet.org . We recommend that in all future EU sponsored projects a provision for digital preservation is part of the agreement.
11. EU funded projects must adhere, or at least be in line, with established standards or standards in the making. All information must be structured according to descriptive languages such as XML and that all meta-data must be well defined.
12. The participants in ICT-based R&D collaborations should pay attention upfront to which forms of IPR creation and usage best serve the aims and purposes of these collaborations. The objectives should drive the choice of instruments, not the other way round.

Management recommendations

13. Working in ICT-based collaborative R&D projects, rather than within the confines of a single company, will be increasingly common. This creates a new dynamic that demands a clear IPR agenda and good IP management.
14. Sufficient resources must be set aside for ICT-based collaborative R&D projects. For example a range of 4-6% of R&D expenditures set aside for IP expenditures is considered appropriate in many companies.
15. Research organisations need to be aware of the fact that the individual researchers have different motivations for their research efforts and are often collaborating in informal ICT networks. Research organisations should therefore make their IPR and

research strategy understood so as to prevent a conflict with the individual researcher's agenda.

16. In order to facilitate the management of IPRs in collaborative R&D networks, collective legal entities need to be created to control the IPRs resulting from the collaboration, and to find ways for dispute resolution, e.g. in the form of contractually founded inter-firm "courts" for arbitration
17. Prospective partners, i.e. academic and research institutions need to be aware of the fact that the generation of IPR is featuring higher on the agenda than in the recent past, but that the level of expertise in IPR matters varies immensely.
18. In consortia agreements, partners need to be aware of the different motivations of their partners and in addition provide for conflict resolution mechanisms. Partners need to be aware of the fact that IPRs provide incentives, but also involve transaction costs which can lower R&D productivity.

INTRODUCTION

The use of new ICT technologies is fundamentally altering the way R&D is done. This is leading to a new research and innovation paradigm, which we simply will refer to as "e-Research". As with contemporary R&D in general, knowledge flows and usage are increasingly influenced by the strategic use of IPRs. ICTs, however, could also be used in conjunction with IPRs to privatise results of “e-Research” more efficiently. ICTs could also be used for more efficient public dissemination.

On balance it could be argued that ICTs have fostered a new type of economy – more knowledge-based and more market-oriented or “capitalistic”, hence the notion of knowledge-based economy or intellectual capitalism. In the gradual emergence of this new type of economy there has been a rapid rise since the 1980s of a so-called pro-patent era, now extending into a more general pro-IPR era. This shift in the IPR paradigm originated in the US with a set of developments from the early 1980s (e.g. CAFC, Bayh-Dole act, change in anti-trust policy, political and industrial lobbying etc.). It then spread globally, even escalating into “patent wars”, especially between the US and Japan in the late 1980s – early 1990s. The shift has also stirred up IPR controversies, old as well as new, the latter also largely linked to new ICTs (e.g. controversies around Napster, open source, DMCA etc.) The rapid and uneven changes world-wide in an IPR “system”, being very old and heterogeneous from the outset, have produced a host of new experimental uses and abuses of IPRs in the pursuit of temporary economic benefits, together with a flurry of more or less justifiable concerns in many quarters, e.g. about “overshoot”, over-protection, inefficiencies, inequities, entry barriers, market power, counterproductive effects on R&D and creative work, university patenting, ownership of inventions and so on. The amount and diversity of stakeholders and concerned parties have also increased as the stakes in IPRs have grown and spread. For example economists have entered the IPR area, neglected for so long by them, while the area has been dominated by IPR lawyers, in turn being a small but growing part of the legal community. It is no understatement that the IPR system is stronger and more controversial than ever before in its long history.

Thus, we witness profound changes regarding the economy at large, the IPR system, ICTs and ways of doing research. As to the latter, more and more research is being conducted using computers, with traditional laboratory research following to confirm results predicted from electronic analysis. Internet-based collaborations are becoming much more intensive, in which a large amount of data and expertise are shared, accessed and modified, involving codified and tacit knowledge, and physical resources. The use of the internet to create large and interconnected databases with vast amounts of scientific data; the new software tools to analyse it; the myriad means to store and access it; and the multiplicity of exploitation of the results both as research tools and end products, have created a new research and innovation paradigm which is dominating several research fields, e.g.:

- biotechnology and bioinformatics (genomes of many organisms, protein composition and structure, functionality, database mining)
- earth sciences/environment (earth and ocean modelling, weather, natural resources, crop management)
- nano-technologies, micro-systems, intelligent manufacturing systems, transport

- large-scale applications where computing, data or knowledge intensive requirements justify a grid (highly-integrated distributed computing) approach.

In the knowledge based society, databases, and software to analyse them have become both new research tools and (in some cases) objects of high commercial value, either directly or indirectly, for developing new products. Databases are usually dynamic objects, needing constant maintenance, new data, and new analytical tools to be useful in the long run. Their value is not static. Their very definition becomes complicated, often involving a wide range of linked data and databases of various types, i.e. sequences, structures, algorithms or images.

An accompanying force which demands analysis is the increasingly rapid commercialisation of scientific or basic R&D. The results of basic R&D are increasingly considered to have major commercial value and to be innovation resources, which should be protected by IPRs. More and more private funding and privatisation of results is becoming dominant in basic R&D as well.

A. IPR legal framework

The scientists and institutions creating, accessing and using the data, have a diversity of motivations and goals, ranging from publishing basic results to developing and marketing innovations.

Research policy has to establish both rules and guidance for researchers, in particular in the public sector, on managing IPRs. This shift from research and development in the "real" world laboratories, supported by computers, the internet, and other ICTs, to the "virtual" world of analysis and simulation of data, involves major changes in the flow and management and exploitation of knowledge.

The IPR legal framework is also evolving for example due to new practices, legislation and treaties. These changes raise new issues and require a shift in the development and use of IPR law, from a predominant concentration on patents to a more balanced dependence on: database rights; copyright; confidential information, contract and other rights and constraints (plant variety protection, trademarks, design law, biodiversity protection and access restrictions).

From an IPR perspective, there are several types of collaboration, for example:

- Publicly-funded collaborations, which tend to occur in "basic science" projects, where data is instantly published and freely made available.
- Privately-funded collaborations with a clear commercial goal which rely on the full range of IPR protection for all data and activities.
- Publicly-funded or mixed-funded collaborations involving universities, public research organisations, small, medium and large enterprises, SME’s doing research involving a mixture of basic and applied science with different needs and use of the IPR system.

Collaboratively generated IPR can be:

1. A general public good – the IPR regime here should focus on maximising dissemination and use, and eliminating entry barriers, e.g. through royalty free licensing.

2. For direct private exploitation – the intent is to control third-party use to generate profits for the IPR creators.

3. For indirect private exploitation, or public/private exploitation, such as standardisation – the intent is the maximise dissemination and use, and eliminate entry barriers, while at the same time preventing appropriation of the IPR by third parties or individual entities involved in the collaborating consortium. IPR regimes for this purpose ensure that modifications to, and derivations of, the generated IPR remain publicly available and *cannot be appropriated for the exclusive use of any party*. The principle of providing an incentive to innovate inherent in the copyright system is thus maintained while freeing downstream and interconnective innovation by all third parties. The GPL is an example of such a regime in copyright licences.

B. Policy considerations

The Commission's 6th Framework Programme (2003-2006) of Research and Development and the related specific programmes will help to realise a European Research Area (ERA).[1] These new research practices are consistent with the goals of the European Research Area. Many collaborative research projects are naturally done on a European or international scale. The benefits and effectiveness of such projects are closely linked to the IPR philosophy chosen.

In particular technical areas, such as biotechnology,[2] the quantity of biological data is vast, fast growing, and presenting ever-increasing complexity. It includes genome and protein data from micro-organisms, plants, animals and man. Linking these data to certain illnesses, biological functions or characteristics creates a wide range of potential opportunities for research and development in the life sciences and the new biotechnologies and their numerous applications both inside and outside the health area. In earth sciences areas such as the weather, worldwide data gathering and database analysis are essential for improving forecasting accuracy.

An important priority of the European Research Area is therefore to stimulate such research and to facilitate access to fundamental data by both academic and industrial scientists, thereby stimulating research and the commercial development of new products, processes and services. The ever-changing IPR environment and the advances in various research areas strongly interact with each other. Within this complex environment, research policy has to establish both rules and guidance for researchers, in particular from the public sector, and investors on how to manage IPRs arising from, or required in their research.

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[1] COM(2001) 94 of 21.2.2001; OJ C 180 E, 26.6.2001, p.156, COM(2001) 279 of 30.5.2001. and COM(2000) 6 of 18.1.2000.

[2] For example, at the March 2001 Stockholm summit, biotechnology was highlighted as the "new frontier technology".

1. ECONOMIC AND TECHNICAL FACTS AND TRENDS

The formulation of problems and recommendations in a report like this depends in no small amount on how the policy environment at large is perceived. In order to make these perceptions clear, explicit facts and trends perceived as particularly relevant are itemised and classified as follows keeping in mind the numerous possibilities to select, formulate and classify them.

Economic

1. Increasing importance of dynamic competition across nations, sectors, companies and markets (incl. markets for labour, knowledge/ideas and financial services).
2. Gradual emergence of a new type of economy (more knowledge and innovation based, ICT-driven, IPR-oriented, etc.).
3. Increasing strengthening, widening, use and awareness of the various IPR systems around the world.
4. Universities and public research organisations are becoming more economically focussed, i.e. becoming more industrialized, commercial, competitive, international, strategic etc., acting with more IPR-consciousness and entering collaborative alliances.
5. Increasing competition and selective cooperation between public research organisations is expected within the European Research Area (ERA).
6. Increasing technology and competitiveness gaps between USA and Europe, including the defence sector.
7. Underinvestment in R&D in Europe with respect to the EU goal of R&D being at least 3% of GNP by 2010 (with no R&D productivity slow-down).

Technical

1. Increasing build-up of in-house R&D in industry, now controlling most of world-wide technology and with and increasing share of worldwide science.
2. Increasing i) international division of R&D labour, ii) use of technology markets and iii) external technology acquisition.
3. Increasing interdependence of technologies, companies and products.
4. A transition from individually based research and invention (for which IPR laws were originally designed) to intra-company team based and further to inter-company team based, i.e. to inter-organisational R&D collaborations.

5. Increasing scale, scope and speed of commercialisation of R&D, including basic research.

6. Overload of information and communication and more ICT intensive R&D, production, distribution, marketing and inter-firm collaboration and commerce.

7. Internationalisation/globalisation/“glocalisation” (i.e. global coordination of firm R&D with increasing concentration to certain technology-intensive regions around the world).

8. Military R&D, still amounting to roughly half of the world's R&D, is shifting character, including increase of IPR relevance.

9. “Scale”, critical mass, “scope”, interdisciplinarity and “speed” to market, will often make collaborations a preferred governance mode over market mediated “coordination”, i.e. interorganisational management coordination is often superior to pure market coordination of large scale R&D projects.

10. More tactical inter-firm collaborations (complementing strategic alliances), more short-lived and volatile, and more “promiscuous” alliances and collaborations.

11. The share of high-technology collaborations (in IT, pharma, bio, aerospace and defense) has grown dramatically to over 80% currently, while the share of international technology collaborations has decreased somewhat to around 50%, apparently related to growth of US domestic collaborations.

12. Emergence of what we can call "e-Research" in intra- and inter-firm R&D through use of various infocom technologies (Internet, multimedia conferencing, networked databases, AI tools, distributed computing and I/O, large scale simulations etc.).

Increasing strategic use of IPRs in ICT-based defence-related R&D

For a long time roughly half of the world's S&T and R&D activities have been defence related with R&D activities performed in mostly national military-industrial complexes, led by super-powers in distinctive alliance structures. The "appropriation" and control of military S&T has formed a special military IPR regime based on secrecy and various types of controls and sanctions, quite separate from the civilian IPR-systems (regardless of type of economic system - market or planned). Military and civilian technology, R&D, industrial activities, IPR regimes and other governance structures, as well as dedicated ICT-systems, have been quite separate from each other (even within firms). For various reasons (downfall of Soviet Union, multi-polarisation of power, US hegemony, growing importance of China, terrorism, rising capital intensity in conventional warfare, rising R&D costs, new technologies, waning geographic borders and distances etc.) this situation is now subjected to far-reaching changes and trends (without completely changing the nature of military affairs, of course).

What is increasing, and already visible in the USA, are: integration of military and civilian technologies (through dual use, lead/lag reversals, scientification etc.); outsourcing of defence R&D, production and services for firms, nations and even for cross-national alliances; internationalisation and globalisation of defence R&D, defence services and defence industries; limited military/police international "ventures"; cross-national trade of military technology; R&D and production collaborations.

The likely implications of this is increasing R&D collaborations across nations, sectors, forms and civilian - military borders; industrial restructuring (divestments, joint venture M&As) and global concentration. Defence R&D as well as defence services (based on surveillance, command and control, robots, unmanned vehicles, electronic warfare, network defence etc.) will increasingly be ICT-based, but possibly with closer integration of military and civilian ICT-systems. This is especially likely in the area of surveillance with its vast possibilities to use ICTs for development, production and exploitation of databases. (Note the military role in developing e.g. Internet and GPS and Echelon). Awareness and use of IPRs beyond trade secrets are also likely to increase in military industry.

The implications of changes like these are of course many and important for a Europe lagging in civilian and military technology, but wanting to avoid technological over-dependence on the USA. A major objective is to foster integration of European defence-related R&D, industry and services and in that connection to consider integrating defence-related R&D in European framework programs – some military, some hybrid military/civilian ones, some closed, some open to non-Europeans. Awareness and use of IPRs are then crucial, necessitating the nurturing of an IPR culture and IPR investments in the traditional military industry.

How can IPR facilitate collaborations in R&D?

IPRs will increasingly play a key role in determining the nature and participation in collaborative research projects and programmes. In entering into such activities, the participants take a view of what the expected outcomes will be, and what the benefits will be to their organisation. Projects must include participants who can bring essential background knowledge to the work planned. Some potential participants may be excluded because of fears that they will gain too much insight into the technological knowledge or commercial strategies of others, or because they will be able to exploit outputs more effectively. Others may steer clear for fear of being exploited.

These outputs will entail IPRs of various kinds: patents and other formal IPRs, and also increased skills and forms of both codified and tacit knowledge and spill-overs (externalities).

Even those taking part mainly for financial gain (such as contract research companies) will consider the wider benefits such as increased knowledge and skills in both technological and commercial spheres. Not all outputs are easily translated into marketable products, but instead can contribute to the overall capabilities and competencies of companies and other research institutions and provide additional positive externalities.

This is especially true for public funders of research collaborations, which are intended to produce economic and social benefits. Apart from pure sciences, most public support for research is explicitly intended as an investment, producing longer term economic and social returns. The justification is traditionally that research produces social benefits which are greater than the private benefits to companies because many of these benefits are non-appropriable or are difficult to protect or even identify in detail. The resulting under-investment in research produced by private decisions can be corrected in part by public funding decisions.

The success of programmes or projects cannot be evaluated merely by counting the numbers of patents generated, but must be evaluated by the more difficult assessment of the overall impact of the range of knowledge and results coming from the research. Intellectual outputs from research collaborations includes formally protected knowledge, tacit knowledge and other results such as commercial knowledge of markets, consumers and other 'non-scientific and technological' knowledge, as well as contributing to the pool of public knowledge. Policies and strategies must therefore take account of this broader range of results.

Hinderance or facilitator in collaborative R&D agreements in an ICT context?

The proliferation of IPRs both in terms of number and type through, sui generis creations, lowering of standards and increased propensities to acquire IPRs, are not necessarily conducive to more basic research or to some types of collaborations. This creates a need for new and complementary IPR approaches, e.g. creation of weak, open or free IPR regimes – with lower transaction costs but sustained incentive effects. The difficulties in tracking and especially in valuing all recordable inputs in ICT based collaborations create a need for more accurate methods of valuation and remuneration, and the use of some complementary liability rules, and other incentive systems, e.g. prizes and recurrent contracting or recurrent grants.

Copyright laws were neither created, nor are obviously suitable for, Internet collaborations. The same could be said about patents in relation to software and biotechnology. Trade secret law is neither well adapted nor internationally harmonised and leaves many grey zones when applied to the Internet as well as to ICTs in general (e.g. faxing). Trade mark laws and Internet domain names are also problematic in general, but the problems are of less importance. Database rights are new and have not been sufficiently tried yet in the present context, e.g. through evolving practices and litigation.[3] In addition, IPRs may often overlap, international legal differences are palpable and jurisdictional problems accrue in cyberspace. This suggests that best practice should aim at availing IPR issues by using decentralised and adaptive contracting as much as possible.

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[3] As discussed further in chapter 2.

2. LEGAL TRENDS IN INTELLECTUAL PROPERTY AND COMPETITION LAW

Conversion of commons into IPRs

A trend is that in various sectors, elements of information are losing their status as commons through being enclosed by IPRs. The question is therefore, whether normal competition rules should apply more strongly in the face of the enclosure of common goods resulting from enhanced IPR protection.[4] Especially in the area of databases, the creation and compilation of (single source) synthetic data, research tools, and business method patenting, as well as raw data which can only be obtained by a one-off investment (*vide* bio-informatics and seabed bio prospecting) raises heightened competition concerns over access to these resources that are primary research tools.

Protection of Databases

A useful working definition of 'database' can be found in Directive 96/9/EC of the European Parliament and Council on the legal protection of databases. Article 1.1 of this Directive defines 'database' as 'a collection of independent works, data or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means'.

The formation and use of databases can be an important feature of modern research projects, whether co-operative or within a single undertaking. Whilst the compilation of databases in the pre-electronic age was often an important part of scientific research, there is no doubt that developments in information and communications technology have greatly facilitated both compilation and use of databases.

Many people regard technological protection measures as an effective means to protect both database owners, and the copyright owners of works included in databases. However, it appears that at the present state of development, all technological protection measures for a single body of data can eventually be defeated.

A possible solution to the problems alluded to in the previous paragraph, is to ensure that the database is not created as a single body of data, but is rather a collection of individual items put out randomly on the Internet, which can only be accessed by a search engine to which only those authorised by the relevant undertaking have access. Since the individual items are not secure, this strategy is appropriate only where the individual items *by themselves* are more-or-less valueless to third parties.

Legal forms of protection are unsatisfactory at present, and are likely to remain so for a number of reasons. Because all forms of legal protection are national, there is an inherent problem as to which courts have jurisdiction to adjudicate disputes, and which law applies to any alleged infringement. These problems are compounded by the fact that: (1) the database may exist in servers around the world; (2) access may be gained from any part of the world, and possibly from computers that are moving across borders; and, (3) the situation of the database owner may be unrelated to either of the previous two facts. Accordingly, there is often no clear connecting factor which would answer problems of jurisdiction and choice of law.

From an international point of view, therefore, the protection of databases at the present time is problematic. Those compiling them, who seek proper security, and possibly additionally, a good financial return from their exploitation, would be ill-advised to rely on legal protection.

Consequently, having regard to the nature of scientific data individual items of which are not usually of any value, the placing of data randomly on the Internet, to be accessed only by specifically tailored search engines, would appear to be a simpler alternative to reliance on legal remedies.

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[4] See the cases *NDC Health Inc. v. IMS Health*: Interim Measures, Case COMP D/338.044 (July 3, 2001), [2002] 4 CMLR 111, IMS Health Inc. v. Commission, Order of the President of the CFI, Cases T-180/01 R, 10 August 2001, [2002] 4 CMLR 46 and Case T-184/01 RII, 26 October 2001, [2002] 4 CMLR 58, involving a refusal to license copyright in a database. Distinguish, however, the Austrian Supreme Court decision of April 9, 2002, Geschäftszahl 4Ob17/02g, involving the *sui generis* database right, where problems seem to stem from the implementation of the database directive as a neighbouring right to copyright.

The problem comes to a head where protection is relatively easy to obtain and distortive rent-seeking occurs. Essential facilities issues involving refusals to licence or supply may increasingly lead to demands for compulsory licensing. The issue of fair compensation and the calculation of reasonable royalty rates in this respect is of the utmost importance. Varying principles and methods of calculation in the Member States, and the related differences in authorities applying these standards also raise concerns about the need for harmonising as well as improving methods of calculation.

Conversion of common standards into proprietary rights v. open source

Two diametrically opposite trends have been present in several recognised sectors (e.g. telecom, universities) of the software market. One is the increasing grip some business players have *de facto* over market standards (Microsoft) that is supported by secrecy over source code. Varying standards on reverse engineering, for example in the USA and the EU, result in strategic use of jurisdictional discrepancies. New dissemination methods and rapid unauthorised accessing, copying and re-development, brought about by worldwide access to software and code via the internet, may prompt companies to be more aware of the benefits of making source code available, possibly under open source licensing arrangements. By relying on copyright and contract this may result in commons that remain within the control of certain market players. It may therefore be beneficial to allow one player or a group of collaborative players to define the terms of licensing or to concentrate IPRs, *provided* this player does not seek rent, but makes available the software in the network on reasonable and non-discriminatory terms. However, one has to be careful to transpose traditional competition regimes to an open source environment. Some open source licences for example could superficially be interpreted as including a compulsory non-exclusive grant-back assignment clause. A closer look at their practical effect shows that this is not anticompetitive, as the software will remain open source, even though it is in the hands of one proprietor.

Open Source, Competition and Commons

The main concern of companies that convert their intellectual property into “commons” is that such property should not be appropriated by anyone, especially not competitors. Therefore, a company may choose to release software, say, into the commons (i.e. by publishing it as open source) for a number of reasons, but in essence because the company’s prime profit does not come directly through licence revenue of that software. The company hopes that releasing such software as open source will generate goodwill; provide benefits from the improvements contributed by open source developers (for which the company does not pay); lead to de facto standards in which the company has a prior expertise, even if it does not retain control of the IPR in the form of software, etc. However, although the company cannot prevent the benefits of such software accruing to competitors, it certainly does not want a situation to arise where these benefits accrue *exclusively* to competitors: i.e. nobody should be able to appropriate the IPR released by the owner company. This explains the popularity in the corporate sector of “copyleft” licences such as the GNU GPL, which require modifications to be also released as open source, i.e. incorporated or returned to the common pool rather than appropriated. As an example, Sendmail, which releases open source software using the GPL, would not like competitors to appropriate and make proprietary improvements to any of the software that Sendmail chooses to make open source. However, as the copyright owner, Sendmail remains free to make its own proprietary improvements to its own open source code for use in commercial products.

Contract as a means to enhance IPR

Alternative business models involving a shift from product to service support, e.g. in software markets, indicate that IPR is not the necessary or preferred basis for the capture of market position. Contract can often even substitute for IPR. Treatment of problems arising from the doctrine of privity of contract (i.e. can a person benefit from a contract to which s/he is not a party, or can someone be burdened by a contract to which s/he is not a party?) and whether virtual click-through contracts are valid, will vary from jurisdiction to jurisdiction. Terms of contractual licences may enhance or even substitute for IPR in the business environment.[5] Issues of pre-emption of contractual arrangements by the IPR exclusions and exemptions is sound in principle, but differs from jurisdiction to jurisdiction. Similarly, the law applicable to the contract governing the terms of use of and access to information may be unclear. Choice of law issues can also raise consumer protection issues.

Electronic rights management

Rights protecting electronic watermarking, fingerprinting and anti-circumvention devices have now been placed alongside copyright law. These measures can be used in collaborative work to determine who has contributed a discrete item of information to the collaborative project. As the utilisation of these devices is likely to increase, so is the inherent conflict between copyright exceptions and limitations and freedom of speech. Here again there is a difference in approach in the US and the EU in respect of IPR liberties based on freedom of speech and freedom of access to information.

Competition laws

Agreements for co-operation in R&D have the potential to raise competition law problems, if they can be said to have the object or effect of preventing, restricting or distorting competition. In such cases, Article 81 EC will be relevant. Businesses will rarely have a clearly anti-competitive intent in co-operating in R&D, so the problem will arise (if at all) in relation to the *effect* of the agreement.

The competition rules in the EC Treaty are concerned, of course, with what goes on in markets. Normally this will be in a market for a product (goods or services) in a form that a customer will understand, or, exceptionally, more than one such markets in an individual case.[6] More recently, though, the European Commission (in the present context, following the lead of the US FTC and DoJ[7]) has begun to consider the impact of R&D (and other types of) agreements in relation to other markets: the market for the relevant technology, the market for innovation in a sector, the market for regulation, the market for the provision of standardisation and related services (certification etc.).

At least where the relevant market is that for a product incorporating technology which is the fruits of R&D (rather than the market for the technology itself), agreements concerned with

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5 Vide shrinkwrap licences and their application after *ProCD, Inc. v. Matthew Zeidenberg, and Silken Mountain Web Services* 86 F 3d 1447 (7th Cir. 1996) and the US Uniform Computer Information Transactions Act (UCITA).

6 Cf., for example, Commission Guidelines on Horizontal Co-operation, OJ C3/2 of 6th January 2001, para. 46

7 See the joint Department of Justice/Federal Trade Commission Antitrust Guidelines for the licensing of intellectual property of 6th April 1995, section 3.2 (www.usdoj.gov/atr/public/guidelines/ipguide.htm)

co-operation in the R&D functions and nothing else, ought not to bring about the prevention, restriction or distortion of competition, and ought for that reason not to be caught by Article 81(1). If the reasoning behind that is that pure R&D is so far removed from the market for the products embodying it as not to have any real effect on that market, then such should logically be the case regardless of whether the parties to R&D co-operation are competitors or not and, if they are competitors, regardless of their market shares. That, very largely, is the position taken in EC competition law.

DG Competition seems to have taken the view initially that agreements for joint R&D were caught by the Article 81(1) prohibition (although, even then, it accepted that they did not need to be notified for individual exemption).[8] Nevertheless, by as early as the late 1960's, when it was in most contexts seeking to apply a very wide notion of what is a "restriction of competition" for Article 81(1) purposes, it had come to accept that agreements concerned purely with co-operation in R&D were amongst the rare types of agreement for horizontal co-operation which would not fall within Article 81(1),[9] on the basis that "the mere exchange of experience and results serves for information only and does not restrict competition" and that the joint execution of research work and the joint development of the results of research up to the stage of industrial application "do not affect the competitive position of the parties".[10]

Indeed, as was pointed out by the Expert Group in its Working Paper "The Role and Strategic Use of IPRs in International Research Collaborations,[11] agreements for pure R&D co-operation generally further the policies set out in Articles 157(1) EC (industrial policy) and 163 EC (strengthening the scientific and technology bases of Community industry).[12]

There is a lack of case-law from the European Courts on co-operation in R&D, suggesting that this is not an area of competition law that has ever caused real problems.

The current Commission Guidelines on Horizontal Co-operation (the Guidelines)[13] continue to evidence a very positive attitude on the part of DG Competition towards co-operation in R&D, the essential perception being[14] that R&D co-operation is likely to reduce duplication

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8 See Reg. 17/62, Art. 4(2)(3)(b).

9 See the 1968 Commission Notice on co-operation agreements OJ 1968 C75/3 corrected by OJ 1968 C93/3 (now withdrawn).

10 Ibid, section 3.

11 Final Report, April 2002, at para 4.7

12 For a wider treatment of how Commission reasoning in the competition field rarely seems to take account (explicitly at least) of Community policies other than competition policy, see Kirkbride and Scholes, EC competition law, in (ed. Howells) European Business Law (Dartmouth, 1996), pp. 55-76. The acknowledgement in the current block exemption for R&D co-operation agreements, Commission Regulation 2659/2000 (OJ L304/7 of 5th December 2000), at recital (2), of the relevance of Article 163 EC in relation to R&D co-operation is a welcome exception to this general state of affairs.

13 Commission Notice: Guidelines on the applicability of Article 81 of the EC Treaty to horizontal co-operation agreements, OJ C3/2 of 6th January 2001.

14 Ibid., para. 40; and see Reg. 2659/2000, recital (10).

of effort and costs, to increase cross-fertilisation of ideas and experience and to result in new products being brought to market and new technologies developed more quickly and more cheaply than if companies did their R&D independently. The view is that co-operation in R&D tends to increase the volume of R&D activities overall. End-users/consumers are seen as benefitting from this process through the availability of new, improved products at reduced or reasonable prices.[15] There is a particular tenderness towards R&D co-operation between SME's.[16]

The Guidelines make clear the Commission's view that the great majority of R&D agreements do not fall within Article 81(1) at all. Certainly this will be the case if the parties are non-competitors (so that the bringing together of their different background technologies would be complementary and presumably, absent the co-operation, neither of the parties would have performed R&D in the same areas independently, applying the "more realistic" assessment of the likelihood of that happening, that has been in use since the *Elopak/Metal* Box-Odin decision in 1990[17]). The only concern here would be if the non-competitor parties agreed on exclusive exploitation of results and one party already had significant market power in relation to a key technology: the foreclosure effect for third parties would then be obvious.[18] The outsourcing of R&D to research bodies or academic institutions is similarly seen as not restrictive of competition, on the basis that the business outsourcing the research would not have performed it on its own and that the outside body performing the research will not have the means or the inclination to exploit the technology resulting from its own R&D work (and so would not be a competitor in any event). This explicit acknowledgement that such relationships are complementary and not restrictive of competition (not unlike that in the Commission 1978 Notice on Sub-Contracting[19]) is very welcome.[20]

The Commission Guidelines go on to point out, however, that -

> "If the true object of an agreement is not R&D but the creation of a disguised cartel, i.e. otherwise prohibited price fixing, output limitation or market allocation, it falls under Article 81(1)."[21]

This is uncontroversial. In such an event, the chances of the conditions of Article 81(3) applying are small.

As has been the case with the other block exemption regulations issued by the Commission in recent years, Reg. 2659/2000 is generally seen as a very significant improvement upon the previous block exemption (which, in the case of R&D co-operation agreements, was Reg.

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[15] See recital (12) to Regulation 2659/2000.

[16] Ibid., para. 41.

[17] OJ 1990 L209/15.

[18] Guidelines, para. 30.

[19] OJ 1979 C1/2.

[20] Ibid., para. 57.

[21] Ibid para 59.

418/85[22]). The clear acknowledgement that, in the absence of a material degree of market power, co-operation in R&D, even where it involves competitors and even where more than co-operation in "pure" R&D is involved, is unlikely to pose a serious threat to competition, is welcome. The move away from a detailed list of compulsory clauses and prohibited clauses in agreements to an approach (below the market share cap) of "Unless a particular term in an agreement is specifically prohibited, it is permitted" increases commercial flexibility considerably and removes the old much criticised strait-jacketing effect (the old R&D block exemption was one of the least helpful ones in this respect). If (as we understand to be the case) the position of the Commission in reality is that the "hard-core" restrictions listed in Article 5 of Reg. 2659/2000 would always be per se prohibited and could never benefit from Article 81(3) exemption on an individual basis, would it not help legal certainty to say so explicitly?

For R&D co-operation agreements between competitors whose combined market shares exceed 25%, one looks principally to the Guidelines.

In summary, the Commission has got the treatment of R&D co-operation under Article 81 EC about right. The application of Article 82 EC (abuse of dominant position) in appropriate cases is, of course, not excluded and this is uncontroversial.

22 OJ L53/5 of 22nd February 1985.

The market for technology / market for innovation

When looking at the market for technology or market for innovation, as distinct from the market for the products embodying a particular technology or innovation or the market for the products capable of being affected by a new technology or innovation, the market needs to be defined. A feature of market analysis particular to R&D co-operation agreements is the use by the European Commission and other competition enforcement agencies of (and resulting need to consider) the analytical tool of the market for the technologies/innovations themselves, rather than (or as well as) the market for the products which embody/incorporate a particular technology or which would be affected/capable of being affected by a particular new technology (the former being in some ways akin to a raw material or upstream product relative to the former).[23] The Guidelines refer to this and explain it briefly,[24] making the point that it will be especially relevant for "pure" blue-sky research where no product embodying it is yet available (and may indeed never be available). It is worth mentioning in passing that there is not universal agreement on the usefulness of "the market for innovation" as a concept in analysing the effects of particular practices.[25] Nonetheless, these are concepts in use in some cases by competition enforcement agencies. There are similar concepts in relation to market definition in other fields, such as the market for the services of standard setting, certification and testing in relation to agreements on standards.[26] The existence of such subtleties is not flagged up in the Commission's *Notice on market definition in competition cases.*[27] We suggest that that notice should be amended to include a section on such matters or at least a cross-reference to other sources (most relevantly the *Guidelines on Horizontal Co-operation*) where an explanation can be found. This would be a significant help to the "user-friendliness" of the Notice on market definition, which is all the more important given the "modernisation" process in competition law enforcement.[28]

[23] Cf. by analogy, perhaps, the relationship between the market for the copyright-protected weekly television listings information and that for the magazines containing that information, in the *Magill/RTE* case, C-241/91 and C-242/91 *Radio Telefis Eireann and others v. Commission*, [1995] 4 CMLRep 718.

[24] Guidelines, paras. 47-52

[25] On this, see the useful review of the literature and discussion in the UK Office of Fair Trading Economic Discussion Paper No. 3, *Innovation and competition policy*, by Charles Rivers Associates, March 2002, Part I, Annex B (pages 132-136), who conclude that wherever possible it is better to rely on an analysis of the market for existing products. This seems to be the approach of the US enforcement agencies: see n.2 above.

[26] Cf. Guidelines, para. 161

[27] OJ 1997 C372/5

[28] Council Regulation 1/2003 of 16th December 2002 on the implementation of the rules on competition laid down in Articles 81 and 82 of the Treaty, OJ L1/1 of 4th January 2003

A note on market definition and the dynamic nature of competition

Competition is a powerful but double-edged tool for price control (static competition) as well as for generating innovations in a broad sense, giving enhanced performance of products and services (dynamic competition). Financing R&D and innovations through related prices and/or taxes builds in counteracting tendencies between static and dynamic competition, thus calling for trade-offs in terms of pro/anti static/dynamic competition policies. Typically these trade-offs have to be made with different time frames and levels of technical, economic and legal uncertainty.

The uncertainty pertains e.g. to innovation returns, market share, market structure, and dynamic market intermediation, but also to the concept of what is a relevant market. Major innovations in the form of entirely new products, processes, methods or services could be regarded as creating entirely new markets ("innovation markets"). At the same time markets could always be conceptualised at multiple levels of products and functional substitutes (e.g. gas-electric heating, sugar, sweetener, foodstuffs), with competition always taking place at some higher level of substitutes, hence the notion of multi-level competition. In addition an increasing systemic nature of complex products and systems technologies create product complementarities, and thereby complementary markets, enabling market leveraging.

Moreover, there is no one-to-one relationship between technologies and products or industries. Rather there is a growing many-to-many correspondence between technologies and products, with the emergence of generic ("general purpose") technologies, having a wide range of product applications, and multi-technology ("multi-tech") products, incorporating a wide range of technologies. With increasing R&D costs for new product generations, increasing division of R&D labor and increasing use of technology markets, competition in products markets is increasingly accompanied by competition in a web of technology markets, including competition between substitute technologies ("technological competition").

Finally, technological change and innovations in general tend to change basic conceptualisations of products, markets and industries (cf. calculator, computer; typewriter, word processor; palmtop computer, handset telephone; copier, printer). In case of converging technologies (with computers and communications as a standard macro example) the concept of a relevant market is broadening. In case of diverging technologies and product differentiation the opposite may occur (e.g. cars historically differentiating into passenger cars and trucks).

In summary the dynamic nature of competition and market definition in connection with R&D and innovation calls for adaptivity in competition policies, with due concern paid to economic efficiency of static vs. dynamic competition on product and technology markets, definable and redefinable at multiple levels of substitutes and complements. How to accomplish this is obviously non-obvious, but novelty in thinking about legal certainty vs. economic efficiency is likely to be useful eventually.

Standardisation

The adoption by providers or acquirers of common technical standards for a product or a process in principle aims to ensure ease of supply, acquisition and use of and access to the product or process. In part this goes to ease of interface/interoperability of that product with similar products belonging to other users; in part, to interface/interoperability with complementary products belonging to the same user. These are especially important in the ICT sector.

Common standards may be adopted in a variety of ways and may be binding on players in a market to a greater or lesser extent. It is impossible to predict in the abstract what the effect of standardisation on a market will be. It may be the only way in which the market for a new product will “take off” at all (e.g. if consumers would otherwise be hesitant to buy the new product for fear of “backing the wrong horse” in a field where technical standards are not established and where they perceive that the costs of switching later to “the right horse”, once a standard has become established, could be considerable). In some circumstances, the adoption of a common standard will facilitate innovation, in others it risks retarding it. It may facilitate market entry, or may act as a barrier to entry[29]. Sometimes the essence of a technical standard will be embodied or capable of being embodied in an IP right; sometimes it will not.

[29] Cf. Lea, Raising the standard? The interaction of intellectual property rights with competition law in the context of standard setting in the software and telecommunications sectors (report of a seminar on 27th October 1999, Intellectual Property Institute, London, 2000).

In markets where technical standards are established and the products are mature, businesses compete in the traditional ways, on price and specification of product/quality of service. In innovative markets which are dependent on technology, on the other hand, for so long as a technical standard has not been established, establishing and then maintaining and controlling the technical standards for the sector will be an important way in which businesses compete and seek to gain advantage.

The trend is increasingly for common technical standards to be established and adopted through initiatives by private parties (i.e. agreements between businesses) rather than through the involvement of governmental and other public bodies (i.e. legislation or delegated legislation).

In competition law terms, agreements whereby competitors agree to adopt and apply a single common technical standard potentially "limit or control technical development" and therefore risk falling foul of Article 81(1) (see Art. 81(1)(b)). That risk will be present whether the standard in question is IP-protected or not. Commission practice establishes, though, that Article 81(1) will not apply where the parties have only a small combined market share in the relevant market affected (on general principles); or where the aspect of the product covered by the standardisation is insignificant in relation to the main characteristics of the product and the main factors affecting competition in the market; or where the parties are free not to apply the standard, if they so choose; or where all manufacturers and suppliers (whether involved in the standard setting or not) who and whose products fulfil objectively necessary criteria applied without discrimination are allowed to use the standard and any related common quality label etc. on fair, non-discriminatory terms. The presence of any related "hard core" restraints (as to prices, production or marketing) will of course cause Article 81(1) to apply and will remove the possibility of exemption.

There has been some addressing of issues raised by industry standards that require the use of a technology that is IP-protected in EC competition law, both under Article 81 (relevant where the IP rights "embodied" in the standard are jointly owned[30]) and under Article 82 (abuse of dominant position).

Under Article 81, in *ETSI Interim IPR Policy (*where the policy was formulated following a complaint by a member to the European Commission that the previous rules amounted to compulsory licensing), associations and businesses participating in the European Telecommunications Standards Institute agreed to inform ETSI in good time if they discovered they had IPRs in a given standard being developed. If the member refused to grant licences, ETSI would seek a viable alternative technology not blocked by the IPR, and if it could not find one no further work on that standard would be performed. Members would be obliged to explain why they had refused to licence, and the explanation would be sent to the Commission. Furthermore, if ETSI discovered there were IPRs in a particular standard, it would ask the owner (be it a member or not) whether it would grant irrevocable non-exclusive licences on fair, reasonable, non-discriminatory terms, refusal to do which might lead to the standard being abandoned. The Commission approved these arrangements as not disclosing any breach of Art. 81(1).

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[30] In relation to the *DVD Patents Pool*. IP/00/1135 of 9th October 2000 (on the DG Competition website) See also *ETSI Interim IPR Policy*, OJ 1995 C76/5 and Commission 25th Report on Competition Policy (1995), pp. 131-132

Under Article 82, the applicable principles are those of essential facilities and refusal to licence, in cases such as the *IBM/370 Settlement* in the 1980's,[31] *Magill/RTE,*[32] *Oscar Bronner v. Mediaprint*[33] and now (which raises standards issues in the Article 82 cases for the first time) *IMS/NDC*[34]. The concern about respect for property rights (expressly assured by Article 295 EC) and the need to show "exceptional circumstances" to justify compulsory licensing as a remedy for refusal to licence as an abuse of dominant position (found to be not present in *Volvo v. Veng*; present in *Magill/RTE*; not present in *Oscar Bronner*; still be to be decided in *IMS/NDC* for copyright in a database) will always make the application of Article 82 EC in such situations very uncertain (as the application of Article 82 invariably is). With the heavily effects-based approach to competition law now applied both at Community level and very largely at national level in the Member States as well[35], leaving the matter to competition law enables all the surrounding economic circumstances to be taken into account (and these may vary dramatically: see above), albeit at the expense of certainty for business. On the other hand, whilst competition enforcement agencies and the mainstream courts are well enough placed to analyse procedural issues, exclusions etc. they are not well placed to handle the technical issues as to the underlying science nor to ascertain reasonable rates of royalty where such are appropriate[36]. Again, *the "modernisation" process of competition law enforcement will increase the need for guidance for business*. Consideration should be given to whether a combination of self-help by business in the standards-setting process (along the lines of the *ETSI Interim IPR Policy* solution, possibly monitored in individual cases by competition enforcement agencies) and the possibility of competition law being applied are sufficient safeguards to protect the public interest in pro-competitive standards embodying IPRs or whether in addition specific changes to IP legislation (within the constraints imposed by the TRIPS Agreement and the international IP conventions) are desirable.

In summary, some clearer guidance from the Commission would be welcome[37] on how it sees competition law applying in situations when industry standards require the use of a technology that is IP-protected, and when access to research tools that are IP-protected is denied, or granted only at unreasonable rates.

[31] Commission 14th Report on Competition Policy (1984), paras. 94-95

[32] above

[33] Case C-7/97, [1998] ECR I-7791

[34] Commission decision in COMP D3/38.044 *NDC Health/IMS Health: interim measures* of 3rd July 2001, suspended by order of the President of the CFI, T-184-01R *IMS Health Inc. v. Commission*, 10th August 2001; suspension upheld by the President of the ECJ, C-481/01P *NDC Health Corp.*, 11th April 2002

[35] Through the (voluntary) adaptation of national competition laws into "clones" of Articles 81/82 EC which has gone on across the Member States (in the UK with the enactment of the Competition Act 1998 and the requirement in s.60 of that Act that (with some qualifications) its terms must be interpreted "consistently" with the interpretation placed by the European Courts upon the similar provisions of Articles 81/82. It is worth noting in passing that the *Oscar Bronner v. Mediaprint* case in the ECJ was an Article 234 reference from an Austrian court on the interpretation of the Austrian national competition legislation "cloned" from Article 82 EC, not as to the interpretation of Article 82 itself.

[36] Cf. the very "rough and ready" order for compulsory licensing made by the Commission in *NDS* (made rougher and readier by the fact that it was an interim measures order), subsequently suspended by the President of the CFI.

[37] It is worth noting that the Commission has the power to issue a block exemption on this subject (Reg. 2821/71, OJ 1971 L285/46).

3. THE SCOPE OF IPR USAGE

IPR Usage

In the knowledge economy, there is a clear shift from the emphasis on tangible to intangible assets. In parallel to this development, it can be observed that traditional property rights on physical goods are complemented or even displaced more and more by intellectual rights, including IPR. In the evolution from the traditional industry-based economy to the new knowledge-based economy, we observe a strong surge of IPR usage.

IPRs cover a wide variety of rights that differ in their principle and justification, in how one acquires them, in the transaction costs associated with their usage, and more generally, in their effects. In the following, we consider usage of all forms of IPRs, such as copyright and related rights, trade secrets, database protection, design, trademarks and finally patents (that grant the most comprehensive property monopoly). Since it is not necessary to register or acquire all of them, the reliability of the empirical evidence about their usage differs. Important industries and knowledge activities have developed on the basis of copyright alone (from publishing to software and more generally the open exchange of knowledge) but there are no statistics of the usage of copyright available. Copyright also had to be registered in the United States until the end of the 1980s, but since then copyright did not have to be registered formally any more, although companies still make use of this opportunity in order to improve their position in case of legal conflicts. Information-based innovations, like information material or software, are covered by copyright protection. By contrast, the statistics on patent databases have reached a very sophisticated level, and there are numerous studies in existence about the use of patents especially in industry. In addition, trademarks also may be registered and therefore detailed statistics are available, and also analysed following the approaches applied to patents.[38] Furthermore, empirical surveys focus primarily on the trademarking behaviour of companies,[39] but reputation building through branding more broadly is also important, not the least in science. Scientific publications are a key mechanism for the dissemination of knowledge and function as important output indicators for research institutes. These publications often have a close relationship with IPRs, because an early scientific publication may prevent a successful patent application. The following overview also includes the rights associated with publications, independently of the fact that researchers are nowadays compelled to transfer their copyright to the publishers of scientific journals.

With regard to the availability and reliability of data about the usage of formal IPRs, a broad discrepancy exists. This increases if one takes into account the IPR usage among universities and other research organisations. Following the US Bayh-Dole Act, passed in 1980, which allowed US institutions undertaking federally funded research to retain control of the resulting IPRs, the awareness and the use of patents and other commercial IPRs has increased

[38] Schmoch, U., Marken als Innovationsindikaoren, Report for the German Federal Ministry for Education and Research, (2002, Fraunhofer Institute for Systems and Innovation Research, Karlsruhe).

[39] Allegrezza, S.; Guarda-Rauchs, A., The determinants of trade mark deposits: an econometric investigation (a case study of BENELUX), in: (1999) Economie Appliquee, Vol. 52, No. 2, S. 51-68.

considerably in universities world-wide. Although these organisations can be found in the respective patent or trademark databases, no statistical data exists about the propensity of researchers to use these and other IPRs, but several studies are underway. Recently, more information has become available on the actual downstream effects of patents through licensing, litigation and settlements.[40] Besides the active use of IPRs, use of disclosed information is of crucial importance for economic impact of the IPR system as a whole. However, on the one hand the data availability concerning this issue is rather restricted and the relevance of this source of information for innovation is of very low importance according to CIS2.[41] Therefore, this aspect will not be dealt with in the remainder of the chapter, although it represents a major challenge for policy makers.

Whilst emphasising the shortcomings of the available data, the following chapter tries to sketch a picture of the use of the different IPRs by the different actors involved in research collaborations. Usage of IPR differs not only according to types of organisation, but even more according to the type of technology in which innovation occurs, and the form of collaboration that leads to that innovation. Chapter 3 is structured according to the different actor groups involved in research collaborations and their use of the different IPRs. In a first section, we focus on the IPR usage of universities, followed by the behaviour of public research institutes, and finally of companies. It should be read in association with chapter 4 (that is structured by type of collaboration).

Universities

The major output of the research activities of universities are scientific publications, since the academic career of a researcher crucially depends on his number of publications in scientific journals of high reputation. According to the Science Citation Index (SCI), the largest share of publications can be observed in medicine, followed by biology, biotechnology, physics, and chemistry.[42] The contribution of universities to the annual number of publications in technology related areas amounts to over three quarters.[43] On the other hand, their share of patent applications rose to just more than 4% in 1997, which means a doubling compared to the figures in the year 1977. Although simple international comparisons cannot be performed due to different institutional frameworks, recent observations suggest a further increase of the patent activities within universities in all Member States. No empirical analyses exist concerning the registration of brands and trademarks, but the importance of registered trademarks is growing in the area of bachelor and master programmes. Universities not only capitalize on the reputation of recognised scientists and alumni, but also register trade marks for distance learning programmes and merchandising purposes. They also register domain names for their websites. Trade marks can also be used to achieve brand recognition for

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[40] See TIIP Newsletter (2002), Jim Bessen, ed.: Technological Innovation and Intellectual Property Newsletter, see: http://www.researchoninnovation.org/tiip/.

[41] Eurostat, Statistics on innovation in Europe, (2000, Luxembourg, Eurostat Datashop), p. 66.

[42] Schmoch, U., Wissens- und Technologietransfer aus öffentlichen Einrichtungen im Spiegel von Patent- und Publikationsindikatoren, in: Wissens- und Technologietransfer in Deutschland ed. by U. Schmoch, G. Licht and M. Reinhard, (2000, Fraunhofer IRB Verlag, Stuttgart), pp. 17-37, p. 21

[43] At least in the case of Germany.

(collaborative) research projects. This is testament to the increasing pressure to commercialise research as part of a strategy to attract both researchers and funding. This is in line with the trend that universities are increasingly run in a more business-like fashion, which also extends to knowledge management.

Publicly funded research institutes

With respect to the IPR usage, the behaviour of publicly funded basic research institutes is quite similar to that of universities, although some differences exist. Depending on the funding of the institution, and the criteria for individual promotion, the number of scientific publications are more or less important as in universities. On the other hand, patents are often less important for these institutions compared to universities, since their total running costs are completely covered by federal or regional governments or ministries. In general, across countries the pattern of IPR usage of universities and publicly funded basic research institutes cannot be differentiated. Public funding is, however, decreasing. In order to safeguard reseach-based business opportunities,[44] publicly funded basic and applied research institutes are more attentive to IPR usage. In the future, applied research institutes are also going to build up very broad patent portfolios, which in some cases lay the foundation for a whole range of services which are offered to private companies. In addition, many applied research institutes develop software, which is protected by copyright, and for which patent protection is also available only in very specific circumstances. Finally, since this kind of institution is very active in the market for services involved in research and development, it also starts to develop an explicit marketing strategy which is often complemented by registered trademarks, which do not only cover the name or logo of the research institute, but also specific services they provide. Summarising the IPR usage of this very important group for the research collaborations, it turns out that it uses the whole range of IPRs more and more sophisticatedly and intensively, because the increasing competitive pressure forces them to become professional not only in the research services they provide, but also in their protection and marketing strategies. Finally, the increasing global sourcing of R&D services also leads to the use of IPR for international protection.

[44] On the possible conflicts this produces see p. 24.

The Fraunhofer Case

The Fraunhofer-Gesellschaft is one of the leading organisations of institutes of applied research in Europe, undertaking contract research on behalf of industry, the service sector and the government. Within the framework of the European Union's technology programs, the Fraunhofer-Gesellschaft is actively involved in industrial consortia which seek technical solutions to improve the competitiveness of European industry. Typical research fields include communications, energy, microelectronics, manufacturing, transport and the environment.

Appropriate means of protection of innovations and their non-exclusive appropriation are important. In order to deal with this difficult framework, the Fraunhofer-Gesellschaft has developed an explicit protection strategy. In every institute, a patent manager is responsible for observing the ongoing research activities and checking if innovations are emerging which are relevant for patent protection. In addition, the Patent Centre for German Research, one of the Fraunhofer Institutes, runs the Fraunhofer Patent Department which is responsible for the IPR portfolio of the whole Fraunhofer-Gesellschaft and supported by the patent manager in the institutes.

In contract research, it is difficult to find an adequate balance between the need to protect its own IPRs and the interests of the clients in industry. Therefore, the Fraunhofer-Gesellschaft strives for unquestionable and transparent protection of its own IPRs related to its pre-existing know-how before the beginning of the research projects in order to be able to use this knowledge exclusively in further projects and not to threaten its core business by losing rights to partners or clients. However, the IPR strategy is also influenced by the cost dimension of its application and enforcement, the market relevance of the protected knowledge and the ability to trace infringements.

The most important formal protection strategy is the application for patents. In the year 2000, the Fraunhofer-Gesellschaft applied for almost 400 patents. Around one third of the patents have been successfully exploited. In addition, an increasing number of around one quarter of the patents is licensed to other companies. Besides patents, the registration of trademarks is already a very important protection strategy. More than 50 trademarks were registered in the year 2000 with a bias to domestic registration. Whereas protection is a motive of less importance for trademarking, the support for the visibility in the market and for the corporate identity are the major reasons. Finally, copyrights are actively used in the area of software licensing because patent protection is only available under very restrictive conditions in Europe at the moment.

The Fraunhofer Patent Department did not report cases where IPR conflicts occurred between partners in a research consortium. However, relevant cases are not all reported or documented, although both negative experiences concerning uncontrolled IPR exploitation by research partners (mostly companies), and success stories like MP3, are widely known.

Companies performing research

Since industry is a key target group of public programmes supporting research collaborations and data is available about the protection strategies of companies performing R&D, this last section will go into more depth concerning IPR usage. As already mentioned in the introduction, the publication of research results in scientific journals may prevent successful patent application at least in Europe as long as no grace period is introduced. Therefore, companies are very reluctant to allow their R&D employees to publish results of R&D activities before possible patent applications are checked, and even object to publication after a patent has been granted, since under most circumstances it is intended to disclose as little information as possible in the patent application. This strategy is confirmed by the high importance of secrecy as an efficient protection strategy.[45] The usage of formal IPR is often lower compared to secrecy, but also to other informal strategies like gaining lead time advantage. This is also reflected by CIS2 data, which illustrate that just one quarter of innovating companies in the manufacturing sector has applied for a patent.[46] Recent results of CIS3[47] indicate that – at least for Germany – this ratio has slightly decreased. In the service sector, not even 10% of the companies make use of patents. These general numbers can be differentiated in two directions. First, more than 50% of innovative large companies with more than 250 employees have applied for a patent, indicating a significant size bias, because patent applications are very costly for SME's which often do not have even the necessary know how. Second, there are major discrepancies between sectors, technology, and countries. Traditionally, the chemical and pharmaceutical industry rely heavily on patents as protection instruments, as well as manufacturers of machinery, office and electrical machinery, medical, precision and optical instruments and car manufacturers.[48] On the other hand, mining and quarrying, manufacturing of food and tobacco, or textiles are sectors with rather small percentages of companies making use of patents. In general, the more science-based a sector is, and the more sophisticated special machinery is used, the higher the propensity to patent. Furthermore, the propensity to use patents increase with the R&D intensity of a sector, since patents are one means to support the appropriation of investments in R&D.[49] As already mentioned, patents are not widely used in the service sector with the exception of technological aspects of services, including R&D services,[50] although some companies in telecom and energy services are increasingly active in patenting.

Whereas registered trademarks are only used by one sixth of German manufacturers, closely correlating with the propensity to patent, service companies make more use of registered trademarks (7.8%) compared to patents (5.8%). Furthermore, the size bias towards large companies in the use of patents is far less in the case of trademarks, since both costs and knowledge necessary for their registration are much smaller compared to patents. Registered trademarks are very popular in the service sector among the wholesalers, the technical

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[45] Cohen et al. 2000 for manufacturing in the US, Blind K. et al., Mikro- und makroökonomische Implikationen der Patentierbarkeit von Softwareinnovationen: Geistige Eigentumsrechte in der Informationstechnologie im Spannungsfeld von Wettbewerb und Innovation, Endbericht für das Bundesministerium für Wirtschaft und Technologie, (2001, Karlsruhe) for software.

[46] Eurostat, n. 41, p. 39. A study launched by the European Patent Office also postulates that besides the share of companies already applying for patents, one third of all companies are able to apply for patents, since they conduct R&D, see European Patent Office (ed.), The Use of Patent Protection in Europe, Eposcript Vol. 3, (1994, Munich), p. 23.

[47] Source: ZEW (2002), printed in Schmoch, n. 38.

[48] Cohen et al. 2000, Source: ZEW 2002 printed in Schmoch, 38. A study by Granstrand O., The Economics and Management of Intellectual Property (1999, Edward Elgar), of large firms in Japan and Europe (Sweden), representing a majority of industrial R&D and best practices in respective countries, put usage of patents significantly on top in Japan, with an upward trend in Sweden.

[49] Bessen, J; Maskin E. (1999 revised 2002), Sequential Innovation, Patents and Imitation, (http://www.researchoninnovation.org/patent.pdf), provide contrary, but disputed, evidence in the case of software.

[50] Source: ZEW (2002), printed in Schmoch, n. 38

services (including consultancies) and computer and telecommunication services. In the German software sector, almost 60% of the companies register trademarks.

Summarising, the IPR usage of companies and emphasising their relevance for research collaborations in general, the following main conclusions can be derived. We observe a general increase of the use of various forms of IPRs among companies. However, the recent upsurge in the registration of trademarks, also caused by the introduction of the community trademark, does not interfere with research collaborations, since trademark protection only covers brands, products names and symbols, but not specific technologies.[51] The widespread and implicit use of copyrights is also only in very rare cases a problem for research collaborations, since copyright protects only one specific version of information or a programme code and circumvention is easily possible. The strongest and most important IPRs are patents, which are mainly used by larger companies in science-based or R&D-intensive sectors, but are increasingly used across sectors with little country variations. Consequently, patents have a major impact on research collaborations.

Overview of the IPR Usage among Participants in Research Collaborations

The survey on the use of IPR among the different actor groups possibly involved in research collaborations elucidated on the one hand a significant degree of uncertainty about the real situation concerning IPR usage. On the other hand, there is a large heterogeneity both between the four types of participants and within the groups themselves. The heterogeneity between the institutions (see table 1) is mainly caused by the different pressure to commercialise results of R&D activities and different responsiveness to the challenges of the pro-patent era. The higher the pressure, the more commercial IPRs, like patents and trademarks are used in order to expand into and secure markets for research services. Since universities are also forced to raise funds from industry, there is a clear tendency to build up patent portfolios and exploit them commercially. Furthermore, the more science-based R&D-intensive and competitive a sector is, the more widespread is the use of patents in order to secure the appropriability of the cost-intensive innovations. Focusing finally on possible fields for research collaborations, it becomes evident that an intensive use of IPR is likely by all possible institutions involved. Consequently, the chances for IPR conflicts are significantly higher in corresponding technologies.[52]

According to the overview in table 1, there is obviously a convergence to a more intensive IPR usage among the actors in research collaborations. Whereas in the past the interests between research institutes and industry have been complementary, in recent years all participants in research collaborations have developed a strong interest in IPRs. Consequently, the likelihood of IPR-related conflicts will increase. A further driving factor for conflicts is

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51 When common or private exploitation is sought, however, branding of the accompanied service offered is necessary.

52 In Europe there is no data available about the likelihood of IPR or better patent conflicts. For the United States Lanjouw, J. O.; Schankerman, M., An Empirical Analysis of the Enforcement of Patent Rights in the United States, Paper prepared for the Conference on New Research on the Operation of the Patent System, sponsored by the U.S. National Academy of Sciences in Washington (October 2001), are able to determine the probability of patent litigation, although many cases are solved before the involved parties go to court.

the tendency towards modular R&D activities, which will also increase the complexity of the respective IPR structures. In addition, in very large research projects with numerous institutes and researchers involved the question of who invented what and with what value for whom and when will become more crucial. All these trends will be aggravated in ICT-based research collaborations, since both the number of participants will be increased without major problems and their relationships become looser. Consequently, the essential informal basis of research collaborations like trust and community will become more fragile.

In summary, the uncertainty in the IPR environment increases and may lead to an increased use of informal instruments, like secrecy in form of trade secrets, or open source arrangements also because of their flexibility and adaptability. This kind of secretive reaction will then prevent the exchange of information, the crucial mechanism for the prosperity of the knowledge economy. A proper IPR regime for ICT-based research collaborations has to take all these aspects into account, which means that simple solutions, like stronger IPRs in general, whatever that is taken to mean may destroy more than help in building up sustainable research infrastructures.

Table 1: Actors in research collaborations and their IPR-usage

Types of Institutions	**IPR-Usage**
Universities	Publications (high); patents (low, but increasing); trademarks (low)
Public funded basic research organisations	Publications (high); patents (low; but increasing); registered trademarks (low)
Public funded applied research organisations	Publications (medium); patents (medium); registered trademarks (low; but increasing)
Companies - Small companies Tech/startup companies, however, may have a large interest in patents. - Large companies	 Patents (minimal); registered trademarks (medium); copyrights (high) Patents (high); registered trademarks (high); copyrights (high)

4. COLLABORATION IN SCIENCE AND RESEARCH

In this chapter the scientific collaboration in research and development is examined using two dimensions. First, the rules and problems of collaboration may be divided according to the openness of the IPR results of a project. There are collaborations where the project participants decide that the results will be published or that they are openly in use by all interested parties. In other kinds of collaboration most of the results stay closely controlled and are mainly for use by the project participants.

Second, the collaboration may be seen as horizontal when all the participants are from the same or close field of technology and are often competing in the market of similar or substitute products. The collaboration is vertical when the participants are in different stages of the production chain or the participants are using the results in products that come from different technology fields.

R&D may be organised as:

- an **internal action** within a corporation, research organisation or university, based on strategic decisions from the management;
- a bilateral or multilateral **co-operation with one or more third parties**, based on strategic decisions from management and a co-operation agreement with the third parties;
- a co-operation with one or more third parties, in the framework of **funded programs** initiated by national authorities or other public authorities, such as the EU Commission.

Industrial R&D in large firms is organised using a mix, including an ever-changing portfolio of R&D collaborations with external parties. One type of the **funded programs** is "**affiliation programs**", where industrial partners have the possibility to join certain pre-defined R&D programs, by paying a contribution to the costs of the program. Industrial partners having subscribed to the program, acquire certain favourable conditions to enter into a licence agreement for the use of the results of the affiliation program, in terms of exclusivity or financial terms applied for the licence. The ownership of the results generated in the affiliation program does not belong to the industrial partner, but solely to the academic partner or public research organisation. Awareness on the competition rules is important in considering the level of the favoured treatment the industrial partners are given with royalties and exclusivity.

Another example of the **funded programs** are the EU framework programs. There are totally new problems to be solved considering the new Integrated Projects and Networks of Excellence of the 6th framework program. The efficient management will be a major challenge for continuing multi-culture co-operation frameworks, where the players may change once in a while. A pressing question is if it is possible to have it handled only by a temporary project management system. The pure financing structure of this kind of effort may require some kind of more stable organisation. On the other hand companies specialising in joint venture management emerge as a possibility.[53] From the IPR point of view the question of who can utilise the results will have another dimension, when the basic rules of ownership and access rights are set by the Commission at the level of the whole project, and where deciding additional ownership and access rights will require various agreements even on sublevels.

In the **internal action** the IPR may be closed or open depending totally on the decisions of the management. When it is a question of any of the types of **collaboration activities** one of the factors influencing the openness of the results is, which phase of product life cycle the collaboration concerns: research or development.

What do we understand by ICT-based R&D collaborations, and what are the possibilities?

More and more research is being conducted using computers and telecom networks. Internet-based collaborations are becoming much more intensive. Thus a large amount of data and expertise can be shared, accessed and modified in common. From the technical point of view there are already some applications available for assisting in communication. With the help of a Netmeeting Program it is possible to connect via internet and have a conversation with several participants and at the same time show e.g. research data, slides etc. The connection is taken by e-mail. To a video conference you may additionally connect an electronic flipchart. This is in connection with the similar flipcharts elsewhere and the drawings and writings may be followed and redrafted in the other locations. Extranet solutions are used for project administration and for managing project data. However, this creates security problems especially, when it might sometimes be a question of a few thousand users. Web solutions are seen as a better choice where safety is in question. Sometimes there is a need to use software that is located in the server of one organisation but that is used by users outside this home organisation. Security problems arise here as well.

One thing that is very much needed is standard platforms for research collaborations. For example, there is the e-learning platform (BLACKBOARD). These platforms integrate a number of software tools that you install on your network that can be used by all participants. The tools include accreditation, testing, chat room, charts, evaluation, video conference facility, etc.

Global co-operation requires and is enabled by the tools for continuing communicating. These tools will be developed to make it possible for people on different sides of world to be in touch. Face to face contacts are still necessary, but the frequency may be reduced. To transfer tacit knowledge you need to have trust. As a human being this trust is easiest to build when you have met the person, and you have formed a personal rapport extending to more than merely those things that are needed for the work.

However, it does not seem that there would be any specific features that would differentiate the ICT-enabled collaboration from the more traditional ways of collaboration considering the IPR issues of the research results. If there are IPR problems they would be there anyway, stronger or weaker. The results of the research are today almost always involving ICT-usage.

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[53] See ETAN Report, n. 11.

What are the IPR and Knowledge Management problems and obstacles encountered?

Overall the ways of showing the intellectual capital and intangible assets on a balance sheet are developing and possibly becoming more important than showing a firm's financial capital. At the same time, it appears that the tacit knowledge, intelligence, creativity and relations carried by people are increasingly even more valuable.

As their intellectual capital is seen as one of the biggest success factors for any company and specifically in R&D work, the competition for highly talented people will make the R&D organisations become more people-oriented. This is a necessity also from the point of IPR strategies. High turnover of workers will make it extremely important for the R&D provider to ensure that everything is documented and filed in an efficiently organised database.

Private companies are constantly building up and forming their strategic views on their intellectual assets. They forecast where they are heading with their technologies and they can make decisions on protection of certain new invention on the basis of their strategy.

There is a growing awareness for a need to define clear strategies for IPR and core technologies also for universities and research organisations. They need to have something to attract funding clients and co-operation partners. There have been many attempts to provide proper valuation tools for technologies and IPR. This has been proven to be a hard task, as the value is different to different players. For a company itself using its own IPR the value of this IPR is easier to define. For an R&D organisation the value of the IPR lies in knowing what the value would be for its customers and collaboration partners.

It will be important for an R&D organisation to find the right timing for the transfer of the technology. This means the technology should be sold to a customer in that development phase, when it has the most value for the customer. Finding the right timing for technology transfer is assisted by close co-operation. The closer and tighter the co-operation is the easier it is to get more value for both of the partners, the company and the R&D organisation.

With the growing importance of intellectual capital, a certain level of hesitancy can be encountered within some university research groups about including members of private industry in their consortiums, in an attempt to steer clear of lengthy discussions concerning intellectual property. On the other hand a growing concern of the researchers themselves involves the spreading of knowledge and expertise that cannot immediately be protected by IPRs.

In public research organisations and universities the "business" decisions are often made in a decentralised way at quite low levels in the organisation structure (e.g. what kind of research is done to whom and in what terms). There is a need to take special care that the research staff is aware and feel bound to the strategy of the R&D organisation. When the most important thing for the researcher is his/her own feeling of continuation of work, s/he may easily agree to such terms that are not the best possible ones for the organisation. In this situation the results of the project may be left without an attempt being made at exploitation. At the same time strong insistence on certain modes of exploitation may reduce the effectiveness of exploration.

A large amount of attention goes to the rights linked with patents, but other regimes, such as software protection, are also regarded as very important. The protection of databases can be equally important, but seems to get less attention at the moment. This does not fit well with the ever growing importance and value of data and databases.

Another problem that arises because of the growing co-operation with different research groups, is the assignment of the rights in the final result of the research. In any loose collaboration and especially in the ICT-area, it can be very hard to determine in the end who contributed which part of the final product.

A large restriction on the development of science seems to be the reluctance of the parties to share their data. Sharing data and the accompanying tools would only work if the climate in the research environments regarding this was changed, which again is in fact a task for IP management which could e.g. be approached by fostering a property incentivised open exchange/sharing environment.

There is also a general conflict between academic and commercial partners between the need to publish and the need to protect to get economic return, as is well recognised.

What are the problems and solutions in specific types of collaboration?

i. Open IPR – horizontal and vertical

Open horizontal research occurs in a variety of contexts: government sponsored research to develop next generation infrastructure (for instance in the Internet, Web and grid domain); co-operative work within a scientific discipline to develop a common set of data, information and associated tools, or to organise research around instruments; mutualised pre-competitive industry research on platforms or standards. The reader will find a detailed analysis of the sources and types of free / open source software collaborations in the appendix.

When co-operative research aims at building a common infrastructure, or an open pre-competitive platform or standards, it must not only ensure the openness of the results, but also take some guarantees for this openness to be sustained. A simple publication or "public domain" type of status will not meet the objective of sustainable openness unless it is supported by an adequate license guarantee against re-proprietarisation of slightly extended or improved versions of the results.

One key issue in horizontal co-operative research is to enable sufficiently low total transaction costs in the sharing and dissemination of results. A scheme in which every piece of (partial) results can be published only through being submitted to a process of formal notification and approval (such as stated in the present rules for Framework Programme RTD) introduces very high transaction costs. It is thus very important for as many as possible of these issues to be agreed upon up-front, within an a-priori agreement, without too many renegotiation options.

The vertical type of collaboration is usually done more in the development phases of a technology, although this pattern could change. The IPR is mostly kept closed from the publicity. However, if vertical type of collaboration is done in the research phases the problems with the IPR are the same as in horizontal type of collaboration. In this context one should be aware of the close mutual interrelations over time between R&D and between science and technology in general, invalidating a linear view of innovation as proceeding one-way from research to development to innovation to market diffusion. The ETAN report entitled "Transforming European Science through ICT : Challenges and opportunities of the digital age", especially chapter 5, further illuminates these points.

IPR issues in Bioinformatics
(Based on workshop report – http://europa.eu.int/comm/research/era/pdf/ipr-bioinformatics-workshopreport.pdf)

Key Recommendations for Policy and Best Practice in Research and Knowledge Management

Bioinformatics - Bioinformatics, a very general term, includes among other areas the computational analysis and manipulation of biological sequence and 3-dimensional data in which pattern recognition helps the researcher to detect sequence similarities and infer structure and function. It is clearly a research tool of value in itself irrespective of the ultimate, possibly commercial, use to which it may be put. Apart from its inherent value to science, bioinformatics may be used to discover end products of value to health care and the industries which invest in developing marketable products.
The types of IPR in Bioinformatics - In bioinformatics, there is a "stacking" of rights. Patent rights protect the use of the genes themselves. Sui generis rights go further than patent rights. Copyright and sui generis rights can overlap. IPR in this field requires proper management.
Patents and Biotech directive - Biotechnology is placing new challenges on the patent system. The areas of invention and discovery are blurred. There are also problems in understanding how a protein really works - a protein may typically have several functions. Gene patenting does not really prevent knowledge dissemination, since it all goes into public databases.
Software - Software patenting is not widely used in this area, as companies are often more interested in keeping it as a trade secret. Software is also protectable by a range of copyright, including a variety of open source licenses.
Copyright and Database law - Copyright law protects expression, but not the underlying ideas. EU database law protects a collection of data. Patents prevent others from using the underlying ideas. Database rights are automatically generated, even if data is freely provided. Software can be protected by copyright and software, with more extensive software patent protection available in the USA than in the EU. The use of database law is complicated by the uncertain nature of database definition. "Flat" files are easier to assess in terms of IPR, where the visible record corresponds to the stored record. It is much tougher with "3D" files, where no visualised record exists, each one is assembled in a custom way from many sources.
Ownership - In academic institutions especially, the ownership situation is often unclear, most especially in collaborations, depending on whether or not employment contracts are clear.
Revenue from databases? - It is difficult for universities and SMEs to generate a significant revenue stream on IPR protected databases and software, unless the databases are large and comprehensive. IPR protection should be used, where appropriate, to achieve broader strategic objectives such as encouraging collaborative project funding and building core knowledge, rather than just licensing income.
Employees and ownership - Universities and public research institutes need to review the terms on which they manage IPR generated by the work of their employees, especially where such work contributes to infrastructure (such as databases and related software tools) of relatively permanent value, but whose value and maintenance depend upon the continuing personal commitment of individuals who may move or lose interest. A consistent policy on ownership of database rights, responsibilities, benefits sharing, and support is needed.
Database ownership - IPR ownership and the roles of electronic database publishing companies pose new challenges that need careful and well understood rules and best practices for all concerned parties, with a balance of rights and responsibilities.
Access to databases - Concerning IPR-controlled access to databases and software, a period of experimentation may be appropriate, ultimately leading to better co-ordinated policies addressing various goals, while not compromising on the need for publicly available bioinformatics databases without charges.

Key Recommendations for Legal Adaptations

Relevant legislation - Political decision-makers need to understand that for a knowledge based economy, and particularly in bioinformatics, IPR is of fundamental significance. Database and software definition and protection within IPR legislation needs to be relevant to bioinformatics research.
Encouraging life science research - Government regulations and legislation should be reviewed to see if they are encouraging life sciences research to remain in the EU, and how IPR provisions influence these choices. The EU and Member states in future need to look at the funding imbalance between the USA and the EU in bioinformatics, as well as the legal, political and public perception environments for research.
Public/private collaboration - While maintaining a strong public sector, public funding and IPR rules should also encourage collaborations, especially public/private ones, that mobilise resources and support innovation. Continuous monitoring is needed to see that public and private sectors remain in balance.

ii. Closed IPR – horizontal and vertical

Horizontal collaborations are typically oriented at the research stage although this may change as well due to technological complexity, and all the partners have some interest in exploitation of results, either for future profit or for building core competencies. As a result, the allocations of IPR rights is complicated in one sense since all partners are similarly interested, but easier in that the research is still highly uncertain with some distance from the market. In vertical collaborations, running essentially from basic research through to products, it is easier to discuss IPR allocation, since the roles and goals of each partner are somewhat clearer and different from each other.

There are a wide variety of homogeneous and heterogeneous partners at the horizontal research level. Also, many organisations are no longer purely academic or commercial, but are subject to a range of goals and pressures.

Each time a corporation or a research organisation engages in R&D activities, the question about the ownership and the user rights on the results of the R&D activities will have to be resolved, preferably before the R&D activity is effectively launched.

The legal entity executing the R&D activity will often not be the (only) legal entity exploiting the results of the R&D activity. Therefore within most large corporations, a system is put in place, whereby all the legal entities that have a need to use the results of the R&D activity, will have appropriate access to it. With respect to patents, corporations have established specific patent strategies, allowing them (i) to stimulate creativity with their collaborators and (ii) to protect themselves against attacks based on infringements of patents owned by third parties.

The same basic problem is evident for the research organisations and universities. When they take part in an R&D collaboration project they need either to be remunerated for all of their costs, including royalty for access rights to their background knowledge, or they need to be provided with the necessary ownership or access rights to allow them to organise the proper utilisation of the project results so that their own costs will be covered. They also need to take care of building up their core competencies and intellectual assets and the proper sharing of foreground knowledge, as well as interfacing with their sideground knowledge.

One model used in Europe is that the industrial partner is sponsoring at least 50% of the costs of the academic partner or research organisation. The rest of the funding comes from public sources. This collaboration is usually bilateral and is used rather in the development phase than in the research phase and therefore the results are usually initially kept secret. In this model, the ownership of the results generated in the R&D action belongs entirely to the industrial partner. The academic partner is in some cases granted a right to use the results of the co-operation for further R&D activities, without prior approval of the industrial partner being required in the event the subsequent R&D is done for internal academic or research purposes. In cases where the subsequent R&D is for the sake of third parties, the industrial partner will in most cases insist on a certain right of control, by claiming a veto, for example when the subsequent R&D is intended for the benefit of a competitor of the industrial partner.

This model has become less attractive for certain academic partners. An example of an IPR scheme increasingly used makes a distinction between several categories of results, type A results and type B results, whereby the type A results are defined as results closely related to the applications and activities of the industrial partner and the type B results as results related to more generally applicable methods, processes etc.

The ownership of the type A results still belongs exclusively to the industrial partner. For the type B results, more extensive rights are granted to the academic partner, or by granting co-ownership rights on the type B results or by granting the academic partner a right to use the type B results for subsequent R&D activities and even exploitation purposes.

When the R&D activity is organised in the form of a co-operation with third parties, a number of specific issues will have to be dealt with.

Already in the phase of selection of the partners for the co-operation, the potential partners, and especially the industrial partners, will often pay special attention to protection of their confidential information. To maintain the protection as a ‘know how’ or ‘trade secret’ for the ideas and information in technical documents, it is necessary to hinder uncontrolled availability to outside parties by measures like locked cabinets, and the application of standardised protection marks. Therefore it will be necessary to enter into a confidentiality or non-disclosure agreement.

In the horizontal type of collaborations especially the industrial parties are ready to share the results among the participants of a project free of charge. They will only collaborate with their competitors if this is approved by management. For research organisations and universities taking part in these projects this might become a problem. If they invest their own funds they would need to be able to gain this investment back at some later stage. Not being in the market of producing concrete products, but research services, and therefore often not being able to commercially exploit their own results generated in these projects, they would need to gain royalties from the industrial partners.

In the vertical type of collaboration the industrial parties most probably do not compete with each other in the market with similar products. Therefore it is easier to agree on access rights to the results for the other participants. However, this does not change the need of research organisations and universities to collect royalties on their own project results.

For both the horizontal and vertical type of collaboration in the ICT-area the problem of not being able to differentiate which part of the final research results originate from which collaborating party must be solved somehow in collaboration agreements.

In summary, IPR considerations are key in all phases of the research process, all the way from forming research collaborations to exploiting the results. The distinction between horizontal and vertical collaboration is also likely to become increasingly blurred due to technological complexity. In order to investigate IPR-ICT issues researchers and research-performing organisations may be confronted with in their collaboration, a table has been constructed below that allows organising the way in which IPR and ICT are interlinked in the different phases of the research process cycle. This table is based on literature findings and common knowledge, and not on a piece of empirical research. However, the table yields some interesting insights, which may call for more empirical research relating to the interface of IPR and ICT in the research process.

The sociology of research type of model underlying the table is based on the idea that the research process is one of “conception and adoption” in which, during the different stages of this process different types of actors (researchers from universities, RTO’s, companies, public authorities, IPR authorities etc.) link with each other in different configurations. Different configurations often yield different types of output as well as different opportunities for the different actors involved (e.g. subcontracting of a piece of research often means that IPR are with the financier of that research; working in a consortium, such as for the European FP's obliges the members to negotiate specific IPR arrangements etc. every time).

Construction of the Table

The **rows** in the table represent different stages in the "research process cycle," i.e.:

- Origins/Background of a research project
  - Each research project begins with hypothesis, a justification etc. which has to be constructed somewhere.
- Defining a concrete research project
  - Research is (increasingly) a quite formalised activity which is well prepared, with proposals written, preparatory meetings between the members of a research team organised, etc. This is captured under this heading.
- Arranging collaborations or outsourcing of research
  - If the research project is not carried out within one single organisation, collaborations have to be initiated and organised. Several forms of collaboration exist of which normal subcontracting is only one (and seldom seen within the research context).
  - Note that this and the previous item are not necessarily in that order – both can occur simultaneously or interactively, reality being less straightforward than theory, i.e. the definition of a research project and the arrangement of concrete collaborations may happen at the same time, hence contributing to the definition of the project.
- Obtaining funding
  - A research project has to be financed, in order to pay for human and material resources. Resources can be internal to each partner organisation of the collaboration (e.g. part of salary costs), can be internal to the collaboration (e.g. one partner subcontracting another for a piece of research work), or can be external to the collaboration (e.g. a research consortium obtaining funding from the Framework Programme). Most of the time all three finance flows are at stake and they may have impacts on IPR (e.g. in public procurement or "full subcontracting" IP is normally owned by the buyer; in a cost shared project IPR has to be defined explicitly).
- Performing the research
  - Once the partnership has been defined the research has to be carried out. Again several configurations exist, e.g. "modular" (every individual organisation works for itself then the results are collated), "integrative" (members of each individual organisation work on the same laboratory bench, etc.).
- Obtaining the results
  - Research normally should lead to results, which can take several shapes, first graphs, measurements, code, …, next publications, prototypes, etc.[54] which, in order to be subject to IPR have, *in fine*, to be translated into text.
- Protecting and disseminating research results
  - In order to be subject to IPR it should be possible to translate the results of research, in fine, into text, data, designs, models, programs and the like.
- Exploiting research results
  - Once they are properly protected (or explicitly not: e.g. scientific publication, open source code…) they may be exploited.

[54] B. Latour's "Laboratory Life" (1979) and "Science in action" (1987) are still highly relevant pieces of work to understand the practice of research(ers).

- Bodies of literature that can be referred to
  - Instead of referring to specific articles each column and (sometimes) each line refers to specific bodies of literature (in itself an interesting finding) which will be presented here.

The **columns** in the table refer to different elements of interest within the framework of this expert group. These are the "criteria relating to IPR-ICT issues," i.e.:

- Coordination mechanisms for shaping the collaboration in each specific phase
  - In each phase (referring to each line, see above) a range of configurations to collaborate is open to the partners of a collaboration, which for each stage will be listed in this column.
- ICT role in enabling collaborations
  - ICT will play a role in each stage, and this role may differ between stages. Different types of uses of ICT exist.
- Role of specific content of research (biotech, physics, informatics…)
  - It may be that the content of the research, the area of research or the object of research has an influence on the way in which the collaboration is shaped, ICT is used or produced, and on IPR.
- ICT as outcome (specific case of previous column)
  - Some pieces of research not only use ICT but have ICT as their outcomes (e.g. in information sciences: software; in biotechnology: databases). This may have special consequences for IPR.
- IPR role (amongst which, legal issues)
  - In each stage of the research process cycle, the role of IPR may differ. For instance, in defining research one has to know what the IPR-status of scientific material to be used is, or be aware of patents; in performing research it is important to make IPR arrangements, etc.
- Actors that have ability to act upon IPR
  - Not all actors in the process have similar ability to act upon IPR. First there are those of course who have the IPRs needed to perform the research project, which may or may not be associated with the project; then one has those actors who will acquire IPRs through performing the research which has to be accounted for. The influence and nature of this IPR ability will differ between stages and asking oneself the question may well change the way in which the collaboration is established.
- Organisation (global/local, public/private)
  - Although the public-private and local-global "divides" play a transversal role throughout the table, in some stages they may be more significant than in others. It seems especially important to note the changing behaviour of public research organisation and universities with regard to IPR (more towards protecting their own knowledge production; behaving increasingly as private companies in that respect).
- Examples
  - If possible some concrete examples will be given here.

Stages in the research process cycle	**Coordination mechanisms for shaping the collaboration in that phase**	**ICT role**	**Role of specific content of research (biotech, physics, informatics…)**	**ICT as outcome (specific case of previous column)**	**IPR role (amongst which, legal issues)**	**Actors that have ability to act upon IPR**	**Organisation (global/local, public/private)**	**Examples**	***Bodies of literature***
Origins/Background of a research project	Roadmapping, foresight, strategic exercises; more or less explicit needs / problems definition; previous collaborations	Internet search; internet partner search; established networks, internet publishing of strategic exercises' results, bi/multilateral electronic communication …	Depending on the area / discipline, strategic exercises and research programmes (in the sociological sense of the word) may be more or less explicit; links between actors may be more or less formal or formalised, and therefore research priorities and paradigms more explicit and shared	This depends on the area. Those that produce software (see Appendix on open source); but also those that produce databanks (cf database directive for instance). Note that the **medium** that carries research results will increasingly be numerically (digital, electronic) based	Different areas and subareas have different IPR traditions which should be taken into account. As the main text of the paper clearly points out, under the influence of ICT, area-specific IPR traditions are undergoing severe changes	The actors involved in earlier research cycles (cf last cell of extreme left column: "exploiting research results"). In fact this line in the spreadsheet is not only the first of a new "research cycle" but also the last element of previous "research cycles"	The public-private and local-global distinctions are transversal to all cells of this table; therefore only some highlights are given below	Roadmapping exercises	*Foresight & Strategic Planning literature ; concrete research planning processes; Sociology and History of S&T*

Stages in the research process cycle	**Coordination mechanisms for shaping the collaboration in that phase**	**ICT role**	**Role of specific content of research (biotech, physics, informatics…)**	**ICT as outcome (specific case of previous column)**	**IPR role (amongst which, legal issues)**	**Actors that have ability to act upon IPR**	**Organisation (global/local, public/private)**	**Examples**	***Bodies of literature***
Defining a concrete research project (this and the following cell are not necessarily in this order - both can occur simultaneously or interactively, reality being less straightforward than theory)	Existing collaborations; Meetings; Virtual Meeting; electronic communication; telephone communication	Support to bilateral and multilateral communication (e-mail, video conf, telephone conf …); Electronic databases used to review prior knowledge and identify IPR protected areas	Access to information in electronic form; In some areas (eg biotechnology, meteorology, in which data banks are increasingly important) ICT has become a crucial research tool related to the substance (and not only the organisation) of the work (or rather: organisation and substance of the work are completely intermingled); the expectation is that this will increasingly be the case for intially less "ICT based" research areas	Make pre-arrangements regarding protection and/or accessibility of the produced ICT (hardware, software, databanks)	Review prior knowledge; identify IPR protected areas, and the "IPR conditions" (depending on area, on type of research result, etc.)	The actors directly involved in the research project, eventually governed by the IPR rules in effect in their respective organisations (cf within a public research organisation, a company…); the IPR protected areas themselves will have a strong impact on IPR opportunities; but now also those who OWN the information (cf paid access to electronic libraries) will be able to have major influence	Shifts are occurring in the way in which "public" research organisations behave with own IPR policies; Shifts have occurred in private companies' way of performing R&D (more outsourcing to global pool of RTO's - cf attractiveness of territories discussion); on a more "micro"-level, researchers will work in teams and do so often with the peers they are already used to working with.	Preparation of a project for the European Framework Programme for R&TD	*Contract and research alliance theories (cf Williamson and onwards) applied to research collaborations. Several schools exist. They should integrate the ICT aspect. The theories are not fixed once and for all, since the world (and thus the way in which collaborations are shaped) changes*

Stages in the research process cycle	Coordination mechanisms for shaping the collaboration in that phase	ICT role	Role of specific content of research (biotech, physics, informatics…)	ICT as outcome (specific case of previous column)	IPR role (amongst which, legal issues)	Actors that have ability to act upon IPR	Organisation (global/local, public/private)	Examples	*Bodies of literature*
Arranging collaborations or outsourcing of research	Negotiations on project team / consortium set up (who leads, contact with funder, contractual agreements to be set up, more generally, roles of every partner in the collaboration)	Use databases to identify partners/contractors	There may be a relationship between "discipline" and organisational structure	There may be a relationship between "discipline" and organisational structure	Use IPR databases to identify partners/ contractors; Negotiate IPR arrangements (increasingly often done before/during contract signature)	Those (whether or not involved directly in the collaboration), that hold the IPRs. Define IPR arrangements at this stage	See above cell	Partner searches. Exchange draft contracts	*idem*
Obtaining funding (note: funding can be internal to each partner, internal to the collaboration, external to the collaboration)	Different types of funding mechanisms, function of type of funder (public, private; research or procurement), type of funded entity (university, RTO, not for profit, private company)	Electronic communication for preparing and establishing contracts between partners in the collaboration and with the eventual funding organisation (eg electronic proposals in FP5)	Some areas will be more "en vogue" than others, and over the last years, ICT on the one hand, Life Sciences on the other hand are areas that have relatively obtained the most of the increases in R&D funding in most of the European Member States	*See Appendix on Open source*	Access to IPR may be impossible or have a cost involved which should be taken into account in the process of obtaining funding	Apart from those already in possession of the IPR needed to conduct the project, the financiers of the project can have a major influence on the way in which IPR arrangements should be settled		Write a proposal to funding bodies, or financiers ; present the R&D project	*There is apparently not much theoretical literature on funding of research*

Stages in the research process cycle	Coordination mechanisms for shaping the collaboration in that phase	ICT role	Role of specific content of research (biotech, physics, informatics…)	ICT as outcome (specific case of previous column)	IPR role (amongst which, legal issues)	Actors that have ability to act upon IPR	Organisation (global/local, public/private)	Examples	*Bodies of literature*
Performing the research	Different configurations are possible for performing research, eg "networked", "star", "hierarchy", "clustered", "subcontracted"…; both research results, communication (whether or not through ICT) and IPR will relate to this configuration	(1) Electronic communication during the course of the research process; "team"-work even across different entities may result in "blurred" effective boundaries on the project level (eg a researcher identifying more with the collaborative project than with the organisation s/he formally depends on); (2) electronic archival of research results; (3) quality systems in place will enhance the use of ICT during the research process	"Research on research" has shown some time ago already that the way in which research is performed depends both on the area/discipline and on the research object and its eventual "modularity". .More recent work establishes methodology to look into these issues. The hypothesis here is that different research areas (rather than disciplines as a whole) will have different ways of organising themselves on the micro level of research performing; this will be co-determined by ICT use within the collaboratio.	*See Appendix on Open Source*	Protect knowledge during research process. Research organisations should be aware of the fact that researchers (or more generally members of a project team) are, because of ICT, identifying themselves more easily with the team rather than with the organisation they formally work in. This may have consequences for IPR to "slip out" of the formal organisation to other ones. Moreover it is not necessarily the researchers first preoccupation to deal with IPR issues, but to do research in a satisfactory manner (both in public and private sphere)	Once in the stage where the research is concretely performed, and under the hypothesis that IPR arrangements have been made at the start and the necessary IPR to conduct the research is acquired, those that can act upon IPR in the first place are those who carry out the research, i.e. the researchers of the project team; the immediate second layer of influence on IPR issues are the organisations they work in	Prolongating the left cell, there will be different rules for IPR for different organisations. Researchers are not necessarily aware of the IPR rules within their respective organisations (though one may expect researchers in private or semi-public organisations be a little more aware of this. Again a shift can be noted in the policies of public RTO's towards IPR	Collective laboratory work; computer programming activities …	*Several "research on research" (sociology, economics, socio-economics, history, anthropology) strands do exist since the beginning of the 1970s*

Stages in the research process cycle	Coordination mechanisms for shaping the collaboration in that phase	ICT role	Role of specific content of research (biotech, physics, informatics…)	ICT as outcome (specific case of previous column)	IPR role (amongst which, legal issues)	Actors that have ability to act upon IPR	Organisation (global/local, public/private)	Examples	*Bodies of literature*
Obtaining the results	Depending on the arrangements made the results will belong to one or several partners of the collaboration. Transfer of final results will depend on the previously made arrangements and collaborative structure (see cell above); if IPRs are to protect the results BEFORE disclosure (see next line), then arrangement should be made to not disclose results, if needed	Level of restriction of access to other information systems		In the case of ICT as an outcome, refer to *Appendix on Open Source*	Protect knowledge during research process; protect knowledge with appropriate IPRs during the process; in order to be able to do this, one has to be able to "sieve out" continuously what belongs to whom, made more difficult by the increased electronic collaboration between the members of a research team.	Again the researchers within the project team can act upon the IPR, but their relation to the organisation becomes increasingly important here: the question is at what time the organisation's IPR expert starts to involve with the project; doing this at the moment of obtaining the results only may be too late, especially when ICT has earlier on facilitated the exchange of research results.	Same arguments as above and left cell.	Results are only "obtained" if they are materialised through either scientific results (measurements, graphs, tables…) or new technical objects (prototypes, computer programmes, etc.), which can be captured in words in order to be subject to "IPR-isation"	*idem*

Stages in the research process cycle	**Coordination mechanisms for shaping the collaboration in that phase**	**ICT role**	**Role of specific content of research (biotech, physics, informatics…)**	**ICT as outcome (specific case of previous column)**	**IPR role (amongst which, legal issues)**	**Actors that have ability to act upon IPR**	**Organisation (global/local, public/private)**	**Examples**	***Bodies of literature***
Protecting and disseminating research results	Idem. This again points out that making GOOD arrangements in initial phases of the collaboration is crucial	Copyright; Access restrictions	Again, opportunities for IPR and traditions will depend on the area of concern	idem	Protect research results with appropriate IPRs (before disclosure)	idem	idem	idem	*IPR literature*

Stages in the research process cycle	**Coordination mechanisms for shaping the collaboration in that phase**	**ICT role**	**Role of specific content of research (biotech, physics, informatics…)**	**ICT as outcome (specific case of previous column)**	**IPR role (amongst which, legal issues)**	**Actors that have ability to act upon IPR**	**Organisation (global/local, public/private)**	**Examples**	***Bodies of literature***
Exploiting research results, by converting results to a commercial product, and by successful marketing	Research often takes longer to be converted into a commercial product than over one single "research cycle". So, in a "conception-adoption" logic of the research process, in principle the whole cycle would start all over again, and the cells can be filled for new partners in the collaboration, for a new configuration of the collaboration, for new ICT uses, for new IPR agreements etc	ICT plays an increasing role in publishing results (once they are IPR-protected). Cf also discussion on open source related topics	Channnels of dissemination and "valorisation" will depend on the area		Use IPRs to secure R&D investment (internal, loans, venture, etc.); use IPRs as a bargaining currency to assemble complex products; use licensing for revenue even without direct exploitation; use IPRs for enforcement against copying or pirating (~6% of world trade)	Those who are in possession of the IPR of the products that are to be adopted by other actors. Difference between "commons" and non-proprietary information. As main report shows, there is a trend that in various sectors elements of information are losing their status of commons, amongst which, the research sector	The impression exists that this trend is not limited to the private sector only. Also the public research sector is becoming increasingly IPR aware	CNRS (French fundamental research organisation) developing an IPR policy	*Economic literature on research commercialisation, on business alliances, product development, etc., intially very much focused on private R&D (cf Twiss 1986 handbook; Klein & Rosenberg 1986 (chain-link model); Porter et al, 1991 etc.) but now increasingly adapted to account for public R&D, and public-private collaborations (cf Callon et al., 1995, and more generally the research evaluation literature*

Stages in the research process cycle	Coordination mechanisms for shaping the collaboration in that phase	ICT role	Role of specific content of research (biotech, physics, informatics…)	ICT as outcome (specific case of previous column)	IPR role (amongst which, legal issues)	Actors that have ability to act upon IPR	Organisation (global/local, public/private)	Examples	*Bodies of literature*
Bodies of literature	*"Socio-economics of research" literature*	*Cf work of the previous expert group on ICT in research collaborations*	*Database directive; a small set of sociology of research publications studying the link between discipline and research practices*	*See Appendix on Open Source and on Sources and types of free/open source software collaborations*	*IPR literature*	*IPR literature to be combined with empirical insights on real research collaborations*			

In Summary

The table, with all the limits it has, highlights some interesting issues:

- Making good arrangements for IPR before a research project starts becomes increasingly important as ICT is becoming increasingly used within research collaborations.
- In the different stages of the "research process cycle," different actors can act upon the IPR issues:
  - Before the research project it is those who possess IPR already who have an influence on setting up the collaborative research (up to linking with these actors).
  - The financiers of research can have a major influence on the way in which IPR arrangements between participants of a collaboration should be made; IPR
  - During the research project the members of the research team (involving researchers from the different organisations) can act upon IPR; this is especially important for the individual organisations, which may want to liaise more strongly with their researchers in order to make IPR policies understood – increasingly important when, on the one hand, ICT facilitates information exchange between individual researchers of different organisations and, on the other hand, IPR policies within public research organisations are enforced.
  - Once the results are produced, the whole cycle starts all over again though with different "actor-configurations" and different implications for IPR

5. SCIENTIFIC PUBLISHING AND ICT

Scientific publications are of the utmost importance for dissemination of information and furthering research and development. Their existence is to a large extent supported by public funding of higher educational establishments and research institutions.

The researcher as a writer

Independent of the technology used, the researcher wants, and society expects, the production of a report of the work performed that will remain readable over time. This work establishes or confirms the author's position as a valued and respected member of the scientific community. Career, prestige and other issues such as funding and communication within a discipline, take the certified and authenticated document as pivotal input.

In an electronic environment, we see a change in form. The reporting ceases to be a traditional document, developed from the archetypal letter to colleagues, that is self-contained and has a linear argumentational structure. In an e-environment, the report can range from pure text, to a mixture of textual and non-textual elements, to non-textual elements only, with a simple data set as an extreme case. All contextual information associated with the reporting can be "outsourced" by adding hyperlinks to relevant explanatory and/or contextualising information elsewhere.

An additional aspect is that the author is perfectly capable, within the limits of a stable software environment, to produce, store and distribute her/his production her/himself.

At present, it is this feature that, at the level of the electronic translation of the traditional document, receives considerable attention from so-called self-publishing initiatives.

Though in the world of self-publishing, ICT allows for transparent communication by, e.g., the establishment of (pre-) print servers and the Open Archive Initiative, three crucial features are not yet tackled by these technological user aids;

1. the organisation of the validation, certification (peer-review) and standardisation procedures;
2. the translation of all contributions to a standard storage form such as XML; the availability of a file is no guarantee at all that it can be read, and certainly not after an extended period of time;
3. the fact, that all these activities remain on the level of the traditional document, instead of looking ahead to the new structural forms of e-documents.

Not only are academic and research institutions contributors to these publications, they are also consumers of such publications. Other consumers of such information can be found in industry and suppliers of professional services.

The researcher as a reader

The reader, who is in an academic environment, frequently also an author, expects from a work that it has a recognizable authentication of authorship as well as a clear validation and certification level, ranging from, e.g., an institute's name to the established peer-review level of a particular journal. Furthermore, the reader needs clear indicators in the form of keywords or classification codes, as well as information as to what extent a particular work has been used by others (citation feedback). An important reader demand is the direct availability of the work in a form that is consumable, i.e., compatible with the technological infrastructure of the reader (OS-platform, viewer software, screen and printer drivers, etc.). In an e-environment, an immense improvement in the storing, searching, finding and retrieving capabilities emerges. Crucial here is the tedious stability issue of storage systems, and software standards, i.e., mechanical wear and the lack of standardisation. Given the pace of the development of scientific reports that entail more than text only, the digital preservation problems are high on the agenda.

Yet many of these publications are marketed globally at a uniform price that has been rising at a higher rate than inflation. Alternative means of electronic distribution are mooted as a solution for price concerns in the market of scientific publishing. In an electronic environment price differentiation between copyright creators (Academia) and non-creative users will develop further.

In view of the developments described above the market for scientific publishing has come under scrutiny of competition authorities. The UK Office of Fair Trading, despite its findings of market distortions did find grounds to intervene.[55] The argument given is that ICT has enabled academics to bypass traditional commercial publishers, so that non-commercial e-journals will become the norm in scientific publishing. It is questionable whether this optimistic assessment is warranted, as the very expensive electronic infrastructure demands permanent investments (opposite to traditional publishing) as this will add extra services to the product e.g., usage statistics, search interfaces, etc.

The publisher's added-value chain and the library

In the paper world, an artificial split occurred between the creation process and its service sector (the publisher) and the consumption phase (catered for by the library). This split was a consequence of the technology used, where finished products were shipped away and stored and used in places unknown to the creator. In an e-world, lots of processes are combined:

- Production is not necessarily bundled into e.g., journal issues. Although the journal as a certification entity that defines a unity of a disciplinary field, a quality level and a culture, will certainly remain as a filter, independent issues of a journal will cease to exist. Publishers are starting to publish article-by-article (and then often bundle a series of articles in a paper issue).
- Electronic production requires a strict production standardisation of information platforms. This means that the web application Extendable Mark-up Language (XML) of the ISO Standard Generalized Mark-up Language (SGML, ISO 8879) forms a universal approach enabling interoperability, easy transfer between platforms and superior search capabilities. Ideally, all author-prepared documents in all available (and often highly idiosyncratic) word-processor packages must be translated into this standardised form to ensure that the material remains usable over an extensive period of time. The use of an XML approach does not mean that all structuring schemes are the same. Publishers develop their own applications, which certainly do not yet map into each other on a one-to-one basis.
- Due to raised expectations resulting from web technology most large publishers are now in the process of converting all back volumes of their journals into an electronic archive form. This involves millions of pages from the back catalogue and implies that some library functions will shift to the publisher. For instance, in November 2002, Elsevier Science's database Science Direct (www.sciencedirect.com) reached the figure of 3.2 million articles tags. In May 2002, 335 new titles of the new acquisition Harcourt General were added. More than 100,000 articles are added per year. A repository is thus created, which, when linked to similar archives of other publishers will completely change the library function for journal serials.
- At present, an endeavour is underway to allow for cross-linking between publishers. This means that every literature reference in an article is augmented with a hyperlink to the database location of that document. A special foundation, the Digital Object Identifier, has been created (www.doi.org), whose results find a commercial application in the Crossref organisation, in which as per today, 157 (commercial and not-for profit) publishers collaborate (www.crossref.org). Such an inter-industrial collaboration demands standardisation as well as considerable investments. ICT allows this initiative to achieve a complete archive of all science ever published. It goes without saying that the access rights for such systems have to be monitored with care.

Authors and research institutions increasingly feel uneasy with a complete transfer of copyright, they do wish to have their own works available on their own web-sites, therefore a shift to licensing agreements may be expected. University-based initiatives that contest commercial publishers so far rarely introduce enhancements in the search and retrieval functions. Conversely, publishers guarantee long-term availability and interlinking of all scholarly research documentation on a common standardised platform, the organisation of

[55] Office of Fair Trading, *The Market for Scientific, Technical and Medical Journals* OFT396, September 2002 (2002, London, OFT), available at www.oft.gov.uk.

peer review and the standardized structuring of the information in such a way that search engines can go beyond simplistic free-text to contextual searching. The scientific paper becomes embedded in a cognitive web of related works. The value of the singular paper will become highly defined by its environment. The IPRs of the paper will be augmented by the IPRs of the embedding database, their structuring schemes and added indices. A caveat in all these stormy developments is that the publisher's database becomes far more than just a repository of independent documents. This will have strong implications for the usage as the EC Database Directive defines such a database as a protectable object in itself.
A second major concern is that every instantiation of a "work" becomes a convolution between the mental product of the creator and a random selection of indispensable soft- and hardware tools (operating system, word processor, image processor, screen, memory system, etc.) carrying their own IPRs. This convolution (or entanglement) of rights may very well become a barrier for the free flow of information, the advancement of science and all societal functions IPRs are supposed to protect.
Whilst in a traditional environment all different kinds of expression are embodied in different analogue media, the main feature of an electronic "creative object" is that all expressions (texts, sound, picture (stills and moving), pure data, etc.) are now stored into the mono-medium of binary signs. From there the whole work or a selection is converted to an expression/presentation. Creation as well as consumption then demands auxiliary IPRs.

An outlook on future development

In Summary, the integration of text, images, sound files, data, etc. in the presentations of research projects (plans and results) demands a high level of integrated software environment. Not only does such an environment require well structured systems of meta-data but also the relationships between the various different objects need better structuring. As in all sciences, the dialectic between the definition of an object as an independent entity and the subsequent definition of types of interactions between these objects is essential in describing reality as a whole. Classifying hyper-links in classes that indicate the reason for the link will certainly be a leap forward. There are also impediments to development; e.g. the lack of interoperability of application software. A strong call for standardisation on a low level is warranted (see also the discussion on open source). If such standardisation is in place world wide 'collaboratories' can perform integrated research based on geographically distributed experiments.

A new phenomenon is the increasing interest in the status of intellectual ownership of scientific results and their relation with reproduction and other rights. A situation takes shape where universities are increasingly forced to act as corporations and as a result will negotiate with their staff the precise terms of the various IPRs. On this basis university administrations will change old provider-customer relationship with e.g. publishers towards a more differentiated relationship. The publishing industry will develop into a broader service industry where on-line storage, usage statistics, search interfaces and archiving will be new "products" next to the traditional editorial ones.

APPENDIX: SELECTED CONTRIBUTED PAPERS

Joost Kircz,	Concerns on electronic publishing and IPR
Knut Blind,	The Role of Patents in Nanotechnology and Software
Rishab Aiyer Ghosh,	Open Source as a training system and US/EU differences
Philippe Aigrain,	Sources and types of free / open source software collaborations
Jeremy Scholes,	Competition Law and R&D

CONCERNS ON ELECTRONIC PUBLISHING AND IPR

Author: Joost Kircz (kircz@kra.nl)

The publishing sector is a service industry enabling the transfer of research results to and from producers and consumers. An interesting phenomenon is that next to the industrial/ governmental users of scientific results, it is the research community itself that is one of the main consumers of scientific reporting and the results presented in this reporting. With a metaphor one can consider publishing as a kind of digestive system in which knowledge is circulated and where once in a while results are excreted or in some cases funnelled by osmosis to societal applications.

1) What is a work? The role of databases

Opposite to the monolithic paper document, an electronic document is a well-defined set of different kinds of elements: texts, images, tables, sets of hyperlinks, and data. The E-document is an envelope of independent objects, in the same way a molecule is a unique object consisting of equally unique atoms. The E-document can then be considered as a new object with various levels of granularity that can be accessed separately.

An essential feature of an E-publication is that it is linked to other works (or elements thereof), hence, in an official publication, hyperlinks must be validated (peer-reviewed) and certified. By nature an E-publication is part of a virtual world-wide database. As soon as works are loaded on a (publisher's) web-site and value is added by, e.g. the maintenance of links, the conversion to a standardised storage scheme etc. we can speak of a database that can claim the database protections given in the EC Council Database Directive. A publisher's database becomes an integrated whole, an object by itself.

2) The role of software

Every instantiation of a "work" becomes a convolution between the mental product of the creator and a random selection of indispensable soft- and hardware tools (operating system, word processor, image processor, screen, memory system, etc.) carrying their own IPRs. This convolution (or entanglement) of rights will become a barrier for the free flow of information, the advancement of science and all societal rights IPR is supposed to protect.

Whilst in a traditional environment all different kinds of expression are embodied in different analogue media, the main feature of an electronic "creative object" is that all expressions (texts, sound, picture (stills and moving), pure data, etc.) are now stored into the mono-medium of binary signs. From there the whole work or a selection is converted to an expression/presentation. Creation as well as consumption demands auxiliary IPRs.

3) How do we measure/pay usage?

In the analogue world there is a distinct difference of payment for author's rights in different media (second hand books, film, art). If everything is stored in the binary mono-medium, every "usage act" can be charged. The implications are twofold:

i- Innocent browsing information (flipping though pages in a bookshop, listening to one track of a record in a music shop) becomes impossible. Every “consumption” act is part of an “e-commerce” activity. It becomes a bit like a museum where you pay licence for a limited time to view art. The downloading of a file than equals the purchase of a Mona-Lisa postcard.
Consequently the outcome of scientific research has to be identified with a licence feature enabling or disabling the automatic counters of the network organisations.
ii- For an independent author it implies that as an information provider (independent of productivity) s/he needs a contract with a network organisation. Self-publishing becomes inherently more complicated.

4) The (in)stability of the work
In the digital world, in all phases of the process from creator to consumer, software is needed. Software can be considered as the transcending of all traditional manufacturing crafts into one, essentially linguistic, method. Unfortunately, the main characteristic of software (and hardware) is that it is unstable over time. Here we enter the field of digital archiving and preservation (Migration, Conversion and Emulation).
For IPR it calls for a new right that ensures that a work is permanently converted to a state of the art consumption capability. Otherwise the rights become empty by simple ageing (long before 70 years after the death of the creator). Doesn't it become almost an Intellectual Property Duty (IPD) for the owner to ensure readability (at least in an EU funded research project)?

5) Content and structure are interrelated but separate: who owns what?
A common approach is to distinguish three aspects in a publication: content, structuring and presentation. The creator writes (or composes) the work, it is structured by rules of conduct and then presented in a certain form.

5.1) Form versus content (content driven publications)
The whole new industry of SGML/XML declarative languages is geared towards presentation, independent storage and the capability to “render” the “content” on different “platforms”. So called: single source, multiple delivery publishing. The IPRs deal only with the “content”.

5.2) Metadata
In order to fully exploit the electronic capabilities an author has to create his/her work according to well-defined rules that enable storage in a multi-media format.
So, the author creates a work including a meta-data structure that guides the reader. The presentation and the content in the electronic version are coalescing to one representation.
In a controlled publishing environment it is a publishing organisation (commercial or not) that creates and maintains the meta-data structure. This means that at least the intellectual ownership is with that organisation and the added value to the “database” in which this structure is implemented is a genuine new creation. In case of the Open Archive self-publishing initiative it is the author who adds a limited set of meta-data him/herself.

5.3) Text and non-text
Soon a scientific publication will become a mixture of text and non-text elements and in some cases even non-text elements only. This original version of a scholarly publication will be a multi-media “document”. The paper instantiation becomes a spin-off, needed for those

who want to carefully read and annotate the work. But this version is not necessarily (and in the near future even pertinently not) the e-version minus the “unprintable” objects. A text for reading demands different grammar than a multi-media document.

Hence, a scientific publication will consist of two or more presentation forms, that all need certification, authentication and validation, just like the old paper-only publication. Each form presents an independent entity, hence deserves independent IPRs.

The publication environment intrinsically becomes a collection with added value, due to the structuring and interlinking of the elements. New extra value can always be added by keyword and classification indexes as well as link-taxonomies (different kind of hyperlinks, each with a meaning of why the linking is added). Those extra meta-data systems are creative products with own IPR.

5.4) Real multimedia “documents” (layout driven publications)

There is a difference between a real multimedia document, where the various expressions (text and non-text) are a united whole and the present-day patchworks of various types of media (in fact multiple-media documents). Real hypermedia documents (an integration of hypertext and multi-media in which time-lines and spatial lay-out are well-defined) will directly be specified in terms of the final presentation (lay-out driven), the segregation between structure and presentation disappears. In such a case DB directive art.5.b., that allows database owners to change arrangements, will come under heavy pressure.

THE ROLE OF PATENTS IN NANOTECHNOLOGY AND SOFTWARE

Author: Knut Blind, FhG-ISI

1. Introduction

The purpose of this background paper is to present empirical insights about the role of IPR in two technologies, nanotechnology and software, where research and development is very often based on collaborative work by means of ICT in the form of Internet-based production and exchange of research results or of common production and use of data bases. The paper concentrates mainly on patents, a comprehensive kind of IPR.

2. The Current Role of Patents in Nanotechnology

With the discovery of manipulation techniques of the individual elements of matter as well as the increasing insights into self organisation principles of these elements, a world-wide industrial conquest of nanoscale dimensions began. Purely geometrically the prefix "nano" (Greek: dwarf) describes a scale 1000 times smaller than that of present elements of the micrometer-sphere (1nm corresponds to the millionth part of a mm). This scale has become accessible both by application of new physical instruments and procedures and by further diminution of present microsystems. Also structures of animated and non-animated nature were used as models for self-organising matter. Only if the mastery of this atomic and molecular dimension succeeds, can the prerequisites be developed for the optimisation of product properties within the areas of energy engineering (gas cells, batteries, solar cells, gas-garrets etc.), environmental technology (material cycles, disposal, cleaning, etc.) as well as in information technology (high-density memories, efficient processors, etc.), can health and ageing be developed.

The most promising nanotechnological lines of development can be divided into five groups, which are areas the German Ministry for Education and Research is funding:

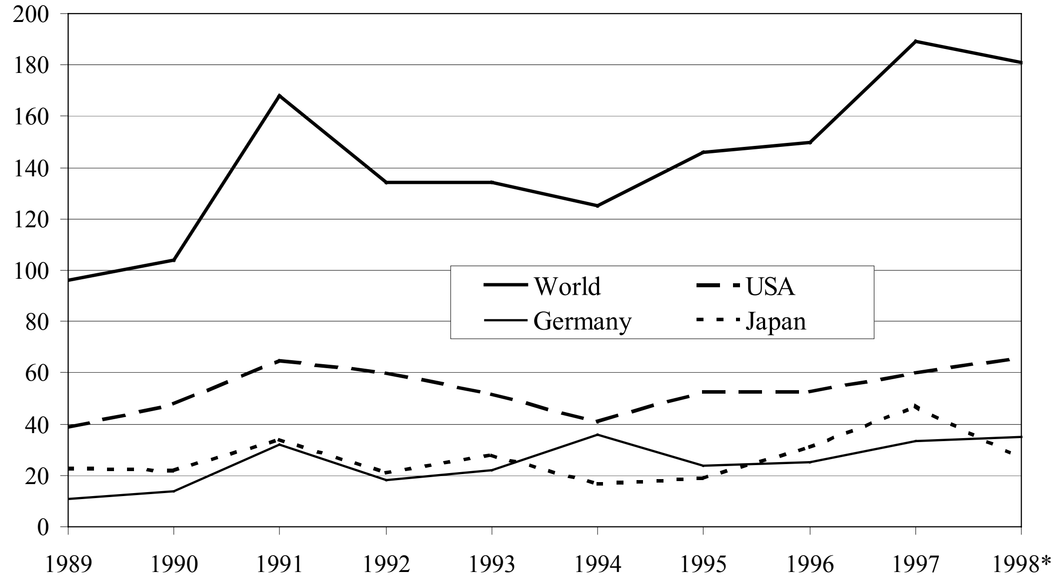
- Ultrathin layers
- Lateral nanostructures
- Ultraprecise surface figuring
- Analysis of nanostructures
- Nanomaterials and molecular architectures

Nanotechnology is currently still in a very early phase of the technological life cycle. Basic research activities make up the lion´s share of the research activities, while first applications are very seldom. This biased distribution has consequences for the existence of IPR relevant for nanotechnology. The main output of the research activities are mainly publications in scientific journals.[56] In 1998, more than 12,000 publications are recorded in the Science

[56] Source: A. Hullmann (2001). Internationaler Wissenstransfer und technischer Wandel: Bedeutung, Einflussfaktoren und Ausblick auf technologische Implikationen am Beispiel der Nanotechnologie in Deutschland, Physica-Verlag Heidelberg.

Citation Index. In 1994, only half the number was counted. In contrast to those significant numbers and growth rates, the number of patents in the broad field of nanotechnology applied for at the European Patent Office is rather small (see figure 1). In addition, no large growth rates can be observed. From all over the world in 1998, less than 200 applications were counted.

Figure 1: Development of Patenting in Nanotechnology (Source: EPAT and Hullmann (2001); *Numbers for 1998 are projected)



The consequence of the small number of patents is that it is difficult to assess their importance for research in general. However, the results of a study can be presented and analysed which focused on the research activities of research centres focused on nanotechnology.[57] Since October 1998 the German Federal Ministry for Education and Research (BMBF) has been promoting six nanotechnology competence centres (CCN) selected by a competition.

The main aims of the promotional measure are

1. to accelerate the rate of converting nanotechnology knowledge into marketable products, processes and services, as well as
2. to establish a competence profile in the selected technology field which also makes the location internationally well-known and attractive.

In addition, the competence centres should develop activities aimed at

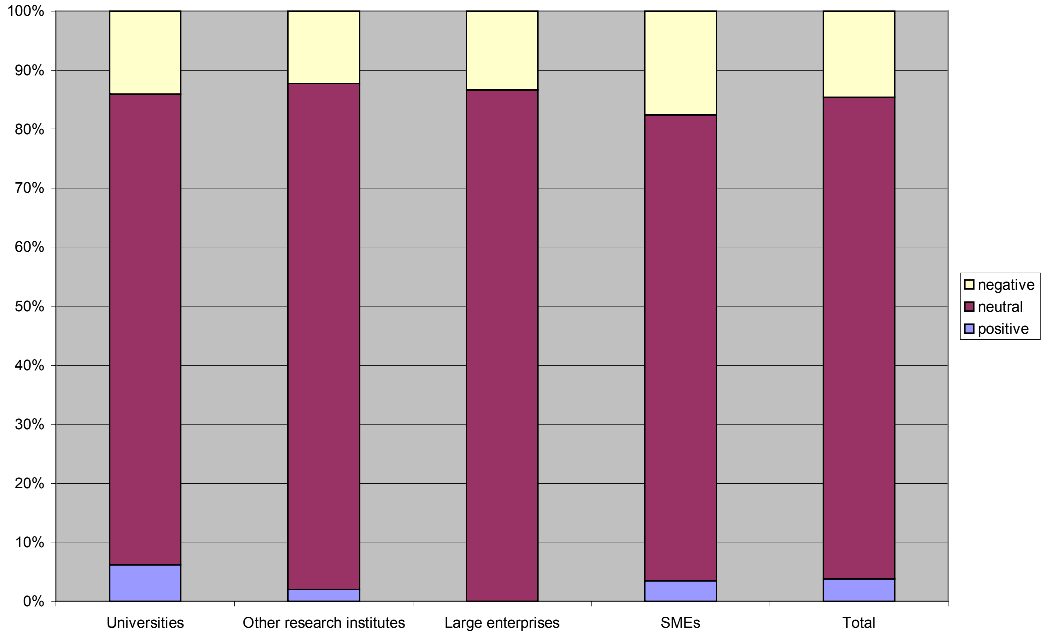
3. improving the situation in training and further education,
4. making nanotechnology known to a wider public, and
5. contributing towards standardisation, metrics and technical norms.

[57] Bührer, S.; Bierhals, R; Heinze, Th., Hullmann A.. (2002): Die Kompetenzzentren der Nanotechnologie in der Frühphase der Bundesförderung, Karlsruhe.

The overall goal is to stimulate innovation networks in the field of nanotechnology, which means in principle that the participating actors should modify their behaviour patterns, away from an exclusive focus on their own institutional background (science versus industry) towards cross-sectoral and cross-institutional cooperation. Not only are the aims of the promotional measure manifold, it is taking place in an environment which is characterised by several challenges: on the one hand "nanotechnology" itself must be mentioned, which as a knowledge-intensive cross-sectional technology presupposes a high degree of interdisciplinary collaboration. Moreover, the measure is being conducted in a multi-actor system, i.e. with a great number of participants who are all intent on pursuing their own interests.

During the monitoring evaluation conducted by FhG ISI, as a combination of coaching and evaluation, a questionnaire-based survey was performed. The results of this survey are representative for the situation of researchers in nanotechnology in Germany, because in the six competence centres between 70% and 80% of the whole research community is integrated. One central question was an assessment of the current framework conditions for research in the research centres. One dimension addressed the current IPR framework. Whereas other conditions have been assessed both more positively, but also more negatively, the IPR-framework does not play a significant role for their research activities, since for the broad majority (over 80%) of the respondents the IPR situation is evaluated to be neutral for their success in research (see figure 2). This result is consistent with the above picture, which makes clear that patents, as one important IPR in nanotechnology, are not yet very prominent and consequently do not yet cause many conflicts for researchers. However, around 15% of the respondents judge the current IPR framework to be negative for their work and less than 5% give a positive assessment. Furthermore, the partners from industry, large enterprises and SMEs, are slightly more negative or less positive than universities and other research institutes, including the Fraunhofer institutes involved. Finally, the members of the competence centre working in the area of nano-chemistry are most sceptical towards the current IPR framework.

Figure 2: Assessment of the IPR-Framework in the Nanotechnology Competence Centres (n= 193)



Interviews with the heads of two departments of the Fraunhofer Patent Office, which is responsible for the IPR issues of the Fraunhofer Institutes supported the quantitative results, since they were not able to report cases where IPR conflicts occurred in nanotechnology between partners in a research consortium. However, they also admitted that the awareness of the responsible project managers in the Fraunhofer institutes about the importance of IPR is still very limited although inside the Fraunhofer Society both negative experiences concerning uncontrolled IPR exploitation by research partners (mostly companies) and success stories like MP3 are widely known. Additional interviews with the co-ordinators of two nanotechnology competence centres were performed. The first main observation the interviewees reported was that ICT-based joint research activities based on common databases or Internet platforms are not yet widely used. Only databases with already publicly available information, like press releases and other publications, have been set up and made accessible to the members of the competence centres. Confidential information is not made available on the Internet, even if the access can be technically restricted to a limited number of people, since the danger of unauthorised access by third parties is assumed to be very high. Within the research projects all possible IPR issues are covered by contractual clauses signed by the participants, since in most cases partners who are not familiar with each other work together for the first time. In constellations based on confidential relationships, the co-operation is often based on trust and not on contractual regulations.

To summarise the observations on IPR in nanotechnology, two main conclusions can be derived. First, research in nanotechnology is still very focused on basic research, whereas first applications only now start to become relevant for marketable products and processes. Therefore, scientific publications are the main output of research and patent applications are only recently becoming more numerous. Second, the distribution of ICT-based research is rather limited at the moment. The anticipated possible threats of the available technical opportunities outweigh the benefits of this mode of performing research. Furthermore, many researchers are obviously reluctant both to use these new technical options and to join research consortia. Third, the awareness about the importance of securing and defining the possible IPR of their work is not yet well developed among most of the researchers, since their scientific career depends more on publications in highly cited scientific journals and not on the number of patents. However, companies, especially the large ones, involved in research co-operations are very aware of possible IPR problems. Therefore they include respective clauses in the research contracts, which are mostly accepted by the other partners, like research institutes or SMEs. Nevertheless, there is a high degree of uncertainty concerning the distribution of IPR in complex and large research consortia, which leads on the other hand to research co-operations at the surface.

3. The Current Role of Patents in Software Development

On the European level, decisions about the patenting of software- and computer-related inventions are very much on the agenda. Although different consultations have been conducted, i.e. by the European Commission or the Patent Office in the United Kingdom, no well founded empirical analysis about the role of IPR in the software sector existed. The Fraunhofer Institute for Systems and Innovation Research conducted a study on behalf of the German Federal Ministry for Economy and Technology to generate representative results based on more than 250 responding software companies and independent software developers.[58] The following sections report results about the idiosyncrasies of the software development process and the innovation strategies of software companies, which have implications for the role of IPR in general and especially for patents.

3.1 Distinctive Features of the Innovation Behaviour in the Software Sector

The significance of patents in the software branch cannot be estimated without knowing the specifics of innovation behaviour. From the analysis of innovation behaviour it emerged that:

(1) Developments in the software area are characterised by very strong dynamics and short development times on the supply and on the demand side, both in the software sector, but also in companies of the manufacturing sector developing software.

(2) The average development duration is correspondingly short and mostly lasts only a few months.

(3) Compared with other areas of the service sector, market novelties are not more frequent in the software branch, but incremental further developments are clearly more frequent.

(4) Rapid innovations and effective development processes are of even more decisive importance for competitiveness than in other service sectors.

(5) Obstacles to conducting development work are thus even more serious in the software sector than in other branches of the economy.

3.2 Distinctive Features of Software Development

Software development is characterised by three particularities which are important for the question of patenting and its consequences: sequentiality, utilisation and availability of open code and the necessity to ensure interoperability:

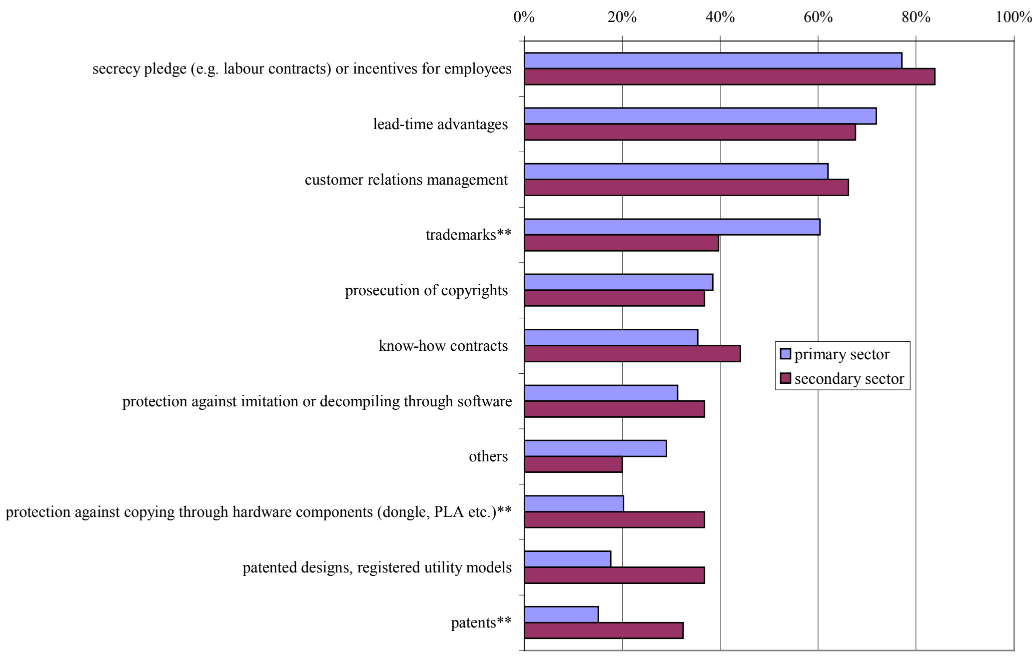
[58] Source: Blind, K.; Edler, J.; Nack, R. Straus, J. (2001): Micro- and Macroeconomic Implications of the Patentability of Software Innovations. Intellectual Property Rights in Information Technologies between Competition and Innovation, Karlsruhe.

(1) The rate of code re-recycling (sequentiality) is very high, approx. one third of own developed software.
(2) In most companies own developments are increasingly dependent on the availability of compatible external inputs, the cross-company co-operation in software developments, which is mostly ICT-based, is steadily increasing according to these data.
(3) Open Source is already the most important external source of software components for the independent developers. If the other software companies are considered, then the application of Open Source is still rather limited.
(4) However, the importance of Open Source is expected to increase very greatly, in all sorts of companies.
(5) Open Source has a generic character, i.e. in many cases it is a functional input which makes the development of own software more effective.
(6) There is not *one* main argument for utilising Open Source, but a relatively well balanced set of motives (among others, adaptability, state-of-the-art, costs, quality).
(7) Disclosure of code is mostly used as information strategy to diffuse information about own performance: quality seal and transparency for the customers, respectively signals for co-operation partners.
(8) The classical Open Source mode, i.e. making the code accessible for public use *free of charge*, thus contributing to a widespread diffusion of the new code, is still a clear domain of the independent developers, although approx. 13 percent of the software companies claim to use this custom.
(9) Disclosure for special customers for a fee is practised by roughly a quarter of the companies.
(10) Disclosure is especially customary for systems software which tends to increase its importance.
(11) For all companies, interoperability is a crucial aspect, whereby the interoperability with customer software is by far the most important.
(12) Interoperability with customer and supplier software and with competitive and complementary products is achieved above all by the disclosure of interfaces, the disclosure of code plays a very subordinate role here.

3.3 Practices and Experience with IPR (especially Patents)

(1) Of all protection possibilities, IPR have only a low or medium importance for the companies (see figure 3). Trademarks and copyright protection are used by around half of the companies, whereas only a fifth of the sample make use of patents.

Figure 3: Utilisation of various instruments to protect software- and computer-related developments in %[59]



(2) Although patents are the least widespread of all formal and informal protective strategies and have the least significance for pure software companies, the actual trends in patent applications and above all patent awards in the software-relevant area however show a clear upward trend.

(3) Innovative companies introducing market novelties patent more than less innovative enterprises, but the R&D intensity has no influence on the patenting behaviour. In accordance with other studies and other branches, small companies in the software branch patent less than large enterprises.

(4) The theory that patents facilitate market access, above all for young companies, could not be confirmed.

(5) Dealing with property rights is still not widely institutionalised in the software sector, with the exception of the large enterprises, and where the need is recognised it is usually met via external consultancy.

(6) Most companies (and in particular the small companies) have little knowledge about property rights, especially patents. However, younger enterprises claim to have a somewhat better state of knowledge than older companies.

(7) The reasons for patenting are manifold; the software companies emphasise the defensive nature (protection from imitation), while the companies from the manufacturing sector set more store by strategy (exploiting the market advantages, reacting to the conditions abroad).

[59] Primary Sector: Software companies (n=188); Secondary Sector: Manufacturing companies developing also software (n=68). The asterisks * point to significant differences between the two sectors.

(8) Reasons for not patenting, besides costs and insecurities, are general reservations against the widespread effect of patents on innovation dynamics of the whole branch.
(9) Even for the companies from the manufacturing sector, more experienced in patenting matters, the lack of verifiable proof, enforceability and thus protection afforded by patents in the software sector are great problems.
(10) The function of patents to inform is only perceived to a small extent in the software sector, especially by small enterprises, and if at all, for defensive reasons.
(11) The negative aspects of patenting are based on:

- legal quarrels: almost 20 percent of the companies in the software sector and almost 40 percent of the companies from the manufacturing sector were already involved in lawsuits pertaining to the general area of IPR.
- hindering own development activities: ca. one third of the software companies and over two thirds of the independent developers have already been hindered in the execution of own projects by patents belonging to others.

3.4 Assessment of Possible Alternatives of the Legal Framework Concerning Patenting in the Software Sector

(1) The independent developers reject patenting on principle and are in favour of a general exclusion of software from patenting, which would mean a restriction of current award practice. The independent developers also reject administrative simplifications and support measures out of hand.
(2) The software companies are in favour of preserving the status quo and tend to have a sceptical attitude towards a spread of patenting practice in the software area.
(3) The companies in the software sector however are polarised, for over 25 percent of them are in favour of an expansion of patenting practice according to the US model.
(4) In the software sector the number of those who advocate the exclusion of software from patent protection is greater, whereas among the companies in the manufacturing sector the opponents of an exceptional ruling clearly predominate.
(5) An extension of patenting to include business processes is rejected by a great majority of all companies.
(6) Administrative simplifications and support measures are greeted by all companies (without the independent developers), with the exception of support of private initiatives on patent enforcement.
(7) The existence of functional patent units, the possession of own patents, as well as knowledge about industrial property rights, tends to produce a more positive attitude towards patenting in the software area.
(8) The size of the enterprise does not correlate with the attitude to the alternative structural possibilities.
(9) Regarding the impacts of a broader patenting according to the model of the USA, opinions among the companies are contradictory. By contrast, the independent developers foresee negative consequences in all dimensions, not only for their own business model (Open Source) but also for the development of the branch and technology in general.

(10) The expectations of companies are ambivalent regarding their own enterprise and also the development of the branch as a whole. On the one hand they expect a strengthening of the national and international competitiveness, on the other hand they fear a restriction of innovation dynamics, product variety and of the development of Open Source.

(11) After cost increases, the anticipated consequence most often mentioned is the reduction in the number of enterprises and resulting concentration in the software market.

(12) Young companies have a more negative attitude towards patenting than established ones. The more companies know about patenting, the more positive their estimation of the consequences of patenting. The size of the company has no influence on the estimate of the economic and technological outcomes of patenting.

3.5 Policy Conclusions from the Empirical Evidence

Based on the empirical survey, which collected both facts about the innovation and patenting behaviour and the preferences for different models of the patent systems from software developing companies, the following conclusions and recommendations have been derived:

(1) Against the background of innovation activities and the self-assessment of the software developing companies, at present neither a radical restriction nor an incremental expansion of the patentability of software can be recommended. Consequently, Germany resp. Europe should not pursue the US development and accordingly not broaden the patenting of software. This also – and especially - applies to business process methods. These recommendations find support by the results of the British and French consultations concerning this issue.

(2) The strategic benefit of patents in international competition is obvious, but concentrated on very few large companies.

(3) The strategic, especially long-term cost of patenting for the dynamics of innovation and the variety of software seem to be higher, based on the results of this study. The greatest danger is seen for the further development of Open Source as a kind of public good, that on principle is available for use by all economic units and thus in the sense of the new growth theory promotes the general technical progress and therefore innovation dynamics. Furthermore, negative effects for competition are expected, because the number of companies will shrink according to the assessment of the respondents.

(4) Considering the recent legal uncertainty, it is recommended to come to a clearer, up-to-date definition of the patentability of computer programmes via an improvement of the examination guidelines of the patent offices in line with the results of this study.

(5) These guidelines should therefore not meet only the “technological” requirements, as the concept of technology is amorphous in itself and does not provide grounds for a very differentiated judgement of the patentability in a legal sense. Rather, as a first step a concrete list should be drawn up of those areas of software technology for which patent protection should be available, according to the present, legally binding court decisions – not according to the practice of the patent offices.

(6) *For the future*, a continuous adaptation of the respective guidelines will be necessary, to take into account the particularities of the software branch (interoperability, sequentiality) and its dynamics. It is recommended to decide on a time schedule for

revision of the guidelines (e.g. annually), whereby an increased transparency for the public and inter-disciplinary inclusion of the experts in this field would be desirable.

(7) Additionally, the introduction of a grace period for novelties is to be strongly supported. The effect of a grace period is that publications of the inventor (also for example a publication of the source code on the Internet) will not be seen as the "state-of-the-art" technology (i.e. they do not stand in the way of a patent award) if this takes place within a certain period before the patent is applied for (priority day). A period of six to twelve months appears practical for this. This would enable the inventor to make his development immediately available to the public without being obliged to apply for a patent in order to protect his rights.

(8) The dynamic development of Open Source and its increasing economic significance make it necessary to keep the future of the Open Source development under close observation. Should a further dynamism of patenting set in, and at the same time the Open Source development be hindered, then a legal special ruling should be considered. For example, a privilege for Open-Source software of the content, that the use of Open-Source software for non-business purposes is excluded from patent protection, even if it takes place in the commercial arena (e.g. an enterprise passing on software free of charge). This should however be attempted, if in the future it transpires that Open Source software is of crucial significance for the development of the software sector and for the world-wide economy, and is being massively and lastingly damaged by patenting.

(9) Below the level of legal changes, there are a number of starting points to improve the existing system. Most important appears to be to increase knowledge about patenting in the software area. The study revealed, even to those enterprises which actively use patents or feel themselves threatened by patents, a clear need to learn more about the patent system. The knowledge deficit is particularly obvious in the area of SMEs.

(10) In order to support in particular SMEs and also independent developers, measures to systematically reduce the costs for application and enforcement of patents, which are often complained about, should be implemented.

(11) At the same time, when making the patent examination more effective, it must be reflected how the idiosyncrasies of the software branch can thereby be better taken into consideration. In particular, the patent offices should have sufficient skilled personnel who are able to conduct the demanding examination in the software area, especially in view of the required non-obviousness, in order not to hinder the sequential innovations through trivial patents.

(12) In order to make patent administration more effective with regard to computer-implemented patents one should further think of introducing an additional code for “computer- and software-implemented inventions”. This code should be allotted to all patents which are based on computer- and software-implemented inventions in addition to their original first classification. Since such a systematic change would not be easy to negotiate within WIPO, one could envisage new guidelines in the German or European patent offices. For example, in the German Patent Office a special code for all inventions that have some effect on the environment already exists. Such an additional code would simplify the research for software-related patents. Furthermore, an additional patent requirement to hand over the source code of a software-related

invention to the patent office, in addition to the regular patent description should be considered.

(13) Should, under the assumption of careful examination of the required non-obviousness, a patent be awarded for a software invention which proves to be crucial for the further development of the entire branch, then the possibility of a compulsory licence (as "ultimo ratio") must be examined. A compulsory licence can be awarded according to current law if a "normal" licence is granted by the patent holder under unacceptable conditions, but simultaneously the permission to use it is in the public interest. The criterion of "public interest" should be primarily understood in the sense of interest for the economy as a whole: a compulsory licence is then imperative, if the interests of the whole economy are massively harmed. The determination of the interest of the whole economy requires an analysis of the present status and a prognosis of the extent to which future innovations will be blocked. It must be remembered however that the elaboration of such a prognosis involves many imponderables. Here the creation of a kind of central complaint and consultancy institution could help, to which the enterprises and above all independent developers could turn, who feel themselves threatened by a patent in their innovation activities. This institution could also collect (circumstantial) evidence which could form the basis for the decision on initiating a compulsory licensing process.

Summary

The brief overview of the current use of IPR in both technological fields nanotechnology and software presented two different pictures. The research activities in nanotechnology are concentrated on basic research, whereas first applications of nanotechnology relevant for marketable products are not yet very numerous. Consequently, scientific publications are the predominant output and IPR, like patents, are not yet very relevant. Furthermore, ICT-based research activities are at the moment the exception due to a high reluctance of both public research institutes and companies to use the possibilities of ICT to perform joint research activities.

In contrast, software development is already a mature technology. However, the majority of companies do not make use of IPR to protect their inventions. In addition, many software companies and software developers are worried about the increasing patentability of software, since they fear to become involved in infringement suits and to incur higher transaction costs by negotiating licensing agreements. Despite these differences, in both sectors a low awareness and knowledge about the IPR regime and its possible benefits is observed. Perceiving an increased complexity of research collaborations with many and heterogeneous actors in both technologies, IPR in joint and ICT-based research will become a more important issue.

OPEN SOURCE AS A TRAINING SYSTEM AND US/EU DIFFERENCES

Author: Rishab Aiyer Ghosh

Most surveys[60] show a balance between open source software development in the US and EU tilting increasingly towards the EU. The WIDI survey has a comprehensive analysis of open source developer demographics through various forms of analysis, including voluntary surveys and analysis of developer e-mail addresses. It also has a fascinating data set on migration patterns, showing that, for example, several developers who are EU nationals actually work in the US.
The growth of an open source developer base is increasingly a proxy indicator of the innovative capacities (within the software domain) of a national or regional economy. This is for three reasons:

1. Open source software is a public resource with low entry barriers. Unlike forms of intellectual property with restricted access for re-use (through patents, restrictive copyright licensing), open source software can both disseminate innovations in the fastest possible way, as well as provide for further development and innovation from any source without inefficient time delays or other costs.

2. Open source software is an excellent training system, provided essentially at no direct cost to society: i.e. neither public subsidies nor future employers need pay directly for the training provided to (often novice) programmers through their exposure to source code and the open source developer network. This is implicitly recognised by employers, who may favour prospective employees who have worked on open source projects; it is explicitly recognised by developers themselves, 79% of whom start participation in the open source community "to learn and develop new skills".

3. Open source software is by its nature almost automatically the source of *de facto* standards for any number of protocols or systems both historically as well as those being developed today. The attraction towards open source software as a way into standardisation for companies has already been touched upon in the previous section. However, it remains a fact that open source systems that have developed into standards tend to be initially developed by small groups and only later (if at all) promoted by companies that jump onto the bandwagon, as it were. Having a large base of open source development therefore helps a region's companies involve themselves early in the *de facto* standardisation process, as well as incorporating cultural factors into the process.

As such, it can be said that open source software support in Europe has a clear socio-political nature to it, while the support for it in the US is more corporate. (This does not mean that

[60] see WIDI (2000), Dempsey et al (2002).

more companies support open source in the US – which is far from the truth – but that the support provided to open source in the US is more from companies.)
Partly this is a result of the large EU student base, and the lengthy periods of university study (one reason why Germany has a very high rate of contribution towards open source). Students may be less motivated by attempts towards standardisation or other economic arguments than by the socio-political objectives.
The lack of software patents in the EU probably helps encourage a larger open source developer base, while the way software patents have been issued and enforced in the US is definitely a hindrance to the participation of US-based companies (and to some extent individuals) in the open source community.
On the other hand, while SME's are rarely in a position to invest in basic research or standardisation efforts and thus participate in open source mostly if it at the core of their business model, large firms can and do participate due to their interest in basic research or the standards process. Firms such as IBM have committed themselves to open source in words as much as in deeds (the much-publicised $1 billion planned investment). As such large companies are more concentrated in the US it may be thought that such concerted support for open source development will be more US-centric. Indeed, this is the case. Typically, large firms either sponsor core development in a big way or release proprietary code into the open source code base, thus setting the initial direction for development. Individual developers or others may then provide the bulk of further development, but a "guiding influence" may well be present.
The result of this is a peculiar situation where although the majority of developers may indeed be European, key decisions end up being made in the US. However, this may change through the growing occurrence, much less in the US than in Europe (and also developing countries, such as in Latin America), of large public-sector demand factors. Government policies at the local, national or regional level that offer non-proprietary solutions a fair chance at providing services create potentially large business opportunities for local entrepreneurs and SME's and a commercialisation of an existing open source developer base. Doing so, they also drive the standardisation and development cycle from the demand side. A large firm can seed a standard by sponsoring or releasing core code, but a large buyer can equally well influence development by asking and effectively paying for certain features that may otherwise be commercially unavailable. With an existing advantage in terms of the size of the developer base, this is a relatively easy way of affecting global standardisation and innovation processes. This seems to be the likely pattern for the increasing influence of European inputs in open source development.

Corporate Motivators for Open Source: Standardisation

The main Open Source activities of firms are in the field of Linux. A major motivation for fostering its further development is the potential reduction of Unix variants towards one major Unix operating system and the associated cost savings. This is actually a motivation that is shared by many other standardisation efforts. Standards provide better interoperability (a program for Linux on IBM can – more or less – run on Linux for HP) and thus a larger market for additional products. It also leads to more trained personnel being available for this operating system and thus lower costs for this personnel.
In addition, reduction of variety as one outcome of standardisation also reduces the risk of investments. If Linux becomes the major Unix OS, developing an application for Linux is in the long-run a safer bet than developing it for a specific company. This point is especially

important for small companies, as betting on the wrong operating system can force them to close shop.

An issue arising in classical standardisation activities is the chance of a single participant taking over a standardisation group. Typically, the party participates in a standardisation body, agrees to a standard, helps in promoting it and eventually, when the standard becomes widely accepted, turns out to have a patent covering part of the standard. Some examples of such behaviour include the discovery of Unisys that it owned the rights for the LZW compression algorithm employed in the GIF graphic format, or Dell's patent covering part of the Vesa Local Bus standard or the European mobile standard GSM. It is not completely clear, whether the behaviour of these companies was intentional from the beginning or whether the companies only by accident noticed that they were sitting on a potential IPR goldmine.
To avoid such potential problems, there is the possibility of requiring that participants in the standardisation process give an assurance that they do not own any intellectual property right related to this standard. The Internet Engineering Task Force IETF has chosen this approach. Another, but similarly motivated approach has been chosen by ETSI in the telecom area.

The take up of open source licensing as a ground rule for standardisation processes brings a major positive impact in terms of operation in an environment of competition law. Competition authorities would look favourably at the fact that not only do open source –based standardisation efforts provide a non-discriminatory environment (i.e. everyone can join in) but are also non-proprietary reducing the risk that anyone left out of a "standardisation cartel" is forced to accept a standard controlled by others, and pay for it.

Corporate Motivators for Open Source: Basic Research

The engagement of software manufacturers in open source projects is very similar to firms' engagement in basic research. In both cases the immediate gain from this activity seems to be much smaller than from devoting resources to the development of other products that can be sold directly.
The social returns from basic research, for example in the form of growth effects, are considered to be extraordinarily large. The same can be said about open source software. As everybody can learn from reading the source code and using it as a basis for their own software, positive externalities of these open source activities exist.
Investment in basic research is justified as rational when firms can capture sufficiently much for private R&D – though not necessarily all – of the gains from this activity. With open source software, there are several ways in which a company could capture some of the benefits from developing open source software: e.g. by using it in combination with other inputs for new products (as with Linux for IBM mainframes), or by obtaining first mover advantages through other means than patents.
As firms can protect most of their intellectual property in the domain of software development, it can be assumed that they only give as much intellectual property away in the form of open source software as is optimal for them. This argument is strengthened by the fact that several different open source regimes (i.e. licenses with varying IPR implications) are possible, giving companies that want to include OS components in commercial products the opportunity do so. (see FLOSS report, part 3, http://www.infonomics.nl/FLOSS)

SOURCES AND TYPES OF FREE / OPEN SOURCE SOFTWARE COLLABORATIONS

Author: Philippe Aigrain (DG Information Society)

There are 3 main sources of free / open source collaborations: publicly funded infrastructure, grassroots co-operative efforts, and efforts stemming out of business strategies of some industry players. The first 2 types coexisted from the start in the first half of the 1980s, while the third has developed more recently. In practice, one can distinguish more detailed types of collaborations, taking in account also the type of software being developed:

General information society infrastructure (Internet, Web, grid)

The Internet Protocol stack software, most essential software for basic Internet applications (bind, sendmail, etc.), World Wide Web software, the computing grid software from Globus and the Global Grid Forum are all free software, and were designed from the start to be so (even if in the case of the Internet it was often before the free software concept was explicited). These developments aim at creating a common information infrastructure. In general they were initiated by relatively small publicly funded teams, but who positioned their work from the start as service to a much larger community of users. The initial design of this software was generally done by a small group of people, but the later design and development decisions were and are submitted to a wide consultation, under the model of "request for comments" (open to anyone). The choice of free licensing was justified as to obtain maximal dissemination, to ensure trust in supplier independence and to be able to mobilise contributions from all. In practice, these developments amount to the joint production of standards (in arenas such as IETF, W3C and GGF) and of their implementations.

Scientific community software and information resources (astrophysics, bio-technology, high-energy physics, geographical and statistical information, humanities)

Another major source for free / open source collaborations has been the activity of some scientific communities. These activities arise from dispersed communities. The most common cases are communities collaborating on instruments (satellites, telescopes, particle accelerators, synchrotrons, etc.), on general databases and catalogues (stellar catalogues, genomic and proteinomic databases, bibliometry, humanities), or developing common tools for the purpose of teaching and research (statistics, robotics, image processing, mathematical software). These projects tend to be collaborative from the start, though their mode of organisation (development model) varies from the very centralised to a pyramidal model. Public funding plays a prominent role, sometimes with an important role of private not-for-profit foundation funding, such as Wellcome Trust funding in the case of genome analysis. The projects focused on instruments are centered on software, while the others have both a software and a free database or information resources dimension. Overall, these projects are creating the infrastructure of a scientific discipline. The case of biotechnology is particularly interesting, as contrary to high-energy physics or astrophysics, it has great proximity to industry applications. It is one of the domains in which it was possible to observe competition between open public approaches and proprietary private-led efforts, and the open public approach does not fare too badly in the comparison. For a detailed presentation on the subject see: http://2001.istevent.cec.eu.int/library/documents/113.pdf . There is debate on whether or not this can be generalised to other domains, some arguing that only the emotional value of human health made it possible to mobilise sufficient not-for-profit resources. Along a similar line, the technology transfer approaches of the National Institute of Health in the US provide interesting distinctions between research instruments (to be licensed under open schemes, whether they are software, databases, cell lines or other entities) and products (possibly appropriated).

Grassroot efforts: (OS, generic applications, mathematical publishing, peer-to-peer, media technology, artistic platforms)

This is the most well known and publicised variety of free / open source collaboration. Free software was initiated as a grassroot movement, ethically motivated by the benefits of freedom itself, well before it became a possible business strategy. The core objective was to make available a free operating system as a universal platform for essential information processing activities. This objective took around 10 years, to be completed from the creation of the Free Software Foundation to the first truly usable and widely distributed versions of GNU/Linux. By then it was expanded as the notion of a universal platform for information processing encompassing new generic applications (office suites, Web applications, media technology etc.). In parallel a great number of more specialised efforts developed in domains ranging from scientific modelling and computation to artistic creation. These efforts were precedented by the remarkable achievements of the TEX scientific text layout and typesetting software, instigated by Donald Knuth. Grassroot collaborations are characterised by real distributed development (of mutually co-opted developers), often worldwide and round the clock. The development organisation can be more or less structured with a predominance of a flexible pyramidal model. On top sits a core group taking key decisions (for smaller projects, the core group can be limited to one person, and for larger projects there can be a "benevolent dictator" on top of the core group, for instance Linus Torvalds for the Linux kernel). Then there is the wider group of important contributors. Then a large group of contributors of minor elements (patches, bug reports, functionality requests). People move relatively flexibly between these positions, based on recognition by their peers. Getting efficient work done out of such a development process calls for a sound initial design of the software (not always explicit in design documents!), a number of support tools (see section on back offices) and management / human relations skills for the head(s) of the development team. These processes include a very important element of skill building and creativity. To the surprise of the classical software engineering community, they have derived remarkably reliable software, at least when the user / developer community is wide enough. It is estimated that there are around 250,000 free / open source software developers involved in such efforts. Two thirds of the individual developers are contributing voluntarily without compensation, and one third as part of their job (university, administration or company). Close to 50% of developers spend less than 5 hours a week on free / open source development, and this ability to contribute relatively small efforts plays a key role. Some analysts have highlighted the fact that with such ability to contribute small efforts the issues of incentives and motivation become irrelevant to understand the overall process and impact. 16% of developers spend more than 20 hours a week and 7% more than 40 hours a week.

Mutualised user investment in platforms and inter-operability (embedded platforms, administrations, health systems)

Many business models have developed around open source software: distribution, support, customised or additional development, etc. One of the most successful ones, illustrated by the case of of RedHat (and the former Cygnus), is to develop free / open source software for groups of large users. This may be seen as the industry or organisation consortium approach to the production of common platforms by mutualising investment. Outsourcing it to an external party, and choosing a free (generally copylefting) license guarantees durable supplier (and competitor in the case of industry users) independence. This model is present in many different fields, for instance it is today developing for administration software, and in the field of health information systems.

Business strategies (manufacturers, service companies)

Open source software is now a major business strategy for a number of industry players. There are 4 mains drivers in this process: the role of manufacturers of hardware, the fact that it can be a natural model for software service companies, the fact that it acts as a corrective to network externalities and increasing returns monopoly effects, and ability of free software to fuel initial usage and build up a potentially interesting market. The case of IBM illustrates the first 2 drivers. IBM is both a manufacturer and the first software service company in the world. As a manufacturer it has made the strategic decision to support Linux for its low cost, reliability and customer acceptance on the server market. As a service company, it is engaged in a major effort of re-engineering based on open source software, including for development tool frameworks such as Eclipse. For service companies, open source software strategies means acceptance of less customer locking in. From this view point, it is a strategy of the strong or of those who wish to conquer new markets. The European software service industry has taken a somewhat conservative position in this respect, a position that it might have to review if it is faced with competition of open source offers. SAP has taken some initial steps in that direction. Some software publishers have recently developed visible strategies for products losing market share or confined to a secondary position, by making them open source and re-engineering their activity around services. Typical examples are Netscape with Mozilla, Matra-Datavision with OpenCascade, Bull/Evidian with its versions of EJB servers, Sun with Open.Office. Such approaches call for a very important initial investment: a product which was not originally designed to be open source has to be re-engineered and strong promotion is necessary to build a community of developers around it. Some specialised companies (CollabNet for instance) make a special business of supporting such efforts. Finally, open source software plays a key role in the development of new personal usage and resulting markets, in particular when initially they are not clearly solvable. They are often used by companies to develop new business in areas that do not constitute their core activity, a typical example being the developer community created by Nokia for its Media terminal set-top box and home gateway project.[61]

[61] Further references:

COMPETITION LAW AND R&D

Author: Jeremy Scholes

EC competition law and technology transfer agreements

Agreements for technology transfer (IP licensing and the like) are also relevant to R&D co-operation. Reg. 240/96[62], the "second generation" of technology transfer agreement block exemption made by the Commission, is, of course, currently under review by DG Competition and is due to expire on 31st December 2006. The history of DG Competition's attitude to technology transfer agreements, as evidenced by the changes between the first published draft (in 1979) and the final version of the old patent licence block exemption (Reg. 2349/84), via the old block exemption for know-how agreements (Reg. 556/89) through to the enactment of Reg. 240/96, has been one of a progressive acknowledgement of the positive contribution of IP rights to economic welfare rather than seeing them purely as a means of carving up the internal market on national lines. Reg. 240/96, with its lists of compulsory clauses, "grey list" and "black list" clauses, stands out as something of a survival from the past when set alongside the "modern" post-*European Night Services*[63] approach to block exemption regulations. This, where the object of the agreement is not manifestly a "hard-core" horizontal cartel, emphasises the need for a complete examination of the economic context in assessing the effect of the agreement. We consider that updating is appropriate. It is obviously beyond the scope of this study to comment in any detail on the review exercise. We would merely comment in passing as follows:

(1) We suggest that the role of patents in the IP "firmament" can be overplayed and that copyright and similar rights have very important (and possibly underestimated) roles to play. The fact that, until now, block exemptions for IP licensing agreements / TTAs have always been limited to patents and those rights treated as similar by Reg. 240/96 Art. 8 and know-how as defined (only covering licences of copyright and other IP rights where such are secondary to a "main" licence of one of the former), has led to significant uncertainty for businesses and their advisers where the protection of the relevant technology is achieved through

Aigrain, Ph. (2002): Collaboration in Open Source Environments, 15th BLED Electronic Conference Proceedings, BLED, Slovenia, June 2002, http://ecom.fov.uni-mb.si/ECBledHome.nsf/5f5370162bfefab8c12565ef00600a0c/2ddb93cc4bc1ca8ec1256bb900331882?OpenDocument#Philippe%20Aigrain

European Patent Office (ed.) (1994): The Use of Patent Protection in Europe, Eposcript Vol. 3, Munich.

Lanjouw, J. O.; Schankerman, M. (2002): An Empirical Analysis of the Enforcement of Patent Rights in the United States, Paper prepared for the Conference on New Research on the Operation of the Patent System, sponsored by the U.S. National Academy of Sciences in Washington (October 2001).

62 OJ L31/2 of 9th February 1996

63 T-374/94 *European Night Services v. Commission*, [1998] 5 CMLRep 718

other IP rights, albeit that the understanding has always been that one should follow Reg. 240/96 by analogy. The Commission considers this in the review document[64]. The uncertainty becomes more important in the light of the modernisation process. We suggest that active consideration should be given to extending the new block exemption to TTAs involving copyright and similar rights, and without limiting the application of the new block exemption to copyrights etc. fulfilling any additional requirement of "super-originality". Such an extension should not lose sight, however, of the differences inherent in the different IP rights.

(2) The limitation of the current block exemption to technology transfer agreements between two parties (i.e. that TTAs involving more than two parties cannot, for that reason alone, be block-exempt) may operate as a constraint to multi-party licensing which can be relevant to exploiting the results of jointly-performed R&D[65], especially in the ICT field. We suggest that a positive approach should be taken to extending the block exemption to multi-party licensing (although we understand the Commission's difficulties on *vires*).

(3) Cross-licences and patent pooling are specifically excluded from the current block exemption for TTAs[66]. The legal uncertainty as to the status of such agreements is notorious, yet in the ICT sectors and in the new economy more generally they are more important than in the past because increasingly the IP rights that need to be combined to make a complicated new product are owned by different parties (cf. the patent pools set up to create the technology for CDs and DVDs). There have been conflicting statements from the Commission over the years, but they suggest that a more positive view of such arrangements is now being taken, at least in "high-tech" markets[67]. Much will depend presumably on whether the relevant patents or other IP rights are complementary or substitutes (the former indicating that cross-licensing or pooling them will be pro-competitive, the latter suggesting that it will restrict competition) and on what restrictions are agreed as to third party access to the cross-licensed or pooled technology. We believe that business would greatly welcome some guidance from DG Competition as to its attitude to such arrangements, whether by inclusion in the new block exemption or perhaps (as the OFT suggests in its response to the Commission consultation exercise[68]) in accompanying guidelines.

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[64] Commission Evaluation Report on Reg. 240/96 (December 2001), Section 5.1.1, paras. 114-115 (europa.eu.int/comm./competition/antitrust/technology_transfer/en.pdf)

[65] Ibid., Section 5.1.4, paras. 132-135

[66] Art. 5 of Reg. 240/96

[67] Contrast the hostile attitudes expressed in *Concast/Mannesmann* (Commission 11th Report on Competition Policy (1981) para. 93 and in *IGR Stereo Television* (ibid., para. 94) with that evidenced by the press release in *DVD Patent Pool*, IP/00/1135 of 9th October 2000, on the DG Competition website). As one would expect, the global attitude of the US DOJ/FTC under the 1995 Anti-trust Guidelines on IP Licensing (n.2 above, Section 5.5) is overall that patent pooling/cross-licensing is likely to be on balance pro-competitive, but with a vigilant attitude taken to the abuse of such arrangements to try to disguise "hardcore" price-fixing and market sharing cartels and concerns about foreclosure by exclusive licensing arrangements where one or more of the parties has market power.

[68] See the DG Competition website (europa.eu.int/comm./competition/antitrust/technology_transfer/27_oft.pdf)

State aids issues in relation to R&D co-operation

Where one of the parties involved in joint R&D is a publicly-funded research body (such as a university or a public research establishment), the questions arise of whether the public financing of the public research body or the making available by the public R&D body of its services to private sector entities in the R&D co-operation, may amount to the granting of state aid within Articles 87-89 EC, and of the consequent effect of that on the R&D co-operation agreement.

The position under Articles 87-89 EC is largely as one would expect from general principles. State support for and the performance of "fundamental research" carried out by a publicly-funded non-profit-making research establishment, not aimed at fulfilling specific commercial objectives, is not within the Article 87 prohibition at all (it is far removed from any market); nor is Article 87 infringed where the results of publicly-funded R&D projects conducted by a public research body (whether it fulfils a specific commercial objective or not) are "made available to Community industry on a non-discriminatory basis"[69].

Where a publicly-funded non-profit-making research body conducts research in co-operation with or on behalf of industry, the Commission works on the basis that there is no grant of state aid where (1) the public body is paid for its services at the market rate, or (2) the private sector participants bear the entire cost of the research project or (3) resulting IP rights either (a) belong to the public research body or (b) are bought at market value by the private sector participants and any results which are not IP-protected "may be widely disseminated to interested third parties".[70]

There are thought to be no problems of principle with the ideas here. It is our understanding, however, that public research bodies would in general welcome some guidance

- as to the assessment of the market rate for the payment for services and of market value where IP rights are being sold (the obvious analogy in the latter case with sales of land by public authorities, on which there is an established jurisprudence, not being very helpful in this respect[71]); and
- as to what they need to do in order to achieve "wide dissemination to interested third parties" of the non-IP protected results of co-operative R&D, and whether this differs from making the results of R&D "available to Community industry on a non-discriminatory basis".

When the Framework is next reviewed, we suggest that some thought might be given to possible clarification of para. 2.4.

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[69] Community Framework for state aid for research and development (as revised in 1196), OJ C45/5 of 17th February 1996, para. 2.4

[70] Ibid.

[71] Commission Notice on state aids elements in sales of land and buildings by public authorities, OJ 1997 C209/3

R&D Agreements between Competitors

One sees somewhat more concern in evidence in relation to R&D co-operation between competitors. The Commission sees this as having the potential to restrict innovation (on the assumption that, if the co-operating R&D parties had conducted their R&D separately rather than together, more innovation might have resulted), as creating the context in which the R&D parties, contact having been established between them, have the facility to liaise for other purposes (e.g. to co-ordinate their market behaviour in existing product markets) and, possibly (in limited circumstances) as leading to foreclosure problems in the exploitation of the technology resulting from the joint R&D (denial of access to the technology for other competitors).[72] Even in such situations, though, the attitude of the Commission evidenced by the Guidelines is relaxed. It accepts that unless the parties have significant market power in an existing product market there will be no incentive for them to restrict innovation or to co-ordinate their market behaviour on those markets (i.e. they will be subject to the play of normal market forces in a competitive market, so they will want to bring the innovative fruits of their joint R&D to the market as widely as possible, and any co-ordination of their market behaviour would have no appreciable effect anyway) and that the foreclosure problem will only be a concern where at least one party has significant market power and that is combined with the R&D parties deciding to deny access to the new technology to anyone else. Accordingly, even where the R&D co-operation has taken place between competitors in the relevant market, there will generally be no restriction of competition and the Article 81(1) prohibition will not apply.

Co-operation in "pure" R&D will otherwise only give rise to significant restriction of competition if effective competition with respect to innovation in the relevant technology is significantly reduced.[73] Here the concept of the "market for innovation" becomes relevant. The Commission will look to see if it is possible to identify with reasonable certainty a range of "poles" of R&D seeking to develop comparable/substitutable technologies for those which this particular R&D co-operation project is aiming, and will be content if after that agreement there will be "a sufficient number of 'viable' realistic competing R&D poles"[74] left (whatever "a sufficient number" means: one would have thought that that did not have to be very many). If that exercise cannot be performed (because it is not possible to ascertain what comparable research is going on) the Commission will look only at the effect of the R&D co-operation in relevant product markets and those for existing technologies.[75] Even if there are concerns, Article 81(3) exemption on conditions may well be available.

The addition to co-operation in R&D of further co-operation between the same parties in related joint production, joint marketing or joint licensing of resulting IP rights (which could take the form of co-operation between all the R&D parties, or jointly entrusting the additional functions to an agreed third party or apportioning it amongst the R&D parties mutually or

[72] Ibid., para. 61.

[73] Guidelines, para. 58.

[74] Guidelines, 51.

[75] Guidelines, para. 52.

unilaterally[76]) obviously brings the co-operation between the R&D parties closer to the market for the products affected by the R&D. In such situations, the attitude becomes more nuanced, and an exercise has to be done in establishing the relative "weights" of the different aspects of the co-operation.[77] Suffice to say here that co-operation in aspects closer to the market than R&D will not by any means automatically present an Article 81 problem[78] (even if it goes beyond the "joint exploitation" permitted by Article 3 of Reg. 2659/2000: see below), but it is beyond the scope of this report to take this aspect any further.

In the current block exemption for R&D co-operation agreements, Regulation 2659/2000[79], the Commission accepts that, in those situations where Article 81(1) applies in the first place (which, as demonstrated above, is not often), co-operation in R&D will be block-exempt under Article 81(3) even where it includes joint exploitation of the results (as defined), but if the parties (and, on normal principles, the groups to which they belong) are "competing undertakings",[80] only where their combined market shares in the market for the products "capable of being replaced or improved by the products resulting from the R&D" are (at the time the agreement is entered into) 25% or less, and provided (whether the parties are competitors or not): all parties must have access to the results of the joint R&D for the purposes of further research or exploitation. On this basis, R&D co-operation to create "open standards" will not be problematic.[81] Furthermore, for a dedicated research body (public or private) which does not normally manufacture or distribute (licence out) the results to agree to limit its exploitation of the results to conducting further research does not fall foul of this principle.[82]

Where the agreement was for joint R&D only, all parties must be free to exploit the resulting R&D, together with any necessary pre-existing know-how independently,[83] though where the parties were not on day one "competing undertakings", a limitation on one or more of them to exploitation in specific "technical fields of application" does not fall foul of this requirement; (evidencing the Commission's greater concerns about co-operation between competitors where matters get closer to the market than "pure" joint R&D). Any joint exploitation of the resulting R&D must relate to technology which (a) is either IP-protected or protected as know-how, (b) "substantially contributes to technical or economic progress" and (c) is "decisive" for making the relevant products or for applying the relevant processes.[84]

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76 Cf. the definition of "joint exploitation" in Reg. 2659/2000, Art. 2(11).

77 Guidelines, para. 12.

78 Guidelines, para. 59, second sentence.

79 See n.12 above.

80 Note the wider than usual definition of "competing undertakings" in Article 2(12) of Reg. 2659/2000, which makes sense given the purpose of the block exemption.

81 See Guidelines, para. 159 ff, and see below.

82 Reg. 2659/2000, Art. 3(2).

83 Reg. 2659/2000, Art. 3(3).

84 Ibid., Art. 3(4).

The agreement must not have as its object[85] one of the "hard-core" restrictions listed in Article 5 of Reg. 2659/2000. If one of these is present in the agreement, the benefit of the block exemption is lost for the whole agreement (i.e. such "hard-core" restrictions are not severable from the rest of the agreement because the block exemption says they are not, even if on their drafting they would, under the applicable law, otherwise be so[86]). It is beyond the scope of the present study to deal with these in detail.

Standards

In competition law terms, agreements whereby competitors agree to adopt and apply a single common technical standard risk falling foul of the Article 81(1) prohibition as "limiting or controlling technical development" (Article 81(1)(b)). That will be so whether the standard in question is based on an IP right or not.
Such agreements will not fall foul of Article 81(1)

- where the parties applying the common standard have only a small market share in the relevant market affected by it (on general principles)[87]; or
- where the aspect of the product covered by the standardisation is insignificant in relation to the main characteristics of the product and the main factors affecting competition in the relevant market[88].

Even if the parties' market shares or the aspects of the product covered by the standardisation are significant, Article 81(1) will still not be breached provided:

- the parties are free not to apply the standard if they so choose;
- all manufacturers and suppliers (whether involved in the setting of the standard or not) who (and whose products) fulfil objectively necessary criteria applied without discrimination are allowed to use the standard and any related common quality label / collective trade mark etc. on fair, non-discriminatory terms[89];
- there are no ancillary "hard-core" restraints as to prices, production or marketing, i.e. it is not a "hard core" horizontal cartel in disguise[90].

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[85] (note: not "object or effect"; the omission of "effect" seems to be significant, and presumably is to be measured only on day one of the agreement and not throughout its life, like the requirement of the 25% market share "cap"). Contrast in this respect the less helpful approach of "through the life of the agreement" in the block exemption for vertical agreements (cf. Art. 9(2) of Reg. 2790/199, OJ L336/21 of 29th December 1999; and *Bellamy & Child*, European Community Law of Competition, 5th edn., 2001, para. 7-20.

[86] Reg. 2659/2000, Art. 5(1), explained in Guidelines, para. 37.

[87] Commission Notice on agreements of minor importance, OJ C368/13 of 22nd December 2001. On the issue of relevant market in the context of agreements for standardisation, see Commission Guidelines on horizontal co-operation (supra), paras. 161.

[88] Ibid., para. 164

[89] Ibid., para. 163

[90] Ibid., para. 165

Individual exemption may possibly be applicable even if those latter criteria are not fulfilled, provided the combined market shares of the participating businesses are not too high and that it can be shown that consumers will receive a fair share of the resulting benefit (but in this context, the Commission seems to be rather more insistent on proof of this latter element than is often the case[91]).

Additional issues arise if the industry standard requires the use of a technology that is IP-protected. Of course, there may be no conflict between the "openness" requirements for standardisation agreements in competition law and the "private" aspect of IP ownership, monopoly etc. The IP right may be publicly owned; or it may not be enforced by the IP owners, whether as a deliberate decision to allow open access (either through altruism or because the owner perceives that this will benefit its sales of some product which is complementary/ancillary to the "standardised" product) or through inertia, lack of funds, the uncertainties of litigation etc. On the other hand, there may be a conflict. An existing large supplier or group of suppliers may seek to make its/their own pre-existing IP-protected technology into the industry standard and thus create a barrier to entry (this was a major factor in the Commission refusing individual exemption to the arrangements for the common standard in *Video cassettes and video cassette recorders*[92]). Alternatively, one or more industry players may seek to use IP rights to, in effect, "hijack" the standard after it has been established. There are examples of this in the USA and now in Europe[93].

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[91] On this aspect see ibid., paras. 168-175 and see the treatment of this issue in the Commission decision in *X/Open*, OJ L35/36 of 6th February 1987, para. 44

[92] OJ 1986 L232/15

[93] See discussion of the *Dell* case in the USA in OFT Economic Discussion Paper No. 3, above, Part I, paras. 6.16 ff and Part II pp. 42-48; and in Europe, the *IMS/NDC* case currently before the European courts, where something similar seems to have been attempted.

GLOSSARY AND ABBREVIATIONS

CAFC	Court of Appeals for the Federal Circuit
CIS	Community Innovation Survey
Collaboratories	A collaboratory has been defined as the 'combination of technology, tools, and infrastructure that allow scientists to work with remote facilities and each other as if they were co-located. In other words, a c. is the prototypical kind of network information system enabling a research community to operate.
DMCA	Digital Millennium Copyright Act (USA)
EC	European Commission
ERA	European Research Area
	COM (2000) 6, (18.1.2000), SEC (2001) 465, (16.3.2001), COM (2002) 565 final
ETAN	European Technology Assessment Network (one of the 4th Framework Programme activities evaluating science and technology policy options)
ETSI	European Telecommunications Standards Institute
EU	European Union
ex post valuations	valuations in retrospect, after the fact
FLOSS	Free/libre and open source software
FP	Framework Program
GGF	Global Grid Forum (community-driven set of working groups that are developing standards and best practices for distributed computing)
GNU	GNU's Not Unix (Unix-like operating system which is free)
GPL	General Public Licence
ICTs	Information and communication technologies
IETF	Internet Engineering Taskforce (large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet)

Internet	A set of interconnected networks, appearing to the user as a single network.
IP	Intellectual Property (also used as an abbreviation for Internet protocol)
IPR	Intellectual Property Rights
MP3	Moving Picture Experts Group Layer-3 Audio (audio file compression format / extension)
OS	Operating system
R&D	Research and development
RTD	Research and Technology Development
RTO	Research and Technology Organisation
RC	Research collaborations
sui generis	of its own kind, unique
SME	Society of Manufacturers Engineers
TTA	Technology transfer agreements
www, Web or World Wide Web	System to link servers together to process data
W3C	World Wide Web Consortium (develops interoperable technologies for the web)
Background knowledge	Knowledge relevant to but produced before a collaborative venture
Foreground knowledge	Knowledge relevant to but produced within a collaborative venture
Sideground knowledge [x)]	Knowledge relevant to but produced simultaneously but outside a collaborative venture
Postground knowledge [x)]	Knowledge relevant to but produced after a collaborative venture

x) Not commonly accepted terms but suggested here.

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