Contract No: 503 594

INTEREST

Integrating Research and Standardisation

STREP

Priority 8

D04 - Report on Case Studies

Due Date: 31st of January 2006

Delivery Date: 16th of March, 2006

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	XXXXXXXX
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission)	

Content

1 Introduction

Standards play a vital but varied role in the European market and in society more generally. Standards have wide implications and they can significantly influence the conditions for technology transfer, for competition, as well as those for public policy concerns. Given their significance, it is important that emerging standards are relevant to—and that they reflect current research. This report starts from the observation that the standards setting process relies to an increasing degree on successfully integrating— or otherwise taking into consideration— up-to-date research and development results (R&D). The successful interaction between research and standards can provide important benefits to society.

There is however a number of challenges that the INTEREST project posit are currently impeding the successful interaction at the interface between research and standardization. One is undoutably the question of awareness about the standardization process both at the level of the individual researchers as well as the organizational level. Where there is awareness, the next concern is likely to involve the dedication of sufficient resources to build up the expertise at each levels. A first challenge is the basic need to better understand the interface between research activities and technical standardisation. An improved empirically based understanding is integral to finding ways to improve how this interface works.

This report provides two main sets of case studies designed to study the relationship between what will be refered to as the Research or R-Frame and the Standardization or S-Frame. This report thus links in with Deliverable D02 by providing indepth empirical information of the interface of the R- and S-frames in given contexts. The nature and objective of the cases are presented below. First, some preliminary observations about the relationship between research and standardization activities, and how it tends to be perceived, are made.

1.1 The relationship between research and standardization

Innovation and standardization are often seen as competing rather than as complementary activities. Since a technical standard effectively constrains choice, it is often associated with a potential block for research and one which may close off certain technical avenues of inquiry. This general perception tends to build on a picture of standards as involving races or indeed wars which pit rival technologies against one another; this casual perception seems particularly prevalent among researchers who fear that their degrees of freedom will be reduced. This casual perception tends to undermine the fact that standards and research can rather involve a complementary relationship.

The general characterization that research activities introduce a diversification of technological possibilities (with their own trajectories) therefore tends to clash with the characterization that standards are variety-reducing and that they serve to select out technologies. This trade-off between variety-creation and diversity-reduction can indeed be seen as a fundamental feature in the evolution of technology. Too much diversity can stifle technological progress if good ideas are crowded out. Over time, therefore, some selection is generally called for, in order for technological products to really take hold and for a technology trajectory to be established. On the other hand, the reduction of variety before the technology has sufficiently matured can negatively affect future developments. Thus, as with any trade-off, there is a balance at work, and timing can be critical.

But this perception tends to overstate the role of standards in constraining functional choices and it overlooks the contribution that standardization makes to improve the basis for research. This relationship between variety-creation and selection is of course a normal feature of the market economy, where the market acts as the ultimate selection mechanism. Many types of standardization, such as measurements and testing standards, really do not affect the trade-off between the two directly. Many others standards, such as coordination standards, aim to promote acceptable parameters and routines at the interface between interoperating systems. Finding a solution can thus be beneficial for all parties (win-win) while not necessarily reducing future technological choices.

Demand for standards can however also respond to a recognized need to reduce redundant technological varieties. Standardization activities have tended especially in the ICT environment to move in front of the market. This tendency towards pre-competitive standards addresses incompatibilities between sometimes minor technical choices. Research in an emerging area might for example be stifled by the presence of divergent technological solutions whose differences do not involve functional scope. The lack of a clear research agenda characterized by recognizable criteria and widely acceptable verification procedures can split a field. The non-functional divergence of a given technological area may lead to a lose-lose situation for which can paralyze future research. In such a situation (see the Object Oriented Computing example cited in the cases), standardization provide an avenue to negotiate between the different approaches in such a way as to retain the functional contribution of each while maximizing harmonization between them. A standard can thus be an important mechanism to focus the research agenda and avoid needless duplicative efforts. The general tendency for standardization to move in the anticipatory and pre-competitive direction highlights the importance of standards to research.

Thus the variety-creation and the selection processes are interdependent processes which feed into one another. Coordination can thus reduce uncertainty about the overall trajectory of a technology and can help improve the research climate. The case that standards and research can rather involve a complementary relationship tends to be obscured by this casual perception that these two processes are in conflict.

1.2 Organization of the report

An important dimension of the interaction between research and standardization is the question of how it takes place within organizations. This part of the project therefore looks into how relevant firms and research institutes organize these activities internally, and what sort of concerns emerge in different settings. In addition, this section focuses on a special concern area of the research-standards interface, namely the need to coordinate and integrate privately held IPRs more effectively and equitably into standards activities. The report is divided into two main parts.

1.2.1 The interface between research and standardisation (part 1)

Part One of this report studies structural factors that promote transfer of research results within organizations to the respective standardisation activities. It utilizes case-based examples in order to generate empirical information about the internal organisational structure of the interface of the research and the standardisation activities. Cases have been selected in order to explore issues and challenges that arise in a range of contexts. The cases presented here provide information about the organization of research activities and standardization activities, the degree of coordination between the two and the degree of integration in the organization. This study provides information about how the R-Frame (research frame) and S-Frame (standards frame) are organized in different organizational settings, it indicates the types of challenges that are faced, and points to ways to improve the coordination of the two frames.

1.2.2 The role of patent pools and IPR coordination in standardization (part 2)

Part 2 of the report goes on to focus on institutional mechanisms to address problems that are cropping up more broadly at the research-standardization interface. Here, there is a widely noted need to improve coordination between private interests broadly associated with research investments and the collective interests which standardization implies. A major concern that has developed at this fault line involves how to equitably deal with patents and other IPRs in the standardization frame. Here we take a critical look at a set of three cases into patent pools and related strategies to overcome coordination problems at the research-standardization interface. We assume that there are current characteristics in the 'market for knowledge' which heighten the importance of mechanisms to coordinate research and standardization activities. One aspect is that they introduce new concerns which potentially affect the interrelationship between research and standardization activities.

The cases will look at the coordination of IPRs in telecommunication standards, especially those related to mobile telecom systems, as well as the coordination of IPRs in standards related to consumer electronics. A third case looks at another approach which has emerged involving the use of Non-Assertion Covenants in the standardization of document file standards. Dimensions of this case will be presented and implications considered.

Part one: case studies on the interface between research and standardisation

2 Introducing the ten organizational case studies

An important dimension of the interaction between research and standardization is the question of how it takes place within organizations. The report first delves into how firms and research institutes, which have active interests in the research and the standardization worlds, organize their relevant activities internally and whether, and to what degree, they link to formal standardization activities. To study this, the project carried out a set of ten case studies which cover the interface between research and standardization activities in a range of organizations. These cases are presented here in Part One.

In this part of the report we focus on organizations whose stakes in research and in standardization raise the question of how the relevant activities are arranged. The case-based examples draw on interviews and other sources in order to provide empirical information about how the relevant activities are organized in different organizational settings, about the types of challenges that are faced, and, where relevant, about potential ways to improve the coordination of the research and of standardization activities. Although the ten cases can in no way be seen as representative of the issues and challenges that arise in every context, they provide useful illustration that complement the output from the survey as well as the project's work more generally.

Two general sets of organizations are looked at. Chapter 3 presents four large Research and Technology Organizations (RTOs) while Chapter 4 features a variety of companies from a variety of markets and contexts. These cases demonstrate different organizational types, and a range of different characteristics, including size, and technological and geographical markets. Against the background of the baseline characteristics of these organizations and their contexts, we present general information and viewpoints on the relative importance of R&D and standardization in the organization, on the organization of these respective activities, the perceived need for coordination between the two, etc. Further, the cases also provide observations about obstacles, challenges and opportunities that are seen as important in this area.

2.1 Approach and Case Selection

The project's original intention was to select a sample of ten of the set of European organizations surveyed in D02 to conduct case studies on the organization of the interface between research and standardisation activities. This approach proved to be impractical as the survey among researchers was postponed to the fall 2005 due to difficulties in getting addresses for FP 5 participants from the CORDIS database provider. In this situation we utilized the general breakdown of the types of organizations in the project lists and shifted more weight to criteria suggested by the literature survey. Two main types of cases were thus chosen. The first include a set of large scale research and technology organizations (RTOs), (i.) because their design generally acknowledges a technology transfer role between research areas and industry, (ii.) because they are involved in a range of different research areas, and (iii.) because RTO researchers are known to participate in different standardization settings. The focus on RTOs was then linked to dissemination efforts at the European research and technology organization (EARTO) meeting in March 2006, where the project was presented and input collected.

The second type of cases the project used to study organizational structures involved a range of commercial organizations. Five of the ten cases look at enterprises in represented a range of industries and circumstances. The cases include research intensive fields such as ICT, consumer electronics, as well as life-sciences; they look at enterprises in mature as well as in service industries; and they consider larger and smaller firms.

The selection of the ten cases will allow us to identify three or four Best Practice cases for the final dissemination products, the manuals for research organisations and standardisation bodies.

2.2 Structure of Part one

The rest of the first part of the report is accordingingly divided as follows. Chapter 3 and Chapter 4 present the cases for Research and Technology Organisations (RTO's)[1] and for private firms respectively. Chapter 5 presents a synthesis of these cases and draws conclusions.

To facilitate the comparison of the cases, we adopted the following format for the case descriptions:

- Introduction
- Baseline organisation characteristics
- Baseline industry characteristics
- Organisation of R&D and standardisation activities
- Obstacles to the participation in standardisation
- Favourable organisational structures (not discussed for every case)

[1] Note that such organisations are sometimes referred to as Public Research Organisations (PRO's) as well, although there are fine distinctions between the two categories.

3 Research and Technology Organisations: five cases

3.1 Introduction

A set of large scale research and technology organizations (RTOs) have grown up around Europe especially after World War II. RTOs such as Sintef in Norway, VTT in Finland, the Fraunhofer Society in Germany, and TNO in the Netherlands have played key roles nationally in building bridges between university research and industrial development. They are central to the innovation systems of these countries.

In our context, their acknowledgement of a technology transfer role between research areas and industry provides a germane context in which linkages between research and standardization have grown up. And indeed the contribution of these RTO researchers are found in national standardization efforts in many of the research areas these organizations are strong in such as mechanical engineering and materials, transportation systems, and information and communication techologies.

How are these research and standardization activities organized in large, diversified research and technology organizations? This section looks at five cases: Sintef, TNO, the Dutch Metrology Institute (Netherlands), the Munich FIW (Forschungsinstitut für Wärmeschutz), and the Fraunhofer Institute for Information and Data Processing. We consider how relevant activities are organized in different organizational settings, about the types of challenges that are faced, and, where relevant, about potential ways to improve the coordination of the research and of standardization activities.

3.2 SINTEF: The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology

Studied organisation	SINTEF: The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology
Interviewees	• Håkon Finne, Technology and Society. Senior Re-seacher. • Ernst H. Kristiansen, Vice President, Research. Management and Staff. • Bjørn Skjellaug, Research Director. Cooperative and Trusted Systems. SINTEF ICT. • Trond Foss, Research Director: SINTEF Technology and Society, Transport Safety and Informatics. • Inge Hoff, Research Director. SINTEF Building Re-search Institute, Road and Railway Engineering. • Arnstein Watn, Research Director. SINTEF Building Research Institute. Rock and Soil Mechanics.
Date	February 2006

3.2.1 Introduction

SINTEF is one of the larger European Research and Technology Organizations in one of Europe's smaller countries. As its name indicates [2], this not-for-profit organization was established in the early 1950s to improve the interface between the academic research technical university in Trondheim (then the NTU or Norwegian Institute of Technology) and industrial R&D. In post-war Norway, the order of the day was industry-building, and the focus was on engineering and the physical sciences: SINTEF was Norway's premier tech transfer institution. The link between research and industrial application is therefore a legacy of the RTO.

This section draws on a set of interviews to explore how the interaction between research and standardization activities is addressed in this RTO. In addition to some baseline characteristics of this organization and its context, the subsection presents interview-based information and viewpoints on a set of related issues, including indications of how these respective activities are organized, and what sort of obstacles, challenges and opportunities are seen as being important to the interaction between standards and research.

The interviews

The SINTEF case is based on a set of interviews as well as background information. Six interviews were conducted in early 2006 with 4 departmental heads, one divisional vice president in charge of research, and one long term observer in the organization. The interviewees were found in three of the research divisions, including the two most actively involved in standardization. All interviewees reported

[2] The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology (NTH)

to have taken part themselves in standardization activities at different occasions and different settings in conjunction with their research. Direct links to standardization work goes back two decades in some cases, and 10 years or more in several others. Participation was linked to international bodies, including consortia, as well as to national activities. Participants reported experience from secretariats, work-group leadership, committee contributors, as well as participation in mirror-committees at the national level.

By and large the interviewees represent cases in which participation in standardization coincides with higher level duties either at the level of a researcher-director or above. Chief scientist and senior scientists however make up the majority of participants in standardization activities at SINTEF. The interviews confirmed that the both standardization and research activities follow project funding, a tendency supported by SINTEF's overall budget. This flat organization means that to a large degree what drives standards participation and what shapes it is to be found with the individual researcher in light of individual research and development projects.

Baseline organization characteristics: Core competences and market

Today SINTEF employs 1450 in Trondheim, 450 in Oslo, with smaller offices in several other Norwegian cities. It also has a limited presence abroad, not least in Houston, Texas which reflects its expertise in petroleum related technologies. There are a total of 1800 employees altogether. The research institute is organized into seven Research Divisions beneath the central managing board. There are a total of over 80 sub-units, including a number of incorporated subsidiaries. In addition, SINTEF continues to maintain close collaborative links to the technical university in Trondheim (originally the NTH, now the Norwegian University of Science and Technology, NTNU) as well as the University of Oslo.

The annual budget of this Research and Technology Organizations was 1.7 Billion NOK or about 225 million Euro in fiscal 2004. Its research activities extend along the continuum between research and development. The emphasis on contract R&D for the private and the public sectors (90% of turnover) means that SINTEF research is concentrated around the development end of the spectrum, where technological solutions are elaborated for clients. A minority of more basic research activities also take place in the RTO which receives public basic funding amounting to 7% of annual budget.[3]

[3] The basic funding provided by government agencies amounts to 3% of the annual budget. Another 4% is however supplied through strategic institute programs. See the Research Whitepaper (Forskningsmelding) for this figure as well.

Baseline Characteristics
• Type: Nonprofit research foundation Research and Technology Organization (RTO). • Structures: overall size 1900 employees. Annual turnover of 1.7 B NOK. • Technological areas: 7 main technical areas, • Location and geographical markets: Trondheim (HQ) with 1450 employees, Oslo with 450. Other Norwegian locations and stations abroad, eg. Houston, Texas. • Maturity: established in 1950 to link academic research more closely to market oriented R&D. A product of reorganization to reflect emerging technologies, such as petroleum and aquaculture.

3.2.2 Baseline sector characteristics

A key aspect of the RTO is that it is not a commercial actor in the sense that its research and development efforts are not directed towards proprietary product lines that compete with private sector vendors.[4] These research areas are currently diversified in seven rather autonomous and distinct areas. The RTO primarily engages in contract-research and thus is primarily engaged in customizing its research capabilities to the needs of its customers. The underlying knowledge bases are in turn cultivated through public- research, its public basic funding, collaborations with universities (primarily NTNU and the University of Oslo), as well as the research interests of the individual researcher.

The Research Divisions emphasize their partnership with industry and relevant public authorities. Based on the website, the seven areas are since January 2006:

1. Building and Infrastructure: SINTEF Building and Infrastructure focuses on research within the building and infrastructure sectors. This division was recently (January, 2006) merged with another research institute, ByggForsk.
2. Information and communication technologies: SINTEF ICT offers integrated research-based knowledge in a range of ICT fields.
3. Materials and Chemistry: SINTEF Materials and Chemistry develops advanced materials, products, processes and new tools based on materials technology, applied chemistry and applied biology.
4. Technology and Society: SINTEF Technology and Society performs R&D and consulting within technology management, working life and transportation.
5. Health Research: SINTEF Health Research conducts R&D to raise standards of health and quality of life, in close collaboration with stakeholders.
6. Marine technologies: SINTEF Marine is made up of MARINTEK and SINTEF Fisheries and Aquaculture. SINTEF Marine is an important

[4] In the SINTEF system, there is a distinction between the SINTEF Foundation and the SINTEF Group which includes private companies.

resource for industry and the authorities in the field of knowledge management for the future exploitation of the marine environment.

7. Petroleum and Energy: SINTEF Petroleum and Energy addresses future-oriented solutions throughout the petroleum products value chain and creates a sustainable energy system based on renewable energy technologies.

Indicators of Research Activities

In addition to turnover, SINTEF's research capacities can be found in other indicators. Here we focus on the involvement of SINTEF researchers in patenting. Patent applications have a long tradition as an indicator of novel research activity which has an assumed commercial potential. The commercialization of SINTEF research is one aspect of the RTO, which has a wholly-owned subsidiary (Sinvent) to manage technology commercialization activities through patents, licensing, and spin-off companies. It reports that over 100 companies with a total of 2000 employees have spun out of the SINTEF-NTNU activities in the last 20 years. In addition, SINTEF employees are involved in patenting activities, primarily in conjunction with industrial sponsors and collaborators.

SINTEF reports filing an average of 14 patents per year domestically (1998-2003), claiming an average of 6 licenses sold per year[5]. But individual SINTEF researchers are involved as inventors in a significantly larger number of patents. Using an approach to identify individual researcher-inventors, (Iversen, Gulbrandsen, & Klitkou, 2005), SINTEF researchers are identified as being involved 357 times in a total of 171 separate Norwegian patent applications in the period 1998-2003. All research areas[6] were represented in these patents, but researchers from the chemical and material area were most frequently involved.

Table 1 breaks the frequency of researcher-invention down according to the technological areas of the underlying patents. This presentation indicates that SINTEF's patentable research activities are oriented in the mechanical engineering area. About one third of this activity involved patents filed by outside companies.

[5] Source: Nøkkeltall for forskningsinstitutter, Institusjonsundersøkelse. Nifu Step.

[6] These areas were reorganized during the period and do not directly correspond exactly to the current research divisions.

Table 1: Frequency of SINTEF researchers involved in Norwegian patent applications: 1998-2003.[7]

Technological Areas	*Total*
Electricity - electronics	48
Instruments	86
Chemistry, pharmaceutics	61
Process engineering	34
Mechanical engineering, machinery	128
Total	357

Indicators of standardization activities

SINTEF researchers are also extensively involved in standardization. Together with NTNU researchers, this population of researchers makes an important contribution to national standards work. Together the SINTEF-NTNU research environment has recently supplied more than 50 committee participants to formal national and international standardization processes according to information provided by Standards Norway. The total number involved in standards activities is however expected to be higher. In addition to widespread contact with Standards Norway, SINTEF researchers are known to participate in formal standards bodies (CEN and ISO) and consortia, including IEEE and the American-based Object Management Group (OMG).

The following table presents the participating researchers on record at the national standards body Standards Norway in addition to two others not listed there. This overview should be interpreted as a lower-bound estimate for the total number of researchers involved in standards work. These researchers may also be involved in several standards activities, which seems the rule rather than the exception based on the interviews conducted at the Research Director level. This interview material is substantially presented in the next section.

[7] Source: Nifu Step's NPO inventor database. Technological Areas are based on the OST/INPI/ISI correspondence with IPC classes.

Table 2: Number of SINTEF researchers involved in standards committee work, by research division[8]

Research Division	*Total*
SINTEF Building Research Institute	9
SINTEF Health Research	1
SINTEF ICT	8
SINTEF Marine	5
SINTEF Materials and Chemistry	1
SINTEF Petroleum and Energy	2
SINTEF Technology and Society	3
NTNU	27
Grand Total	*56*

Table 2 breaks down the number of researchers from the different research divisions of the RTO, also indicating the number that comes from the NTNU university. It illustrates that, of the 30 SINTEF researchers who have been involved in standards committee work in recent years, the bulk have been in construction and infrastructure area, including transportation, and in ICT. It is notable that researchers from all researcher divisions are represented.

We might also mention that SINTEF has also been involved in other capacities related to standardization processes. For example SINTEF established the Centre for Railway Certification ("Senter for Jernbanesertifisering" - SJS). SJS was appointed as a Notified Body (NB) under Council Directive 96/48/EC on the interoperability of the trans-European high-speed rail system on the 16th of December 2003. SINTEF NBL AS is another example which performs conformance-tests with most Norwegian, European and international standards (NTFIRE, CEN, ISO, IMO) and is recognized as a Notified Body for several product areas.

3.2.3 Organization of R&D and standardization activities

SINTEF is organized as a research foundation with a central board of eleven person management team including representatives from the Research Divisions. The research divisions are themselves autonomous from one another, and are broken down into smaller research laboratories or departments. One area that is centralized is the support function for commercialization of research results in cases where commercialization is not arranged through collaborations with the client. Otherwise research is organized with the divisions in smaller teams or departments.

The central mechanism for organizing research activities at this contract-research oriented RTO is ultimately the project. The researcher’s competences combined with the premises of the researcher’s contract-research determines to a large degree the direction of the research. Some strategic priorities are obviously made within divisions and subdivisions— for example through recruitment, through long-term

[8] Source. Håkon Finne (SINTEF) compiled this list on the basis of information provided by Standards Norway.

relationships with major customers, or through organizational changes to pursue long term research aims— but research activities generally remain decentralized down at the project level at which researchers are expected to generate project-revenue.

This autonomous organization also provides the modus operandi for standards participation. The participation of SINTEF researchers in standards work is 'rooted in project, especially contract research for public and private sector actors. At one point SINTEF is said to have attempted to centrally coordinate participation of its researchers in standards committees to a certain degree. It is unclear how advanced or far-reaching this attempt to coordinate activities across divisions had been. The interviewees with standards experience were not aware of such attempts, and were mainly sceptical that a more centralized organization of SINTEF's total standardization activities would improve the interface between R&D and standardization at the institutional or the national level.

Instead, the general organizational principle at SINTEF was described as largely self-organizing while primarily conditioned by funding activities. In some cases standards participation had the quality of an ad hoc, voluntary cooperation to help a neighbour ('dugnad'). The problem identified with the model was not so much that it was left to the researcher; this aspect was in fact seen as a sensible strategy since participation ultimately comes down to the expertise of the individual researcher and, provided resources, his links to other relevant stakeholders, whether public or private-sector interests, the national standards environment, or research-collaborators at universities or research institutes. The general complaint, which we see below, was more about the almost voluntary nature it takes on. Here the point was repeatedly made that in order to contribute fruitfully to standardization work you need not only the time and resources to travel but also to prepare and to follow-up in order to make substantial contributions. Participation on a shoe-string basis may be sufficient to observe but it generally hinders the progress of committee work.

Involving researchers in standards development

The way and the terms by which the researcher at SINTEF becomes involved in standards activities seem to depend to a certain degree on the relevant technological area and its market context. We generalize some of the conditions for standards-participation from the SINTEF interviews.

- One type of situation emerges where there is a central public actor (such as in the area of transport infrastructure[9]) with established interests in the outcome of international standardization activities (e.g. as a procurer and a regulator) and where SINTEF is a recognized national authority on a related technical issue. In this situation, the contractor is a major sponsor of a series of targeted R&D projects and has established research collaborations with SINTEF researchers. In the context of such long term R&D engagements, the contractor

[9] The Norwegian Public Roads Administration. The Directorate of Public Construction and Property can also be important.

will engage the competences of SINTEF researchers to participate as national representatives in specific international standardization activities on a project-basis.

- Another type of situation involves cases where participation in standardization activities is motivated more by the researchers' interests. This is cited particularly in ICT research projects where there is a recognized need to promote the adoption of a standard; the motivation may be to establish acceptable verification procedures to avoid duplicative efforts and wrong-turns, and hopefully to build consensus around preferred solutions. Although this particular situation involved a single research area (e.g. object oriented programming see also below) where approaches were contended, the experience served to sensitize researchers to the general importance of standards. Funding from EU framework programs is cited here as a vehicle for standards-participation and where standards work is explicitly built into project-design.
- A more common situation spanning different R&D areas in the RTO is one in which R&D-projects commissioned by private-sector companies. On this basis, the researcher is subsequently engaged by the client to participate in a relevant standards activity based on expertise in the field. Expertise in a specific technological area is therefore a criterion both to engage the researcher in contract R&D and to underwrite that researcher's participation in relevant standards activities where there is a national stake. National mirror-committees are used to collect national expertise in the area and to inform about relevant developments in standards activities.
- In addition, standardization activities can be subsidized by SINTEF subdivisions to a limited extent. This situation emerges only in a couple of cases in which the researcher participates in more than one standardization activity. Internal funding is used to underwrite committee participation in a given committee while participation in others is underwritten by an R&D sponsor. Internal funding is only enough to facilitate observatory status in the committee work.

Some illustrations of how the interrelationship of research and standards work were provided in the course of the interviews. We focus on two of these in cases where Norwegian research competencies have been pioneering.

<u>Illustration 1</u>: One of the illustrative examples of how standards and research can reinforce one another comes out of the SINTEF ICT area mentioned above. In this case, different (object-oriented modelling) programming approaches had emerged and were had started to diverge. During the nineties, there was a growing need to focus research resources in order to establish a recognized and uniform approach according to which developments in the field could proceed. Norwegian competencies had been built up around pioneering work in object-oriented programming and the Simula programming language (Dahl and Nygaard) in the 1960s and 1970s. This early work fostered subsequent research interest and activity in this area in Norway.

The tendency towards a split in object-oriented programming mainly involved two complementary approaches in the US. In this situation, activities were organized in the standards consortium, the Object Management Group (OMG)[10] to promote a common approach. SINTEF and the University of Oslo were involved in this process. The success of UML first as developed in OMG (later transposed into an ISO standard) provided a standard basis on which the programming approach could grow and tools could be developed. The standard thus managed to solidify an object-oriented base and to focus OO research and commercial efforts.

The standard has continued to evolve and is now in UML 2.1. Its development can be tied in with another longstanding area of Norwegian research and standardization activity in the field of digital maps and geodata. The National Map and Geodata Authority (Statens Kartverk) pioneered work in this field and was behind the "SOSI-Systematic Organisation of Spatial Information" standards work. Attempts have been made to transpose this longstanding work into the relevant activities of international standards bodies (CEN and ISO). These attempts have included implementing a UML metadata approach for geodata, where central SINTEF researchers have been involved. The brief illustration serves to demonstrate the relationship between standards and research in different areas and over time.

<u>Illustration 2</u>: Another illustration of the interrelationship between standardization processes and R&D involves electronic toll collection systems and urban road charging systems. This area is currently the subject of a European Directive[11] now moving towards ratification. Electronic toll collection is also an area where Norwegian interests have done pioneering work. The Norwegian Public Roads Administration implemented the world's first system in the 1980s in Trondheim, where SINTEF is based. Since then, the technological solutions have grown, and as many as one million electronic tags have been sold in the Norwegian market.

The roll out of electronic road toll infrastructure was accompanied by the R&D work of a Norwegian private sector research in the company Micro Design AS. Today called Qfree, this company pioneered the air-interface research and developed tag technology starting in the 1980s. The company was well-positioned when the European standard for radio-communication was proposed for the 5.8 GHz band in the early 1990s and for procurement of such technology, for example in Portugal in the mid 1990s. The further evolution of CEN standards has involved coordination with other standards activities, such as those in ETSI. It has also involved a series of conflicts over time about specific technological solutions (there are five main private sector actors mentioned in the proposed directive currently under preparation). An interesting point is that the technical state of the art had in the meantime progressed and overtaken these disagreements. This, and the increasing interest, such as that

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[10] Wikipedia provides some history of UML and some pertinent links.

[11] Proposal for a Directive of the European Parliament and of the Council on the widespread introduction and interoperability of electronic road toll systems in the Community /* COM/2003/0132 final - COD 2003/0081 */

involved in the proposed European directive, has helped move things ahead, paving the way as it were for next generation systems. This illustration provides another dimension of the way standards and research activities interact over time.

3.2.4 Obstacles to the participation in standardization

In general, several factors are important in promoting the participation of researchers in standards work. The prerequisite is of course that the researcher/research group can be identified as a national expert in a specific area and that the researcher/research group is interested and capable to participate. Once recognized, the researchers can become involved through R&D contracts as illustrated above, through contacts with others involved in relevant activities or, in individual cases, based on the researcher's own initiative. Getting researchers interested in standardization is not always easy, and the interviews indicate that attempts to do so in Norway have largely failed. Once knowledge and interested researchers have the opportunity to participate, the key precondition for fruitful involvement depends on financing. Here we look at the several dimensions of these questions as informed by the interviews.

Attitude/Awareness

An interest among sponsors of R&D and funding agencies is a key dimension. Here, the interviewees indicated that those stakeholders with the clearest interests in the outcome of standards, also tended to be best at providing the requisite resources for fruitful participation. In general, it was questioned whether actors with weaker links to the standards process could reasonably provide the ad hoc support to keep a process like standardization going. However, even in cases where strong interests are involved, some interviews indicated that a more proactive stance to standards could be adopted instead of the default stance which tends to react to standards once they are adopted. Cases were mentioned where Norwegian interests could have influenced the outcome of international standards, instead of simply having to implement them.

Another factor is the attitude of researchers to standardization. Most interviewees emphasized that participation in standardization contributes to their research activities particularly by bringing them in touch with international concerns and by helping to build networks with researchers in other countries. They also noted that, while attitudes may be changing somewhat, there remains a general reluctance for researchers to get involved in standardization work themselves. There is an image question here: a general perception is that standards are boring. While reading a standard may not be exiting, interviews emphasized that involvement in the process could be very rewarding including having one's proposals incorporated into international standards.

General awareness of the standardization process, and its merits vis-à-vis the research process, are required at different levels. In some cases, researchers found their participation thwarted by national funding agencies that did not recognized the significance of standards-work as part of R&D output. A counter example was that of the EU Framework Program (which is also funding this work). The EU FP was specifically cited as a funding agency that recognized the interrelationship between research and standardization. Branch organizations, especially those under the Confederation of Norwegian Enterprise (NHO) were also suggested to be a type of organization that should become more aware and involved in this area.

The national frame

Some concerns were linked to how the national system prioritizes standardization. In general, the interviewees recognized national coordination as being important. The role of Standards Norway was noted to have recently been reorganized as have responsibilities within the ministry that supports it, the Ministry of Trade and Industry. By and large, the functioning of national mirror-committees was seen to work very well. Yet there were expectations on how the reorganized national standards system would develop especially in light of the changing division of labour between national and international standards, in which the latter continues to strengthen at the cost of the former.

The question of prioritizing types of involvement at a national level was mentioned more specifically by a couple of interviewees. One general observation was that Norwegian interests tend to be absent from much relevant standardization work. One interviewee saw this absence in light of the encouragement to respond to 'public consultation' on standardization which was questioned if a primary mode to contribute.

Financing

The major topic emphasized by all interviewees is the availability of sufficient funds to finance participation in standards work. This is of course linked to attitudes and interests above. Interviews indicated that where researchers had sufficient financial backing to participate in the committee and where the researchers had done their homework, the standardization process tended to run more smoothly and to schedule. Delays and lack of traction were generally seen as being more probable when the potential research contribution is not backed up by sufficient resources (and nobody does any work between meetings). The issue of improving the conditions for financing standardization participation was raised at different levels by all interview-ees with experience in standardization.

The most common concern is again that standardization work is recognized as being important by those commissioning R&D. An indication is that having a researcher committed to a standards committee might cost in the neighbourhood of 500,000 NOK (or about 60,000 Euro). This is a substantial sum and tends to limit the number of contractors willing or able to fund participation. There may be other channels for funding, not least at the national level where national authorities contribute to standardization activities. Here there was a question of whether public funding is oriented too much towards administrative activities in certain areas. Participation in secretariats is important, but there is also the larger need to get researchers to take part in the committees. This need does not seem to be sufficiently recognized at the national level. The national budget indicates that around 25 million NOK are set aside for standardization activities (National Budget Proposal, 2006). One suggestion was to earmark funds for participation in standards committees (not just in secretariats).

Another suggestion was to get branch organizations more involved since standards both imply compliance costs for industry but also represent a potential way to forward Norwegian interests internationally. Branch organizations were therefore suggested as potential contributors to the participation of Norwegian researchers in international standardization activities. (see also the awareness question)

Conditions for participation

There were no indications that the way standards bodies themselves are organized dissuaded the pick up of research into the standardization process. Some however remarked on the changing standardization landscape, which makes tactical participation more important. This heightens the political dimension of participating in standards. At the same time some underlined the need to continue to focus on consensus as a goal of the process, despite the difficulties this might pose.

In this setting, IPRs were acknowledged as something of a concern with increasing relevance in standards work. Some noted the tendency for IPRs to spark conflict. Some interviewees emphasized the aim of not allowing technological interfaces to become encumbered with patents. But IPR-based conflicts were not seen as a key concern for the SINTEF researchers.

Personality can be a factor inside the committees, and the quality of the secretary is important here to keep things moving. The existence of strong-personalities in the committees can push the process along, but can also drag the process into conflicts. It is important to have steady and focused committee leaders in such cases to avoid problems.

3.2.5 Favorable organizational structures

The general tendency for standardization to move in the anticipatory and pre-competitive direction indicated to some interviewees that the importance of standards to their research as contract researchers, and thus the importance of participating in the standardization process, will continue to grow in an increasing number of research areas. At the same time, this will probably put pressure on certain aspects of the process, especially the goal of consensus which was stressed by some.

The interviews indicated that the self-organizing mode by which SINTEF researchers get involved in the standards activities is a productive mode for involvement. It provides the necessary flexibility for researchers to link up with relevant standards activities over time. This is important as the standardization and research activities continually change. While more centralized coordination might increase focus on standardization or perhaps even its effectiveness, whatever it might achieve would probably come at the cost of an extra layer of administration. There were some suggestions that the administrative layer was already too heavily emphasized.

The level of the individual researcher was stressed. Here the combination of technical knowledge, knowledge of the standards-process and the wider (political and market) contexts, and some social characteristics (such as the ability to work together with others) was seen to promote fruitful participation. In general, it was recommended that the researcher develop a clear and considered standpoint on what is to be achieved, although necessarily combined with a certain degree of flexibility. In several cases, the importance of strong personalities was emphasized. Examples were provided where such actors, both among researchers and among other central stakeholders such as the public authorities, were crucial in initiating the standards process and giving it the required momentum. The motivation of the special actors is in part idealistic, driven by a perception that current solutions are poor and, moreover, by the perception that much better solutions can be elaborated with the help of different stakeholders.

But a self-organization approach seems to have a couple of weaknesses: recruitment of new researchers to standards activities and securing adequate funding across a larger range of standards activities. On the first, the problem is not the availability of competent researchers—although several point out that certain personal qualities are necessary for successful, not only technical skills. A self organizing model does not necessarily help if attitudes among potential participants are adverse to standardization. One deficit is on the interest of researchers in standardization activities. Here, some noted that attempts have been made to recruit more researchers to standardization activities in Norway, but added that these have largely failed.

The other question is the universal concern about adequate funding. Long-term R&D contracting with major actors that have stakes in standardization outcomes provide a good basis for involving researchers in relevant standards tasks. More ad hoc R&D contracts for individual private-sector companies may also provide a good funding basis. So can EU funding under the Framework Programmes of the EU, which was seen as engendering good practice since it encourages participation in standardization activities.

A lack of awareness or interest in the standards activities either by the actor who commissions the R&D contract or by the researcher can otherwise get in the way. The overall cost of standards participation, although now somewhat lower than a decade ago, will tend to pose a barrier to entry for potential new sponsors to get involved. A question is whether other sources could be involved or improved. Here suggestions were made to earmark some public funds to standards participation or to get branch-organizations more involved—perhaps through co-financing of standards activities. Another possibility is to develop a support scheme involving the support-structure, Innovation Norway, perhaps in conjunction with the role already played by Standards Norway.

3.3 TNO: Netherlands Organisation for Applied Scientific Research

Studied organisation	TNO (Netherlands Organisation for Applied Scientific Research)
Interviewees	• dr. M.O. van Deventer, senior scientist broadband and voice solutions • ir. A.H.J. Norp business consultant mobile networks
Date	January 2006, authorized

3.3.1 Introduction

TNO is, by far, the largest research institute in the Netherlands. It was established by law in 1930 to support companies and governments with innovative, practicable knowledge. While it has been usual to refer to organisations such as TNO as public laboratories, over the last decennia they have become increasingly dependent on market revenues. In fact, the large majority of the current funds are raised by contract-based research and consultancy work. Overall, TNO employs around 5000 workers and has a total turnover of approximately 550 million Euro (2004 figures).

3.3.2 Baseline organisation characteristics: Core competences and market

The organisation's main services are (1) contract research, (2) consultancy (on products and processes, as well as policy), (3) testing and certification, and (4) licenses on TNO's patents. Its main clients are governments, companies and organisations. The activities of TNO are grouped along five core competences:

- Quality of Life;
- Defence, Security and Safety;
- Science and Industry;
- Built Environment and Geosciences;
- Information and Communication Technology (ICT).

TNO also owns shares in other organisations; one of them, the fully-owned Dutch metrology institute NMI, is covered in a separate case study.

As these core areas have different characteristics, they also differ widely when it comes to the role and importance of standardisation. This interview focuses on the core area of ICT, where compatibility standards are dominant. TNO Information and Communication Technology has approximately 300-400 employees. A few years ago, it acquired the full research department of the Dutch incumbent telephony operator KPN, and this operator (and its foreign subsidiaries) is a large customer of TNO. Other clients include other telecommunications companies, municipalities, defence organisations and firms (from SME to large corporations). Similar to the overall organisation, contract research and consultancy are the two most important products of this department. TNO Information and Communication Technology did bring forth a number of spin-offs, and holds a number of patents. As a geographical market, the department focuses on the Netherlands and the adjacent countries.

As indicated above, the reminder of this case study focuses specifically on the core area of ICT.

3.3.3 Baseline industry characteristics

Competition in the field of research and consultancy services is substantial. Not only are there various types of organisations offering such services; clients may also decide to satisfy their needs in-house. The degree of specialisation is high – it often concerns high-level knowledge, and projects are by definition customized.

Research intensity in the sector is high – also by definition. Within TNO, two motives may be distinguished for conducting R&D: (1) to strengthen the internal knowledge of the organisation and (2) to perform activities that are directly related to client contracts. The R&D volume of the latter is the highest. Given its high research intensity, TNO has a large R&D staff, supported by staff such as account managers, program managers and the sales force.

Reliance on standardisation is high. To understand role of standards from the perspective of the market for research and consultancy services, it is useful to distinguish four usual phases in technical product development. They are presented in Figure 1, below.

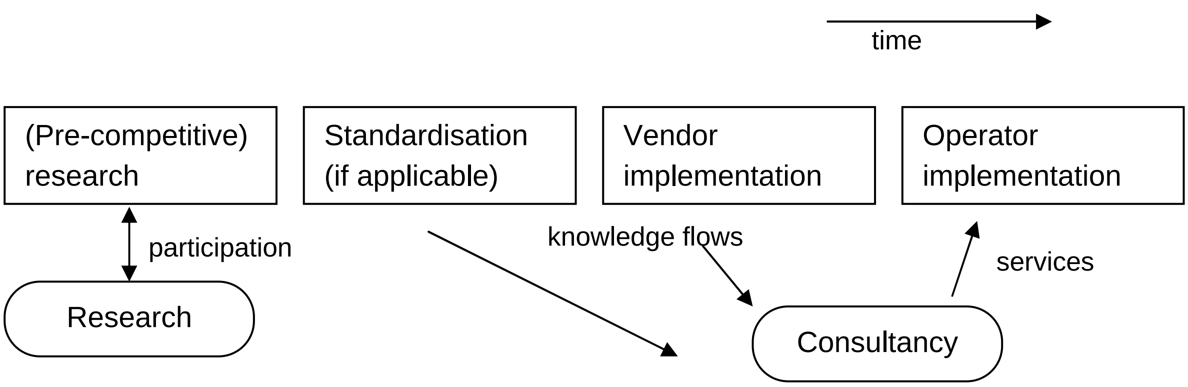

Figure 1: Phases in research and development and their relation to standards

As indicated, activities of public labs such as TNO Information and Communication Technology usually focus on research and consultancy services. In the case of telecommunications, research activities often involve participation in research cooperations, such as those in the European framework program. Consultancy services are aimed at clients as operators, among other organisations. For this, valuable knowledge has to be acquired about the matter in question, and this knowledge may come from the output of standardisation processes.

For TNO, and for TNO Information and Communication Technology in particular, patents are important. Unlike a vendor or an operator, however, the focus is not so much on implementing standards in products or into their own assets (networks, systems). Instead, from the perspective of a public lab, involvement in standards can serve four different functions:

1. Knowledge about standards contributes to the knowledge stock of the organisation and its individuals. For both research and consulting activities, standards can provide valuable knowledge. For instance, when supporting an operator by preparing requests for information (RFIs) or requests for proposals (RFPs), when advising an operator on which offer to chose, or other consulting on network or IT implementation, information from standards is often indispensable. One may acquire this information by reading standards and other information related to the standardisation process, but also by actually participating in the standards bodies.

2. Standards can be the basis of work performed under a direct contract with a client. Given the expertise of TNO some firms grant them a contract to participate in a standardisation process on their behalf, and with their interests in mind.

3. Standards are a mechanism than can enhance the utility of a self-owned patent. If a standard embraces a protected invention (or better: if a standard is designed in such a way that a certain patent becomes essential to it) than obviously this will have a positive effect on the number of licensees and thus on the potential revenue of that patent. Participating in (and thus influencing) standardisation processes may help to achieve this situation. Although TNO does own some patents that are essential to standards, it must be noted that such occasions are relatively rare (especially compared with the patent portfolio of vendors) and that there is no explicit strategy for this.

4. Standards may be mechanisms that ensure that knowledge that has been developed in earlier, pre-competitive research projects (possible in alliances) remains valuable and exploitable. In other words, when research organisations are involved in pre-competitive research projects - including those within the European Framework program -, it can be useful if the outputs are being transferred into standards, as the research firm could later offer valuable consultancy services on the basis of in-house developed knowledge.

Nevertheless, the exact role of standards for TNO as a whole – and even for TNO Information and Communication Technology – is difficult to generalize: for many different areas, standards mean different things.

3.3.4 Organisation of R&D and standardisation activities

Organisation of research

Given the size of the organisation, a hierarchical organisation is necessary. Nevertheless, it is an organisation of professionals and (research) staff have a high level of autonomy and own responsibilities, within the boundary conditions of commercial target and firm strategy.

Priorities for research are first and utmost set by market needs (customer-oriented); most activities are being conducted within the direct realm of contract research. Nevertheless, a certain portion of the overall budget (in the order of 20%) is reserved for R&D efforts without a direct link to ongoing contracts. For this, internal call for proposals are organized, in which researchers they can suggest research that they consider to be important for future purposes. Management makes a selection of the proposals, also keeping the potential long-term value of such research into account.

For research, TNO does employ incentive mechanisms. The most direct incentive mechanism can be found with patents: work that resulted in a patent is rewarded by a direct financial bonus for the inventor. Also, research performance is an important aspect in the evaluating of the performance of scientific staff: researchers are not forced to become managers to be able to get into the higher levels of remuneration. Other mechanisms are more indirect: good research is being recognized and valued both among colleagues and by the management; excellent accomplishments are rewarded with the title of 'TNO fellow'. However, this does not alter the fact that at the end of the day, the organisation's structure is more sensitive form commercial success than for scientific success. This is reflected by the fact that a strategic publication in professional literature that is read by clients yields in higher apprecia-tion in the organisation than a publication in a refereed scientific journal. Of course, these are generalities; reward and appreciation may differ among departments and even the more among different individuals.

Organisation of standardisation

TNO does not have an explicit strategy to influence standardisation. It does however have a strategy on how and where to use standardisation as a source for knowledge. TNO makes, a yearly inventory of all standardisation involvement, and allocate budgets to participate in standardisation.

Interest in standardisation is amongst operators. After some years of cutting costs and diminishing interest in standards, operators again seem to be interested in what is going on in telecommunications standardisation and how they can take advantage of that. This increases possibilities for organisations like TNO Information and Communication Technology to do contract standardisation (representing clients in standardisation).

3.3.5 Obstacles to the participation in standardisation

Five different types of obstacles for standardisation involvement of R&D organisations were mentioned and will be discussed below. Note that these obstacles do not all relate to TNO, but are also based on experience of the interviewees with other R&D organisations.

1. Awareness and budget allocation dilemmas. Standards are important for public labs, but often there is only an indirect benefit (such as increasing the knowledge stock). As a result, the awareness at higher management levels is lower. Standardisation is not seen as a strategic issue, like it is for telecommunication vendors.

In the (favourable) case in which a budget is reserved for standardisation, organisations face the dilemma how to allocate that optimally. Do we distribute it evenly over the full staff? In that case, every researcher has equal chances to get involved in standardisation, but it will allow no more than a superficial involvement, possible visiting a standardisation meeting every year or so. Another option is to focus strongly on a limited number of standardisation activities and get involved more deeply. The advantage is that such close involvement (for instance, somebody visiting all committee meetings within a certain field) brings in-dept knowledge and recognition in the field and opportunities to really learn from your peers. On the other hand, such strong focusing limits the opportunities that standardisation offers to just a few individuals. The only way to overcome this dilemma is to increase overall budgets, but given the relatively low awareness and the direct pressure that is exerted by commercial targets, this is unlikely to occur.

2. Recognition and incentives. Researchers face low recognition of their standardisation activities in their own environments. A very illustrative experience is that not long ago, a senior staff member of a Dutch telecommunications operator was member of ICANN (Internet Corporation for Assigned Names and Numbers). However, few of his colleagues or other Dutch people realized how important, prestigious this membership was, and of what relevance to the technical and non-technical society.

Also for more down-to-earth standardisation involvement, recognition from colleagues and management is limited and it no matter how important standards can be for an organisation, it remains difficult to justify standardisation activities. Compared to other activities (commercial successes and, to a lesser degree, research performance), there are often no direct or indirect incentives for being involved in standardisation, such as bonuses, better career opportunities, and so on. On the positive side, employees that are intensively involved in standardisation benefit from, and enjoy having an extensive international contact network. On the negative side, it implies being away from home and family.

3. Costs of being involved in standardisation. The obstacles discussed above are predominantly of an internal nature to the firm; the cost of involvement in standardisation is an external factor. These costs can be substantial: membership fees, travel and accommodation costs as well as opportunity costs. It must be noted that membership fees differ widely for both formal bodies and fora, but they can mount up to 10.000 Euro annually). More important are costs associated with attending standardisation meetings themselves. A typical standardisation meeting may take a week (person hours that cannot be spent on other projects) and costs some 2500 Euros on travel and accommodation. Attending at least a few meetings on a yearly basis is needed to follow what goes on in a particular standardisation body.

4. Public and semi-public institutes have no direct interest in standardisation. In contrast to firms, public and semi-public institutes (including universities and public labs) have no or fewer reasons to get involved in standardisation. Typically, they do not implement standards in their products or systems/facilities (except from those in some areas such as IT, but these standards will be developed anyway, also without their involvement). They have little need to influence standards towards their own technologies, IPRs or technological capabilities. For some firms, involvement in standardisation is a very strategic matter, and receives a high priority and likewise budgets, but for public and semi-public institutes this is a totally different matter.

As a result, public lab representatives would typically visit some but not all of the plenary meetings of a certain committee; whereas firm representatives would typically go to every plenary meetings, many of the meetings of technical subcommittees and ad-hoc meetings, and would also have internal coordination meeting specifically geared towards a certain standardisation trajectory. As such, they are very intensively involved, have the means to influence standardisation, and are involved in intensive learning processes. Being at some meetings is definitely not the same.

5. Different interests for research and product development departments and timeline incompatibility. When we focus on standards implementators (specifically: equipment vendors), we observe that their main involvement in standardisation is from the product development department. There, direct interests exist to influence standards and to build extensive knowledge of standards (to be able to implement it in the best and least expensive manner). Their activities usually also align in time with the standardisation efforts. In facto, research departments from these firms are involved far less frequently. In fact, in quite many firms, R&D and product department are divisions that are rather far apart. Some firms even prevent that R&D staff participate in standardisation meetings, when commercial interests are at stake.

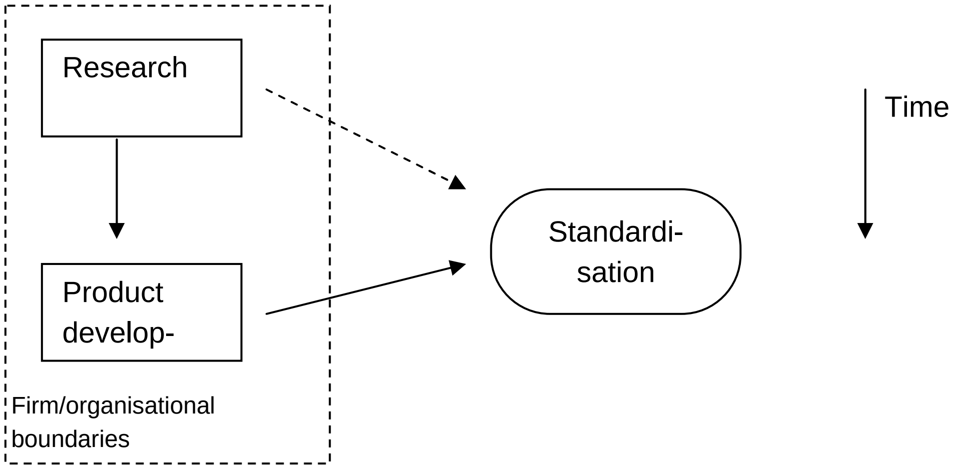

Figure 2: Shifting focus of standardisation involvement of research respectively development over time

As a result of this, research departments of vendors are often not involved in standardisation. This puts public research labs, that do not have a product development department in the same sense, in a strange situation. If they participate, they are not working in the committee with their peers (researchers from vendors and other organisations) but with product implementators, with different interests. Vendors and operators assess R&D results to see if they align company strategy and commercial interests before they input them to standardisation. Public R&D companies are involved in the same research projects, but don't have a similar process.

Assessing the actual commercial benefit of R&D results is an important step in technology development. Therefore, it is rather questionable whether a stronger involvement of research staff in standardisation (either from vendors or other organisations) will actually work or contribute to the value of standards. An interesting exception is the IETF, where research staff of firms is more heavily involved. IETF also attracts more researchers from universities and public labs often talking more on their own behalf than that of their employer. However, input from vendors in IETF is being influenced by commercial interest more and more.

Finally, it should be noted that not all research is in fact appropriate as input to standardisation. By definition, research includes the risk that hypotheses get rejected; that there is no outcome, that a certain technological route is not working. Although from the scientific perspective that can be a valuable outcome, it is obviously not a favourable outcome for standardisation.

3.4 Fraunhofer Institute for Information and Data Processing

Studied organisation	Fraunhofer Institute for Information and Data Processing (Institut für Informations- und Datenverabeitung - IITB)
Interviewees	Prof. Steussloff, former director of the institute
Date	December 2005, approved

3.4.1 Introduction

The following case study describes the activities of the Fraunhofer Institute for Information and Data Processing, a private non-profit institute of the Fraunhofer Society. Although the researchers of the institute do not play a very offensive role in standardisation, standardisation activities and standards are important instruments for future research activities if the institute.

3.4.2 Baseline organisation characteristics: Core competences and market

The Fraunhofer IITB is a private non-profit research institute and member of the Fraunhofer Society. In 2004, more than 150 people were employed by the institute. The turnover was over 15 million Euro.

The Fraunhofer IITB has seven business divisions located in Karlsruhe. IITB's Sub-Institute, the Fraunhofer Institute for Transportation and Infrastructure Systems (IVI) is being organized in Dresden. It is divided into two business divisions – Multi-modal Transportation Systems (MVS) and Process Control of Infrastructure Systems (PFI). This sub-institute is not covered in the description. Another IITB branch office is the Fraunhofer Systems Engineering Applications Center AST in Ilmenau. IITB maintains the Fraunhofer Beijing Office for Industrial Organisation and Automation (FBB) in the People's Republic of China in order to have, with its partners, a presence in that market.

The IITB covers the following technological areas in its portfolio:

- Visual Inspection Systems: Vision systems using line scan cameras for the automatic inspection of bulk materials for/from continuous industrial production processes.
- Autonomous Systems and Machine Vision: Automatic imagery and signal analysis for recognition, analysis and diagnosis in complex environments.
- Interactive Analysis and Diagnosis: Solutions for the technically-supported analysis of signals and images to solve diagnostic tasks
- Interoperability and Assistance Systems: Development and evaluation of interactive systems, especially for reconnaissance and monitoring supported by imagery.
- Control systems: Production monitoring and control systems, manufacturing management systems, production data acquisition

- Systems for Measurement, Control, and Diagnosis: Online monitoring, diagnosis and control of industrial plants, mechatronic and robotic systems
- Resource Management (Ilmenau Center for Systems Technology Applications): Water management, Electrical Power Management, Energy Distribution Management.
- Networks: Planning, installation and operating secure computer networks including network management, firewalls and encryption.
- Information Management: Information and knowledge logistics, specialty information systems, facility management; simulation: information & knowledge systems, operator training; information & knowledge consulting.

Besides research services, Fraunhofer IITB offers the following products:

- Visual Inspection Systems - Products and Services
- Recognition Systems
- Information Management
- Systems for Measurement, Control, and Diagnosis
- EMI Testing and System Development Advice.

The domestic and the European market are equally important for the institute, although research projects at the global level gain in importance.

The institute is active in rather fast developing markets.

3.4.3 Baseline industry characteristics

The general competitive dynamics in the submarkets of the institute differ significantly. We list some examples.

The market for automatisation technology is rather stable, although new software technologies and robotics technologies emerge.

The market for information management systems is highly dynamic. Especially, the connection of data with environmental information represents a new emerging and growing market. The institute provides solutions for decision support, including the connection of data e.g. on rivers and ground water provided by different institutions.

In the case of resource management, the institute combines different methodologies to optimise the use of resources. The institute offers only customised solutions. Capacities for serving a mass market are not available. The institute spends about 20% for applied research activities funded by institutional funding. Another 30% of the budget stems from research projects on behalf of public institutions. The remaining 50% are covered by contract research projects for private industry.

Standards are used as far as possible. Besides general software standards, standardised programming languages, open source software and standardised platforms are used. The institute uses standards even if the customers are not inclined to use or implement standards.

3.4.4 Organisation of R&D and standardisation activities

The institute has a rather flat hierarchy. Under the head of the institute, they have departments. Within the departments research groups are managed by group leaders.

Alongside with research, raising of research funds has high priority. The institute is very successful in acquiring follow-up projects from the same client. Often, a line of five project for one client is realised. The heads of the institute are responsible for strategic contacts. The acquisition of 60% of the budget is realised by the head of departments, 40% by the group leaders.

Among the main incentives for the researchers is the need to raise research funds. In addition, participating in licensing revenues is a more theoretical incentive, research premiums are more important. Furthermore, the internal and the external career is promoted by the acquisition of research funds. Whereas scientific publications are not an instrument to increase personal reputation, the reputation in the community and the market is promoted by presentations in conferences and industry fairs.

Standardisation activities are only started or initiated after consultation with the clients. There are no "intrinsic" standardisation activities within the Fraunhofer IITB. The coordination of standardisation activities is done by the project managers, i.e. it is a pure bottom-up approach. The incentive to join or even to initiate standardisation processes is driven by customer-orientation. Furthermore, standardisation increases the reputation in the own research community. The participation itself is an opportunity for networking with potential collaboration partners. The return of the investment in standardisation is rather high by the establishing and intensifying such contacts.

3.4.5 Obstacles to the participation in standardisation

The transfer from knowledge from the R-frame to the S-frame is no problem for the institute, since the individuals are active both in research and standardisation. Sometimes the awareness and sensitivity for standardisation issues could be elaborated better. This is supported by the notion that only the participation of 3 researchers in standardisation processes is officially reported in the annual report 2004.

The main problem for the transfer of knowledge from research to standardisation is the inadequate public funding of pre-normative research or research-oriented standardisation. In Germany, the industry is expected to fund standardisation activities. However, the industry is rather restricted with funding standardisation through cooperation with scientific institutions. The standardisation activities of Fraunhofer IITB are often funded by follow-up projects funded by industry. Joining standardisation consortia is driven by customer needs (and funding). Even if the main focus is on formal standards and less in very specific consortia standards, IITB has e.g. been working in the field of defining and establishing conformance tests for field bus consortia.

Patents are no issue in the software area. However, Fraunhofer IITB applies for process and hardware patents. In 2004, the researchers of the institute applied for 10 patents and 3 trademarks. There are no experiences with patent pooling.

Besides the missing funding for the participation in standardisation, some formal standardisation bodies collect membership fees, which is a further obstacle for the participation in standardisation.

The publication of TC membership lists would be an additional incentive for the participation in standardisation. The reputation of the participation of Fraunhofer IITB personnel in standardisation is also fostered by the neutral position and the role of a competent mediator in standardisation processes.

Furthermore, personnel of the institute are involved in standardisation processes, which try to standardise converging technologies and issues. One issue is the standardisation of smartcard for the health system, which involves numerous and very heterogeneous stakeholders. Chairing such TCs fosters the role of the institute as competent, but neutral and mediating actor in the standardisation process.

The successful handling of the interface between research and standardisation is based on two key elements. First, project managers decide bottom-up whether, where and how to get involved in standardisation processes. Second, those researchers involved in the related research will also join the relevant standardisation processes. Consequently, there is no real interface and therefore friction or obstacles between research and standardisation. Still, more public funding would be appropriate to overcome the public good problem of the active participation in standardisation, especially if industry is reducing its budgets for the support of this engagement.

3.5 Munich FIW (Forschungsinstitut für Wärmeschutz)

Studied organisation	Forschungsinstitut für Wärmeschutz e.V., Munich FIW
Interviewees	Dr. rer. nat. R. Gellert (Manager) Dipl.-Ing. (FH) H. Anton (Research coordinator)
Date	September 2005, approved

3.5.1 Introduction

Standardisation is an important issue in the construction sector. The following case describes the research and standardisation activities of a private research institute focusing on thermal insulation and reveals impressively how to exploit successfully the interrelation between research and standardisation.

3.5.2 Baseline organisation characteristics: Core competences and market

FIW is a non-profit association with the purpose of promoting science in the area of thermal insulation. In 1921, the association was entered in the register of associations under the (original) name of “Forschungsheim für Wärmewirtschaft e.V. München”.

The purpose of statutes is mainly realized by:

- Study of heat and material transfer laws, especially of the scientific fundamentals of thermal insulation,
- Dissemination of knowledge,
- Technical tests of construction and thermal insulating materials and the structures in which they are used (practical performance),
- Co-operation with energy-efficiency associations, technical organisations and scientific institutes.

FIW has 48 employees, including twelve engineers, in 2004 and generated a total turnover of 4 million Euro. The company is located in Munich. The institute is structured into the following departments:

- Management;
- Accounting Department and Human Resources;
- Insulation Products for Buildings;
- Industrial Insulation;
- Building Physics and Building Components.

Research projects are conducted in all departments (see below). FIW spends on average between 300,000 and 500,000 Euro for research activities. Part of the research is funded by profits generated by its service activities and membership fees. FIW is active in research, testing, surveillance, certifying, measurement and calculation, consulting and examination, information and training.

The focus of FIW is on testing and surveillance. Meanwhile, two thirds of the turnover are generated by services for domestic customers and one third for customers from abroad, which require testing services in order to receive the CE mark. For example, a customer from Thailand wanted to import insulation material to Germany, which was only possible after receiving the CE mark.

3.5.3 Baseline industry characteristics

FIW has around 60 competitors in Europe, other notified bodies. In Germany, around 10 testing bodies (PÜZ-Stellen) are competitors. However, the sector faces a concentration process. FIW is confronted with little competition in Germany, since the relationship to their customers is very close. In Europe, FIW has a rather unique position in industrial insulation, because German technical regulations are becoming European standards. This gives FIW a significant time advantage in offering testing and surveillance services, not only in the domestic, but also in European market.

The services are very closely tailored towards the needs of its customers. “Commodity” services are not feasible, due to the very specific materials to be tested and certified.

FIW spends about 10% of its budget for applied research. Around 50% of the funding of the projects comes from public sources, like the local or federal ministries responsible for the economy – supporting SMEs in particular. The research projects aim in general to develop test and analysis methods and equipment applicable to thermal insulation materials, like testing methods for the determination of the emission of regulated substances from insulation material. However, in a few research projects FIW tries also to develop specific thermal insulation materials. FIW does not follow an explicit IPR strategy, nor does it apply for patents.

Standards are crucial for testing and surveillance services. New emerging services depend on the establishment of common test standards. A new emerging market will grow around the issue of energy saving in relation to thermal insulation.

3.5.4 Organisation of R&D and standardisation activities

The general organisation principle follows flat rather than hierarchical structures.

Research is organised horizontally - i.e. by project - involving all of the three technical departments. Additionally, one engineer of the institute (who is reporting to the managing director) is explicitly responsible for research coordination and for detecting new sources of public research funding, research co-operations and the development of research incentives. The research intensity fluctuates by technological area, according to recent trends and the dynamics relevant for the services provided by FIW. FIW reacts also to the ideas and initiatives of universities and other research institutes, like Fraunhofer Institutes.

Incentives to conduct research have to be focused on the drafting of research proposals and the related administrative requirements. However, the reputation of the institute, which is relevant for its competitiveness, depends on its research performance. The engineers are well aware of this relationship and a "research culture" has been developed accordingly. Special incentives for the engineers are the opportunity to publish articles in national and international engineering, but also industry journals. Furthermore, the researchers have the opportunity to present their research results at national and international conferences. FIW also organises a European conference on heat protection in order to increase the reputation of the institute.

Standardisation activities are very important - but not centrally organised. The participation in national (DIN), European (CEN) or international standardisation (ISO) processes is driven by the particular technical interest of the engineers “as part of their job" and requests from industry associations to have a "neutral expert" on the committee or the delegation of a national representative into an international committee. The engineers have no formalized "mandate" from the institute for their standardisation activities – the membership is usually a personal one. Each of the twelve engineers is active in at least one technical committee. The lists of technical committees in which the engineers are involved are displayed in the annual report. There are no incentives necessary to motivate the researchers towards an active participation in standardisation. In contrast, some engineers have to be reminded not to over perform in standardisation. The engineers are aware of the reputation building effect of active participation in standardisation bodies. Especially chairing a technical committee has very high reputation effects and a high visibility. This has indirectly a positive marketing effect among customers and improves and stabilises the relationship to their customers. Consequently, FIW aims to chair some strategically important technical committees. In total, FIW spends around 40,000 Euro on travel costs and 300,000 Euro of personnel costs on standardisation activities. Parts of the costs are covered in publicly funded research projects as dissemination and knowledge transfer activities.

In general, there is no need for explicit coordination between (applied) research and standardisation activities. A natural balance between research and standardisation activities dominates. However, there is extensive research demand in some areas, which cannot be adequately funded within public research programmes. FIW explicitly misses programmes for pre-normative research both at the national and the European level. FIW does some contract research without following an explicit strategy. There is an increasing demand from abroad to perform applied contract research. Especially from Arabia and Asia, FIW is approached to perform research and development in the field of energy efficiency. A new strategic business area will develop around energy saving. Related research is necessary and also subsequent standardisation activities.

3.5.5 Obstacles to the participation in standardisation

Due to the integration of research and standardisation within the engineers at FIW, there are not two explicit R-frame and the S-frame, which require a transfer. The integration of research and standardisation activities with one individual is obviously the best solution for overcoming barriers between the R- and the S-frame.

In general, FIW complains about the lack of openness of public research programmes for standardisation-related activities. Adequate research is necessary to be able to improve existing standards and to develop new standards. Since FIW does not actively use patents and other IPR and faces no problems with the IPR portfolios of competitors or customers, it perceives no need to change the existing IPR frame or its own missing IPR strategy.

In standardisation activities, several problems have to be addressed. First, a clear definition of objectives is missing in many standardisation processes. Second, the efficiency of standardisation processes can and should be improved. Third, a clear division of labour between closely related technical committees would help to avoid unnecessary duplications of work. Fourth, the interface to other stakeholders outside the standardisation processes should be improved especially to local authorities and ministries, which are responsible for regulations to be coordinated with standards. Here, the implementation of the New Approach needs to be improved. Furthermore, the quality of European standards is not sufficient from the perspective of the regulatory authorities in the German construction sector, which may again create trade barriers. Fifth the voting rules within technical committees should be revised. The unanimity rule should be abolished and the chairmen should receive more far reaching power. In general, the voting of country delegates about technical questions is often questionable and counterproductive.

The following two critical issues are relevant for the research-standardisation interrelationship. The personnel and travel costs for the participation in standardisation activities is too high in relation to the research budget. Here, public funding agencies should reconsider their funding practice. In order to reduce travel costs, FIW hosts some of the sessions of the technical committees in Munich.

Furthermore, the price for standard documents in the construction industry is too high. Additionally, the language and the intelligibility of the standards is not given, which hinders their implementation and wide diffusion, which is also not positive for innovation.

3.6 NMi: Dutch Metrology Institut

Studied organisation	Nederlands Meetinstituut (NMi; Dutch Metrology Institute)
Interviewees	• dr. E. de Leer, Director of Science
Date	January 19th, 2006

3.6.1 Introduction

The NMi is the institute that, among other things, is made responsible for the Dutch activities relating to the international Metre Convention. As such, it carries out a public task. It is nevertheless organized as a private company, and has a contract with the Dutch Government for performing the aforementioned task. In addition, the NMI is involved in a range of other activities, including research and development of measurement systems and apparatus, certification and type approval, inspection and consultancy.

Given its very high research intensity (see below) and its intensive involvement in standards bodies, NMI is an interesting case for the INTEREST project.

3.6.2 Baseline organisation characteristics: Core competences and market

NMI has a turnover of approximately 30 million Euro annually, and employs about 250 persons. It organizes its activities in three divisions: the Van Swinden laboratory (VSL), Certin and Verispect. VSL particularly focuses on activities relating to the Metre Convention; whereas the other subsidiaries have tasks such as verification and inspection of compliance with the Weights and Measures Act and other Dutch legislation, and also design of measurement instruments and consultancy services. NMi was privatised in 1989, but until 2001, all shares were owned by the State. Nowadays all its shares are owned by Netherlands Organisation for Applied Scientific Research (TNO). Nevertheless, NMI operates rather independently from its owner and has its own contract with its clients (including the government).

It has to be stressed that measurement standards, in which NMI is heavily involved, are in many ways different from other types of standards. Care should be taken, that some findings from this case study might be specific for this context. This does not preclude, however, that NMI is also involved in (and contributing to) other types of standards.

Obviously, one important measurement standard is that of length (the meter). But there are many more measurement standards areas in which NMI is active, including flow and volume, ionizing radiation, electricity and magnetism, acoustics and vibrations, optics, chemistry, mass, pressure, force, and viscosity. Examples of highly advanced apparatus that NMI has developed are a low-tolerance temperature meter for delicate processes at high temperature (e.g. in the petrochemical sector), and precision measurement devices for liquid gas and other substances (for the transport of gas and oil by pipes). In these field, the institute is recognized as a leading global player. The company does procure some of its instrument form suppliers, but given the complexity and desired low tolerance of many of their apparatus; NMI actually develops and produces quite a lot of its apparatus itself.

The market for NMI consists of different type of parties. Roughly, one can distinguish the following clients: (1) the government (particularly focusing on activities relating to the measurement convention, worth 4.5 million Euro per year); (2) accredited laboratories, such as KEMA, which buy (calibration) services from NMI, and (3) private firms, that acquire measurement instrument and consulting services. Especially the third market has been growing strong over the last years.

3.6.3 Baseline industry characteristics

The market (or field) of metrology is an established one, and the market structure used to be rather stable. Most products and services are highly customized. Quite recently, however, the market structure for accreditation services is subject to strong changes. The new European Measuring Instruments Directive (MID) directive (expected to be implemented in Dutch law in 2006), states that a device that received type approval in one country may be brought on the market in any (EU) country, without the need for new approvals. As such, certification/accreditation laboratories will face growing international competitions, and the total demand for type approval services within the European market is likely to decrease.

NMI is very research intensive. At the Van Swinden laboratory, 80 of the staff of 100 work in R&D and about half of them holds a Ph. D. degree. The other two divisions of the company are less research-intensive and the staff operates mostly on a medium to high technical level. There are many research co-operations, including several shared Ph.D. projects with universities. The high research intensity is typical for the sector of metrology.

3.6.4 *Organisation of R&D and standardisation activities*

When it comes to standardisation, the core activity of the Van Swinden laboratory is contributing to the measurement convention, i.e. measurement standards. As stated above, this is a very specific type of standardisation activity, not to be confused with others. Besides that, NMI (including all its departments) are involved other standardisation activities, usually relating to measurement procedures. It participates actively in ISO and CEN committees, for instance in the fields of electromagnetic compatibility and in chemistry. For some committees with global scope they even provide the chairman, such as the ISO-REMCO committee for reference materials and the ISO TC-158 committee for Gas Analysis.

The research and standardisation strategies at NMI are closely integrated; which is to some degree also inherent to the specific fields in which NMI operates, and to the public tasks it performs. Long-range strategic plans at the various levels of the organisation all integrate standardisation activities. For the involvement in large, international standardisation activities, high-level strategic choices are made; however, for participation in national standards activities (e.g. in NEN, the Dutch standards institute) the choice is often left to the individual worker whether to participate or not. This individual will have to weigh his or her personal interests to the available time and capacity (as NMI is a private firm, workers do have to meet certain commercial criteria).

3.6.5 *Obstacles to the participation in standardisation*

The overall observation is that NMI can (and does) effectively contribute research results to standardisation. There are some issues, however, that to some degree impede this contribution. These issues are discussed below.

A. The costs of participating in standardisation. The costs of participating in standardisation processes are substantial, and industry cannot always bear these. One example: NMI has one of the leading Dutch research groups in nanotechnology. One member of the research staff showed interest to contribute to the Dutch standards body in a nanotech committee. He was required, however, to contribute 5000 Euro before he could participate and contribute his knowledge. Having world-class knowledge but no commercial activities in this area, NMI refrained from participating. It must be noted that standards bodies vary in the contribution fees they charge; and incidentally the EU subsidizes a standardisation activity and compensates for all costs (even the drafting of the text of the standard). But these are exceptions. And, of course, contribution fees are only one (small) part of the total costs, which also include travelling, hours that could also be worked on a commercial project, etc.

As employees/researchers within NMI also have certain commercial responsibilities, this does mean the standardisation efforts do get lower priorities than what might have been optimal from the public perspective. This development is not unique to NMI and is reinforced by privatisation: many institutes that perform public tasks have turned from non-profit bodies into private firms.

B. The sluggishness of standardisation processes. It is the personal experience of people working at NMI that standardisation is slow; it takes years to come to a draft standard, and then it has to be followed by a public enquiry procedure – usually via national standards bodies – again taking a lot of time. Especially because of these lengthy procedures, there is the risk that a standard at the time it is formally established is already superseded by advances in science. This deters participants – to some degree – from participating in standardisation. It also feeds alternative means of harmonisation, such as consortia. In fact, in the field of metrology, users of standards in certain sectors such as the US car industry turned their back to formal (ISO) standards.

C. Mismatch with new technological areas. In new technological areas, it is unclear what benefits there are to participating in standardisation, and the fast pace of development does not easily fit in the slow(er) pace with standardisation. An example with which NMI has been struggling is that in the area of nanotechnology (as mentioned above). NMI has one of leading research groups in this technological area, but up to now there are few incentives to participate in standardisation. Possibly, such participation may result in spin-offs, but one can never be sure.

IPR issues are hardly problematic in the field of metrology. No specific best practices or areas of improvement (other than those related to the three issues discussed above) were mentioned.

4 Commercial Enterprises: Five Cases

4.1 Introduction

One crucial aspect of the RTOs surveyed above is that they do not have a set of commercial product lines around which to organize their research and standardization activities. The arrangement of the interrelationship of the R and S frames generally reflect the fact that their underlying activities grow out of projects and out of the expertise of individual researchers. In this chapter focus will shift to a set of different private enterprises. This shift in focus should are expected to provide a different perspective on these issues.

The fact that commercial product lines necessarily provide the basis for research and standardization activities at enterprises we expect that the organization of these activities—and the challenges associated with their inter-organization— will likewise be different. A variety of enterprises are included in the five cases. These include research fields of varying intensity such as ICT, consumer electronics, as well as medical devices; they look at enterprises in mature industries (ship-building) as well as in service-based technologies; and they encompass larger and smaller firms.

4.2 Sun Microsystems (network computer products and services)

Studied organisation	SUN Microsystems
Interviewees	• John L. Hill, Corporate Standards • Doug Johnson, Corporate Standards. Manager, Standards Strategy. • Susy Struble, Corporate Standards • Eduardo Gutentag, Corporate Standards. Director of Technology. Chair of the Oasis board (to 2007)
Date	March, 2006

4.2.1 Introduction

Sun Microsystems[12] is a major international company working in the area of network computing products (hardware, software) and services. This multinational has an established track-record as both a research- intensive and a standards-intensive company. It has stressed its commitment to— and its dependence on— both activity areas. In this light, the fact that, at 23 years of age, Sun employs 31,000 suggests its success in managing the relationship between research activities and standardization activities.

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[12] For the SUN case, we made use of the following references: Cargill, C.F. (1989), Sun Microsystems (2005), Computer Business Online (s.a.), Gartner Symposium (2001), and Sun (S.A.).

This section focuses on the interface between research and standardization in this particularly relevant organizational setting. It builds on information and viewpoints collected in interviews[13] with four members of Sun's Corporate Standards, a unit which coordinates the company's wider operations with its extensive presence and participation in standards work. It presents general characteristics of the company and its industry[14], it surveys how the research-standards interface is organized, and discusses some of the challenges and potential solutions that are seen to emerge here. Contact persons have been with the Corporate Standards Department within Sun's Chief Technology Office (see overview of interviewees above).

4.2.2 Baseline organization characteristics: Core competences and market

Since it was established in the early 1980s, Sun Microsystems has grown into a major network computing company. The company builds on the idea that 'linking computer systems increases their overall power dramatically', and it has focused on 'network computing infrastructure and the community that it enables' (Annual Report, 2005: X). With its emphasis on integrated end-to-end networked systems, Sun is involved in a range of interrelated areas, notably processor and systems architecture, and software solutions. Its business operations are spread across the globe.

This multinational is headquartered in the US but does business in more than 100 other countries. It employs 31,000 and has a direct presence in 48 countries (especially strong in the UK, Germany, and Japan). In 2005 it reported revenues of $11.1 billion, with the proportion from abroad climbing during the last several years.

Some Baseline Characteristics

1. Company Type: Network computing products and services
2. Structures: overall size:
- Revenues (fiscal 2005): $11.1 billion
- Employees: 31,000
3. Technological markets and main outputs: Network computing infrastructure solutions
- Computers systems (hardware and software)
- Network storage systems (hardware and software)
- Support services
- Client solutions/educational services
4. Location and geographical markets:
- USA (incorporated in Delaware, HQ in California
- Doing business in over 100 countries)
5. Maturity: A relatively young firm (established in 1982).

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[13] Phone interviews during January and February 2006 with different locations.

[14] Additional information about the company has been compiled from available sources Including the Annual report 2005, publications of interviewees, various press releases, and the web-based information etc.

The company stresses its ability to attract large communities of developers around its solutions. In addition to its focus on networked technology, networking— and the need for standard interfaces—are also important in a more organizational sense. Sun is involved in variety of partnerships and alliances, including those with Fujitsu and Hitachi, and it depends on a series of external manufacturing partners internationally. The company has longer-term links with individual suppliers (such as Texas Instruments), as well as with individual customers (such as GE). Networks thus pervade not only the products but also the operations of Sun.

4.2.3 Baseline industry characteristics

Sun's 23 year focus on network computing has been in phase with the industry's remarkable, network oriented development during the same period. R&D and standardization have each been integral in keeping the company at the forefront of developments. R&D and standardization activities are both central to Sun's extensive operations, and it has emphasized its commitment to, and dependence on each throughout its relatively short history.

ICT is an R&D intensive industry, figuring prominently in the OECD listing of high-tech sectors (those with R&D budgets over 8% of revenues). In this environment, Sun has consistently stressed its commitment to research. It reports an average annual budget of over $1.1 Billion or up to 16-17% of revenue in recent years (falling off slightly most recently). According to senior VP and strategic insight officer, Larry Singer (quoted in Gartner), "(Sun has) the largest R&D budget relative to revenue of any company in the industry.[15]"

The company emphasizes the importance of end-to-end integrated systems in its network computing infrastructure solutions as well as that of scalability to suit different needs in different environments. It is involved in several large-scale development activities in different business areas. Sun's activities fall into four main areas:

- Computers systems (hardware and software)
- Network storage systems (hardware and software)
- Support services
- Client solutions/educational services

The interrelationship between hardware and software is critical to Sun's operations. Revenue is generated mostly in hardware areas but the two general sales types are seen to reinforce one another, although they are not co-dependent[16]. Sun's offerings

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[15] http://symposium.gartner.com/story.php.id.1167.s.5.html

[16] in line with the interoperability ideal, the hardware runs different software and the software can run on different hardware

encompass processor and systems architecture, operating systems and desktop and web- services software. These include well-established product lines, especially:

- Scalable processor architecture (SPARC),
- Technology based programming environment (Java)
- Solaris Operating System (Solaris 10)
- X64 computing systems (useful for grid-computing)

These areas account for different levels of R&D expenditure, with development in next generation SPARC technologies and Solaris 10 accounting for substantial shares.

Sun is also a standards-intensive company. This dimension of Sun is linked to its long term commitment to interoperability, emphasized in the promotional sections of its annual report for 2005. A degree of interoperability, and thus standardization, comes with the territory of doing business in a network-industry but is especially pronounced in Sun's case due to its networking focus and its goal of promoting end-to-end integrated yet open systems. Greg Papadopoulos, Senior Vice President and Chief Technology Officer, clarifies the company's commitment to standards in general while making the case for open Standards:

> "A network functions through collaboration and standards. From the start, Sun Microsystems based our product strategy on hardware and software standards. These include Berkeley UNIXÆ, TCP/IP, Ethernet, and the VME bus. We have long recognized the importance of network concept to social and economic growth, and this notion is part of Sun's corporate DNA. Our commitment to Open Standards continues to attract some of the best standards people and engineers in the world.[17]

At another level, standards are also useful for Sun to improve the coordination of intermediate goods from its component suppliers or to encourage wide-spread development efforts in development communities. As a result, Sun is one of the most actively and visibly involved ICT companies in international standardization activities, both in formal bodies and consortia.

4.2.4 Organization of R&D and standardization activities

As a large multinational company, Sun is a multifaceted organization involving a range of internal and external operations. Beneath the CEO, activities are generally organized in product oriented portfolios and a range of business-units. These report up through the organization to respective points in the upper management structure.

The bulk of the R&D budget goes to activities with direct relevance to product-line development. These activities are generally organized within product area operations in the business units. However a proportion of the substantial budget is also allotted to research activities at Sun labs. These activities have no immediate application and

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[17] http://www.sun.com/software/standards/overview.xml

might have a 2 to 15 year outlook. There is even a small budget earmarked to social-science research on standardization [18] R&D activities at Sun are distributed internationally particularly in eight locations, including Norway. An additional mode to acquire new competencies is to acquire companies with complementary assets, such as in the storage area.

An essential aspect of the Sun case is that the company has a Corporate Standards Department within its Chief Technology Office. Corporate Standards was turned into a formal unit about five years ago but less formalized activities were found at the company before that.[19] Today Corporate Standards has a full time staff of 10 and is led by Carl Cargill who has been a central figure in IT standards practice as well as research since the late 1980s[20]. The department is central for example in spelling out the company's vision on interoperability which is explicated in a set of "Common Criteria for IT Interoperability"[21]. But its main focus is on promoting and coordinating different types and levels of Sun's participation in standardization activities.

In general defining Corporate Standards as an integral part of the organization testifies to the importance of standards to the company. This importance is emphasized by the direct link to the vice presidential layer of the organization. This link to the chief technology officer, Papadopoulos quoted above, provides the basis for close communication between standards and the overall strategy of the organization. This placement also makes it autonomous of the product lines and the project engineering groups, whose participation in different standards committees the unit attempts to encourage and to coordinate.

Defining Corporate Standards as an integral part of the organization moreover testifies to the challenges that a large company faces in maintaining a consistent and efficient presence in the changing standards environment. There is currently an estimated 450 Sun employees who participate directly in standardization activities: they may take part in more than 150 standards bodies (maybe a total of 300 working groups) at any given time. As many as half the R&D staff are likely to be involved in standards-related activities in the course of their work.

Most direct participation takes place at the technical level, through working groups and committees. Participation at this level is aligned with product-level developments and generally involves advanced product-development teams. Participation in standards work involves the technical know-how and the objectives of product-lines. Technical input is left with the advanced product-development teams and the

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[18] No partners in the present project receive any support from Sun.

[19] It is said that the need to institutionalize the coordination of standards activity was particularly recognized after a technical argument at an IETF meeting. In this setting where committee participation is at the individual rather than company level), it was later revealed that the argument substantially was between two Sun employees (who were unaware of each other's affiliation).

[20] He has authored several recognized publications on different facets of IT standardization, including: Carl F. Cargill, Information technology standardization: theory, process, and organizations, Digital Press, Newton, MA, 1989

[21] http://www.sun.com/software/standards/overview.xml, See above.

discretion of the individual participants. There is also participation higher up in standards bodies, for example at level of the board.

Corporate Standards is involved internally to promote participation of the product lines in relevant standards activities and to avoid duplication of efforts. The questions that may be encountered include how to match its R&D roadmap to ongoing standards efforts, whether to modify that roadmap based on such efforts, or if and when to initiate such an effort based on internal developments. Based on its extensive expertise in the standards-market, the unit helps to advise on which standards setting environment to participate in, when to get involved, and how deeply.

In addition to the technical dimension, there is also a more ‘political’ or strategic dimension to standardization. Here Corporate Standards may also advise participants on sensitive strategic interests in cases where company rivalry is particularly pronounced. The constraints imposed by such tactical concerns has however been reduced in recent years, not least since Sun and Microsoft entered an interoperability agreement a couple of years ago. This allows the company to focus more on the standards and their implementation than on more tactical concerns.

4.2.5 Obstacles to the participation in standardization

Internal coordination between activities. In general, the existence of Corporate Standards unit provides the basis for good links between standards and overall business strategy at Sun. The link to the management level via the CTO was seen as conducive to promoting standardization in the organization. Here individuals seem to make a difference. The fact that the current CTO understands and supports standards was emphasized as an important factor in positioning standardization activities in relation to the company’s overall strategy. The implication is that things might be different with a less supportive link at the highest management levels.

The challenge of linking standards activities more strategically to the company’s overall operations is more pronounced down into the R&D activities of the company. At the level of the product engineering groups, the tendency is to think of standards as a chore less than as an opportunity or as something to be removed when budgets get squeezed. In this environment, standards were likened to sausages which are messy to make but which everyone enjoys once they are made. This perception was linked to the reluctance of researchers to participate in the standardization process. In this setting, the R&D staff tends to see standardization less as a complement to, than as a distraction from, this work: they would rather concentrate on R&D.

Addressing attitudes to standardization is an area that Corporate Standards is working on, and there were some suggestions that R&D staff perception of standardization activities is improving. However, interviewees indicated that the link between standardizations activities and other Sun activities— especially those R&D activities organized by the product-lines— needs to be further improved if it is to be made more fruitful. The difficulty of getting different areas to think more long-term about the role of standardization was cited, both in terms of their contribution to standardization activities and about the contribution of standardization to their activities. One challenge is thus to change the tendency towards shortsightedness about standardization and to better integrate it further into overall operations.

Challenges of the changing landscape. Changes in the standards 'ecosystem' are recognized to raise challenges for those who actively participate in standardization. The proliferation of bodies and activities can make standardization decisions more challenging but it can also provide greater choices for actors like Sun to promote their activities. Since there is a cost-side to participation and since benefits are not always clear to all relevant layers of the organization, even a company as large as Sun cannot productively follow a multiplication of relevant activities beyond a certain point. However, there was no particular complaint about the current development of the standards environment in the interviews, beyond that it is changing and that it makes vigilance and a proactive stance important.

Challenges to lead a standard activity to fruition were mentioned based on the company's experience with promoting its Java technology in an international standard. A lesson here involved the importance of timing standardization activities in the technology and the commercial cycle. Such events can have a learning effect both at the individual and at the organizational level.

Although there may be some aspects of the standardization process which can be generalized, it was stressed that on the whole standardizations decisions need to be made on a qualitative basis since circumstances vary from case to case.

Open Standards and Intellectual property rights (IPRs). 'Open Standards' is an area that Sun stresses in order to counteract the drift in the standards ecosystem away from some perceived fundamentals. These include the tendency for standardization to move closer to implementations (as opposed to interfaces), for standards processes to move from earlier ideals of 'due process', and for patents and other IPRs to be used more opportunistically in standards processes (cf. FTC versus Rambus). Some of the ideals that Sun associates with Open Standards, a term with many definitions, are laid out in the Common Criteria for IT Interoperability cited above.

Here, the relationship between intellectual property rights and standardization activities remains tense. The interviews acknowledged the need to for better ways to deal with IPRs that may be deemed 'essential' to the functioning of a standard. There are some general IPR related challenges. These include concerns about the quality of patents in general, about their applicability in software, about their potential to encumber interfaces, as well as about the way different actors use them.

The interviews observed that the policies that different standards bodies have towards IPRs can affect where central stakeholders decide to take a given standards activity. Some concerns discussed included how to define licensing (RAND) terms, how to deal with 3rd party IPR, and how to deal with cumulative costs (see ETSI Press Release, 1 March 2006).The IPR guidelines of certain bodies were found more equitable than others. Another current challenge that was mentioned is how to deal with the emergence of IPR holders without production activity (e.g. Eolas) who are simply interested in royalties (not, for example in using IPR defensively or for cross-licensing).

The threat of 'patent trolls' was identified as one area which is not adequately addressed in the current environment. In terms of improving the readiness to cope with IPR and licensing questions, two opportunities were recognized: the Department of Justice initiative to allow licensing terms to be discussed in standards bodies and the multilateral use of non-assertion covenants (see more below).

4.2.6 Favorable organizational structures

Formalizing the coordination role. The creation of a Corporate Standards unit and its position in the organization (reporting directly to the chief technology officer) provides the basis for a close link between standards and the overall strategy of the organization. Its complementary position in relation to the product lines and the project engineering groups means that the unit can coordinate standards across business unit frontiers and argue for their importance on a more autonomous basis. In this way the unit can advocate and coordinate participation at an aggregate level in the company.

While there are such formalized structures in place, more subjective aspects remain important. One aspect of this is that it is important that the links to upper management recognize and understand the importance of standards. Another aspect is that qualitative judgment remains important when making decisions about individual technologies.

Improving the negotiation environment. The US Department of Justice issued a statement in 2005 which allows the discussion of licensing terms during standards activities. This was seen as a promising initiative which could improve negotiations and ultimately aid the broader dissemination of standards. One aspect of this initiative is that it might promote multi-lateral instead of bilateral negotiations. This could among other things allow greater openness about what constitutes fair and non-discriminatory terms for essential IPRs since negotiations would take place more in the open. This openness could reduce uncertainty and qualitatively change the playing field rationalizing the licensing terms. However, attention would still need to be exercised to avoid cartelization.

IPR coordination and open standards. Non-assertion covenants (see Part 2) were seen as an important development. Sun refers to its open letter promising that it will not assert any of its patents that are relevant to the Oasis Open document format. Microsoft also has a similar covenant for a competing standard.[22] Where properly drafted, such covenants reaffirm the intention by the holder that IPRs will only be

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[22] The relative merits of these covenants are contended. See Consortium Info. http://www.consortiuminfo.com/newsblog/blog.php?ID=1762.

used defensively. In a standards setting environment, this was seen as the proper stance to have for IPRs. If widely used this mechanism might be useful to signal intentions and to promote adoption of a standard.

Open source activities also hold promise in this situation. Sun has turned to open source components of the Java Enterprise System as well as the Solaris operating system. It is noted that Sun has even open sourced hardware in the OpenSPARC project in order to promote better coordination between Sun and clients and the development communities. Open-sourcing is changing standards dynamics.

4.3 Telecoms company

Studied organisation	Anonymous
Interviewees	n/r
Date	November 18th / December 7th 2005

4.3.1 Baseline Organisational Characteristics

The enterprise is the world leading equipment supplier and network service operator in mobile and fixed communication with the focus on mobile communication. They offer a range of mobile devices, including those supporting multimedia applications and other personal communication services. In addition, the range of products comprises products for special applications within defence systems, enterprise, cables, mobile platforms and power modules. While these are important, they only represent relatively small business units.

Based in Northern Europe, the enterprise has a global presence with worldwide presentations split into 24 regional market units. Their operational organisation is built around a structure of centralised business units responsible for the delivery of products and services to decentralised market units that are responsible for local sales and customer support. The workforce is approx. 50,500, 25% of which are female, and 63% of which are based in Western Europe.

Table 3: Selected financial key data

Research Programme	*2004*	*2003*	*2002*
Expenditures (million Euro)	2,243	2,339	2,833
As percent of sales	15.8%	18.5%	18.1%
Employees working in R&D positions (end of year)	16,000	16,500	20,500
[new] patents	16,000	15,000	12,000

4.3.2 Baseline Industry Characteristics

Competition is decidedly global with a few major players, two of which are based in Northern Europe. Standardisation is a must for every player involved, since especially the mobile communication industry is highly standardised. The service operators are very careful not to buy only from one supplier in order to not get locked in. In consequence, compatible and standardised technology is the result. No single player really dominates the standardisation process – i.e. there is no Microsoft – even small start-ups are sometimes participating.

The Third Generation Partnership Project (3GPP) and Third Generation Partnership Project 2 (3GPP2) are both worldwide "partnership groups" which define standards and in which standardisation bodies (e.g. ARIB, CCSA, ETSI, ATIS, TTA, and TTC[23]) are members. The proposed standard is then later on formally endorsed, in Europe by ETSI. The ITU in turn sets the (legal) framework and requirements for compatibility, limitations for spectrum, etc. It has to be noted though, that governments played a key role through licensing, e.g. with the decision on GSM-technology in Europe. Nowadays, licensing and tenders are supposed to be technologically neutral.

With regard to non-licensed mobile communication, e.g. W-LAN, the process is less defined. Companies and industry consortia have so far found a consensus, moderated by the IEEE. Fixed-line communication in contrast is converging towards IP-protocols and therefore the standards are mainly determined by the IETF.

4.3.3 Organisation of activities in the company

The company declares itself committed to open standards and a strong driver in major standardisation forums for many years, through all generations of mobile technology. They are a member of for example 3GPP, 3GPP2, Liberty Alliance, IETF (Internet Engineering Task Force) and OMA (Open Mobile Alliance).

The research unit is organised as one corporate unit, belongs to the R&D group, and directly reports to the CTO. Regional research centres are spread around the world and are always linked to a development unit. The research centres maintain close links with each other, e.g. by frequent telephone conferences. This is also reflected by joint projects.

The decision on which projects to follow through with and how to utilise the research output is taken by the enterprise-wide technical steering group which consists of both executives who are coordinating the research and standardisation strategy and the resource owners, i.e. research directors. The steering group coordinates in both

[23] ARIB: Association of Radio Industries and Businesses; ATIS: Alliance for Telecommunications Industry Solutions; CCSA: China Communications Standards Association; ETSI: European Telecommunications Standards Institute; TTA: Telecommunications Technology Association; TTC: The Telecommunication Technology Committee

directions, in taking up proposals from inside the company and also by bringing outside evolutions to the attention of the researchers and research directors. At the same time they set the timeframe for standardisation and ensure that the company's activities in the different working groups and standardisation organisations follow the same business strategy. Hierarchically below, standardisation committees deal with the coordination of ongoing standardisation activities in different (product) groups and try to align them, e.g. by reducing overlap. Their orientation is a bit more technical. Despite the mentioned hierarchy, decisions are usually taken by consensus. These committees convene every three or four weeks, often by telephone or net-meeting. Email-lists are also an important tool in this regard.

The two most important outputs of research are standards and patents. A third output which is always welcome is the formation of new business segment. Ideally, a new technology would first be patented, and then follow publications and standardisation activities. Since standardisation is never an end in itself, consumers' requirements and competitors' positions need to be taken into account and balanced against each other. In consequence, those firms one combines forces with in the standardising committees change dynamically, with the process usually being consensual.

In fact, this consensus-orientation permits a feedback loop into research activities. Joint research projects, as for instance EU-projects, give a platform in which to communicate and negotiate about the direction the technology path is supposed to take and learn from each other.

Standardisation activities are seen as time-consuming but quite important for the company. By being active in standardisation the individual researcher shows social skills such as discipline, especially if a technology favoured by the researcher is not supported by the company, being able to form coalitions and negotiating skills. From the approx. 30 researchers in this research centre about four or five are actively participating in standardisation committees but many more give input before and during the process and help in preparing the standard. This includes the review of competitors' technologies.

For career purposes, one can advance both with and without involving oneself in standardisation. Even if the researcher may engage in research which is going to result in one or more patents and standards, the publication channel still remains open to gain renown in the research community. At least in this area of research/industry the two do not rule out each other; the standard e.g. defines how the communication between two nodes works in general, while the research result published in a journal would then describe a specific algorithm at the interface. Scientific publications are also viewed as positive for the company's image, for the relation to service operators and as a signal to universities: "This company is innovative".

Nevertheless, it does not hurt to have experienced all aspects of the job, including doing very detailed research on the one hand and supervising a project and playing a part in standardisation on the other. This applies especially if one is interested in moving on into the business sphere, ideally by “shepherding” the new technology - if it is seen fit to be developed into a product - into the appropriate product (development) unit. This path is encouraged by the company. It is also an opportunity for the researcher to ensure that his or her research results will have a chance to find their way into the standard. Likewise, a researcher may take on tasks which are normally residing in the product unit such as coordinating the company’s standardisation activities in his or her area of expertise. In the case of one of the interviewees, half of his time is dedicated to the coordination of activities in 3GPP and accordingly, half his salary is accounted for in the standardisation budget. On another note, the visibility gained in the standardisation arena sometimes attracts job offers from other companies.

Concerning the feedback loop from standardisation requirements to research, email-lists seem to be very helpful in finding and attracting the researchers, who can best give input to questions. Budgets for standardisation work are quite flexible, in order to allow researchers to put work, within limits, into other projects as well. Only once they have to dedicate too much time into a “foreign” project, must budgets and arrangements be adapted.

Research co-operations with universities usually take the form of research students working or doing an internship at the company and writing their diploma theses. This is why it is useful to locate a research centre near a technically orientated university. In our case, the company has donated an endowed chair which is located at the research centre. Research grants by the German Research Foundation or by the Ministry of Education and Research also require that universities participate at the project. Bilateral research contracts where the company subcontracts certain parts of the research are another kind of co-ordination. Here the problem arises that nowadays universities are encouraged to try to gain patents, following the success of mp3 by the Fraunhofer Society, which would allow them to collect license fees. Especially in the 3G markets the company feels that more fees on top of the already existing ones would be too much, thus precluding co-operations which otherwise might have come to pass and shifting the cooperation from conceptual projects to projects on implementation. Alternatively, joint research can be conducted in the pre-standardisation phase. Standardisation work in research co-operations with universities mainly lies with the company.

Although revenues from patenting are not dismissed, the priority is to develop products. The company holds approx. 16,000 patents worldwide and files approx. 1000 patent applications each year. The share of patents from research and from development is approx. 50% each. Any company using technology included in the leading standards requires a license from them as they are the unquestionable leader holding patents covering UMTS/WCDMA.

4.3.4 *Obstacles, challenges and opportunities*

The structure of the standardisation arena changes constantly with new player coming into existence at a rapid pace. Matters are complicated by the fact that new technologies often encompass several interfaces which are in need of standardisation. Also, there is hardly enough time for a new idea to mature. This is where EU- and other joint projects play a significant role as an incubator. In the existing consortia IPR issues pose a problem. The same problem arises on a super national level where IPR protection in some countries is lacking. At the same time, national and European policies concerning patenting clash with the national governments usually promoting patenting while on European level standards are requested.

4.3.5 *Deriving favourable organisational structures and successful practices in the different settings*

By and large, standardisation institutions seem to work well despite the large overhead involved. One potential for improvements would be in the maintenance of existing standards.

In joint projects such as one large EU-funded project on mobile communication of the next generation which involves 40 partners, the patents issue in standardisation is circumvented by publishing everything early on, in order to hinder oneself and everyone else to get a patent on the research output. This requires trust among partners and is supported by the possibility to trace research results and which organisations or individual researcher was partaking in its development. Patent-sharing is also a way out. In the end, the possibility to realize license fees is limited by the fact that the greater part of manufacturing is taking place in countries which usually do not pay license fees, anyway. The significant advantage rests in the project functioning as an incubator for the new technologies.

As for successful practices, the processes within the company seem to be working well.

4.4 Blohm und Voss

Studied organisation	Blohm + Voss GmbH (Surface Vessel Division, Hamburg), a company of ThyssenKrupp Marine Systems
Interviewees	- Dr. Hans-Hagen Bartsch, Head of Standardisation, Archive, Print Service - Stefan Deucker, Senior Manager Research and Development/ Product Development
Date	November / December 2005

4.4.1 Baseline Organisational Characteristics

In the beginning of 2005 today's structure of ThyssenKrupp Marine Systems (Hamburg) has been finalised with the merger between ThyssenKrupp Werften and Howaldtswerke Deutsche Werft. Blohm + Voss are a subsidiary of ThyssenKrupp Marine Systems (Hamburg) and are directly controlled by them. An agreement has been made that profits are transferred to ThyssenKrupp Marine Systems GmbH.

Blohm + Voss (further abbreviated as B + V) have 125 years experience in shipbuilding and mechanical engineering. Today, B + V are a highly specialised industrial enterprise in which "sophisticated products are produced for the world market". These are naval vessels and mega yachts.

In the course of the years, B + V underwent a transformation from traditional shipyard to a systems supplier representing a workforce of about 900 today and annual sales of typically around 250 million Euro. Therefore, nowadays B+V integrates parts produced by subcontractors to systems which necessitates a close relationship with these subcontractors and partially shifts research and standardisation activities from B+V to them.

4.4.2 Baseline Industry Characteristics

In Germany there are about 100 shipyards with 50+ employees, 20 of those employ 500+ persons. Shipbuilding is a mature industry which nevertheless has to innovate in order to stay competitive and ahead of competitors in low-wage-countries. Specialisation and creation of new niche markets are a means of asserting that goal.

Increasingly, large projects are realised in a consortium with other shipbuilders. This is the case particularly for naval vessels, which are procured by the national governments on their terms. In consequence, this form of co-operation shifts the focus from company standards to consortional design and construction guidelines as a means of knowledge transfer. In contrast to producers on mass markets, shipyards often build in accordance to customer's requirements. Nevertheless, formal standardisation, namely with the NSMT, the Shipbuilding and Marine Technology Standards Committee of the Deutsches Institut für Normung (DIN; German National Standardisation Institute) has a long tradition in shipbuilding. The NSMT comprises about 50 working groups, is financed to a large part by the German shipbuilding industry - with the rest covered mainly by tax money - , and channels the standardisation work to the appropriate international liaison. In the last six or seven years the NSMT's budget has halved.

Participation in standardisation however, seems to vary considerably among firms. Some shipyards, among them one German competitor of comparable size, do not participate at all for no obvious reason while for others, e.g. the shipyards in the German Baltic region, the ostensible reason to refrain from involving themselves are the costs involved.

4.4.3 Organisation of activities in the company

Standardisation

In shipbuilding, 80% of the standards used as inputs are from international bodies. At the same time, since the focus on R&D is on the development side, company standards play a major role.

The standardisation department is responsible for standardisation as such, archive, and printing services. When Dr. Bartsch took over the department six years ago, it consisted of about 25 employees and ranked as a principal department in the technical design and construction unit. In the course of the reorganisation, the department has initially been moved to the technical services unit with currently has 10 employees. Since other shipyards in the group have adopted the former organisation of standardisation as it was practised at B+V before reorganisation started, it is to be expected that B+V will follow suit.

The main task of the standardisation department is standards management with the department functioning as an internal service provider. The company standards are accessible by the whole shipyard group. Standardisation activities as such, be it on company or institutional level, will likely gain more substance in the future.

The bulk of the work (about 80%) concerns design and construction. However, standardisation takes place in various forms and many of those who standardise may not even be aware of it, e.g. the company standardisation of material catalogues that take place in the IT department. Apart from members of the standardisation department, about 15 technical designers on the shipyard are active in formal standardisation, mainly in the NSMT. Other options are also available through the parent company, i.e. the access to IFAN (International Federation of Standards Users). This option allows for direct impact on international standardisation developments without interference from national standardisation bodies. In addition to that, since naval vessels fall into the military domain, standards cannot be generated in the normal fashion, Instead design specifications are issued by the ministries of defence or the national government. Nevertheless, currently the CEN workshop 10 scans existing standards which might be relevant for military applications.

With regard to the relative importance of standardisation in the company, the executives do not always know in detail what is being standardised and who participates. While technical designers and marine engineers are nearer to the practical standardisation activities the shipyard’s management are in charge of the strategy and the two sides need to be linked. To cover the gap between practical standardisation and standardisation strategy, the approach is twofold. First, an internal marketing approach (as presented in Part 5 of this report) is in place and second, the standardisation department links to other relevant committees and standardisation organisations, thereby fostering the information flow.

For instance, the department manager of standardisation is also head of one regional group of the Ausschuß Normenpraxis (ANP), the German Committee of Standards

Users. In the NSMT he is chairman of the advisory body (as a counterpart to the general manager who is commissioned by the DIN) and in addition he is involved in the working group application of standards in shipbuilding in the Verband für Schiffbau und Meerestechnik e.V (VSM, the German Shipbuilding and Ocean Industries Association). These activities provide him with a good insight in ongoing developments in standardisation and allow him to actively bring relevant standardisation projects to the attention of the appropriate person in the company. The interaction of the shipyards, especially those which are now in the same shipyard group, is consensus based in that relevant topics are usually coordinated on the phone before they create problems. The fact that the managers responsible for standardisation in the different companies are usually running across each other in different working groups time and again naturally furthers communication.

The apparent advantages of standardisation for the company are the reduction of design hours, being able to order standardised inputs, and to allow cooperation of different shipyards in joint projects as a virtual company.

Research

R&D chiefly takes place in the form of applied development. Innovation usually occurs directly at the prototype, which is typically built in response to a customer's requirements.

The research department surface vessels in its current form has been developing since February 2005 with currently five employees and a projected target of 10 employees. In addition to that, in a second shipyard which specialises in container vessels belonging to the group there is so far one person active (target 5). For the whole shipyard the budget on research is allocated to: (1) order-based R&D which accounts for the largest part, (2) Free R&D (not directly linked to an order), and (3) only accounting for a minor part of the budget: Contract R&D

The research department focuses on its steering and coordinative function but also applies itself to R&D. Mainly, R&D takes place in the specialist departments, the research department is addressed in particular to evaluate inventions and decide on how to utilise and commercialise them. The legal side of the maintenance of patents is then handed over to an external patent office. At the same time, the research department is responsible for surveying relevant disclosed patents of competitors. A fixed process for checking the potential of inventions for standardisation is not in place.

Few of these R&D projects are realised by B+V alone, co-operations with other shipyards, research institutes and to a lesser degree universities are the norm. Examples for co-operations with universities are the participation of B+V in a large e-learning project on standards with a university and the supervision of diploma theses of students from several universities. There are also examples of students working on diploma projects in cooperation with a working-group of the NSMT on chain cables, which nicely shows a (not institutionalised) link between research and standardisation.

Utilisation of research

The shipyard owns about 50-100 patents which are balanced by thousands of company standards. While designers participate financially at the patents they developed, the recognition for company standards is only indirect. Successfully implemented new designs and technologies improve the products and thus help in securing employment. Another channel for R&D results is the company's CIP (continuous improvement process); an estimated 70% of submitted ideas are of the technical kind.

4.4.4 Obstacles, challenges and opportunities

One obvious reason for a potential lack of knowledge transfer from research into standardisation lies in the fact, that putting additional labour into defining a standard always incurs costs. If the new technology or process in question is used by everyone involved in the value chain, there is no gain from making it available to outsiders, even if it did no harm. For example, B + V together with several shipyards and suppliers have generated a system of three company standards for the different layers in Auto-CAD and thought about making it publicly available. But in the end there would have been no advantage in transforming it into a Publicly Available Specification (PAS).

Thus, what is really needed is a tool to evaluate objectively the value standardisation has for the company. For B+V, the first step in this direction is a seven-page guideline elaborated by a consultancy for DIN which meets these requirements.

More importantly, the advantages of standardisation are not clear to everyone. A clear priority is given to technical design over standardisation. This is reflected in the (lack of) recognition for standardisation effort in terms of hours or material budgets. Thus there is no incentive for the individual designer, to participate in standardisation if it has no direct impact on the improvement of processes or the product. Sometimes a potential advantage may indeed be hidden. For example, participation in the standardisation processes in one specific case would almost certainly have helped the project in avoiding a claim which was brought against B+V on the grounds of using cables of bad quality from a certain supplier. Information on the supplier was available in the relevant standardisation working group.

The external standardisation-standardisation interface, i.e. between DIN and standardisation department and management respectively is working well with the qualification that information from DIN is addressed to different levels and sometimes goes astray.

Despite the fact the technical designer who developed a new technology or process which is patented later on is awarded financially, IPR or copyright issues do not seem to be important inhibitors for standardisation in this company.

4.4.5 *Deriving favourable organisational structures and successful practices in the different settings*

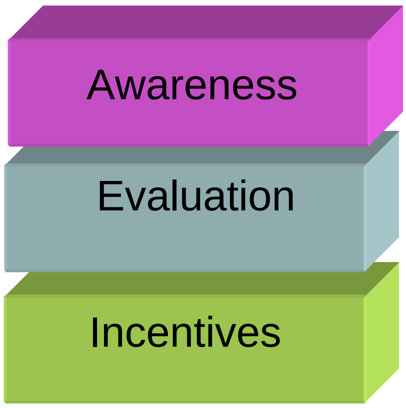

Figure 3: Three main steps for successful practice

The standardisation department sets itself the task of raising awareness for the benefits of standardisation on all management and individual levels. To achieve this goal, B+V use internal marketing. An important part of it is the intranet-site on standardisation which makes all company and non-company standards available to employees. A forum on standardisation within the company is to become a second tool in that strategy. This in turn will be integrated with a series of seminars and presentations on standardisation.

To address the topic of evaluation, the published standardisation strategy of the DIN is seen as a useful guideline that needs to be brought to the attention of decision makers more forcefully to support standardisation activities in the companies.

As for the incentive structure, no change in the budgets for hours and material etc. for employees is envisioned yet, but is clearly seen as an important topic. Naturally, this would not only imply that the before mentioned awareness were there in the first place but also mean a considerable change in the organisation of R&D.

A promising potential is also seen in the outside research-standardisation interface, i.e. between external research organisations and the appropriate standardisation organisation. The shipping industry has several semi-private research organisations , e.g. the HSVA (The Hamburg Ship Model Basin, which is a central point for applied research in all areas related to transport systems and ship technologies in open water and ice), or the Center for Marine Technologies (CMT) which would set a good example. At present, the Hamburger Schiffversuchsanstalt (HSVA), the Normenstelle Schiffs- und Meerestechnik (CMT), and the above-mentioned NSMT share the same address in Hamburg but fail to cooperate in standardisation. In general, it would be considered beneficial if the NSMT were to be integrated better in research activities, such as in applied research about ballast water, a field which mainly concerns the shipyards' suppliers and in which some national SDOs are very active.

At the end of the day, the key factor for successful knowledge transfer at the research-standardisation interface remains the network of standardisation and research practitioners.

4.5 Teer Coatings (and SME in coating technologies)

Studied organisation	Teer Coatings Ltd
Interviewees	Dr Dennis Teer, Technical Director
Date	November 2006 Draft – Not yet Authorised

4.5.1 Introduction

Teer coatings Ltd is an SME founded in 1985 by Dennis Teer who is an ex-academic from Salford University, UK. The company provides high-tech coatings services and makes coatings manufacturing and test equipment for sale in the global market and is a clear leader in its field. The case was chosen because Teer Coatings is a research-intensive company and has strong IP interest as well as experience of standardisation work.

It operates from a single site in Droitwich, Worcestershire, UK with 50-55 employees and an annual turnover of about 5.6 m euros.

4.5.2 Baseline organisation characteristics: Core competences and market

The company's main business streams are twofold: a) the provision of an extensive range of coatings on a production basis and b) manufacture and supply of state- of-the-art coating deposition equipment incorporating their patented closed field unbalanced magnetron sputter ion plating (CFUBMSIP) system as well as testing equipment for testing.

Coatings production Services. The Coatings Production Department of Teer coatings Ltd has ten systems dedicated to the deposition of hard, wear resistant coatings by magnetron sputter ion plating. Coatings may be applied to a wide range of component sizes, with both continuous production facilities as well as on a small-scale specialist job basis to meet customer requirements. Various coating types are produced such as hard, wear resistant coatings, and low friction solid lubricant coatings. The company has a barrel coating facility to enable all over coatings onto small components.

Coatings Manufacturing and Testing Systems. The Equipment Building Department manufactures and supplies CFUBMSIP coatings systems including small systems for R&D purposes to large production systems and barrel coatings systems. In addition, they design, manufacture and supply magnetrons and sputter targets. Teer Coatings also design and manufacture state of the art thin film coating test equipment that include machines for measuring friction and wear properties and adhesion to the substrate using the scratch test method.

The market for their products is worldwide and one half of the income comes from exports. Sixty machines have been sold based on basic designs but supplemented with customised elements. The company has performed well in Japan and is making good progress in India and China and some eastern European countries. However, they have not done so well in the USA.

Universities represent approximately half of the customers and purchase equipment for R&D use. The field for application of thin film coatings is diverse and key application areas include optical, wear resistance, low friction, and electrical. There are huge potentials in areas such as polymer forming and fuel cells.

To develop the business in the Chinese market, the company has recently launched a new Joint Venture company in China with the Chinese Group, Zhejiang Huijlan that will offer a coating service to the Zhejiang Huijin Group and others. Teer Coatings have three other Joint Ventures in China. It has a Joint venture also with an Indian company.

Teer Coatings discovered that the patented ‘closed field’ coating process produces metal-oxide thin films at high rates with excellent optical properties for applications in multilayered optical coatings. Hence a new company has been formed called Applied Multilayers Ltd in 2003 with venture capital support to exploit opportunities in the optical coatings market.

4.5.3 Baseline industry characteristics

Teer Coatings have unique capabilities in the world market for specialist coatings and claim to be able to put on any coatings in a controlled manner. They experience severe competition for routine production of coatings from large companies. Teer Coatings are working with large automotive companies like Toyota and GM and find that the sector is extremely cost conscious.

4.5.4 Organisation of R&D and standardisation activities

Despite being a small company, Teer Coatings has a significant level of R&D activity and the R&D Department employs twelve research scientists with degrees along with high quality technical support staff. Annual R&D spending is approximately 1.4m euros. There are ten PVD coatings systems totally dedicated to R&D. The company supports several PhD students at various universities in the UK and attracts students from all over the world for education and training. Furthermore, it uses strong academic links of their Chinese Joint Holding Company to support their R&D.

Teer Coating have regularly participated in European and National Co-operative R&D Programs involving key industrial and academic partners in Europe. The company has won contracts for both STREP and Integrated projects in FP6. For example, in an FP6 Integrated Project called AMBIO, Teer Coatings is a partner. The aim of the project is to apply nanotechnology to the development of new polymer surfaces that will form the basis of a new generation of antifouling coatings for applications in the marine environment. The project has 31 partners from 14 European countries. Ten of the 15 companies in the consortium are SMEs whilst there are 10 universities and 6 research organisations. The role of Teer coatings in this project is to produce new experimental coatings based on their substantial in-house expertise.

R&D activities of the company have led to the development of many new and successful coatings, magnetrons and coatings production systems. According to Dr Teer, much of the expansion of the company's business over the years has been R&D led. Although very successful in obtaining EU support for R&D, the company finds the procedures for FP projects somewhat complex, bureaucratic and resource intensive.

The company protects IP through patents as appropriate. The most important of its current portfolio of IP is for the CFUBMSIP system. These patents are reaching the end of protection.

The company has a relatively simple structure. The MD is the son of Dennis Teer who now acts as the Technical Director. There are two other members of senior staff – Head of Marketing, and Manager of Coatings. Effort on marketing is relatively small as most customers approach Teer Coatings directly themselves. There is no special incentivisation for R&D staff, and the company believes it is important for the R&D staff to be allowed to get on with research and not be burdened with other responsibilities. R&D people are moved into the production teams when appropriate. Production and R&D teams work together very effectively and communication is good within the company. The company has been accredited to ISO9001.

Standards are important for test and measurement of coatings. For example there is a universally recognized standard for adhesion testing and there are standard methods for hardness, indentation and wear testing. The company was involved in an EC R&D project working to develop a scratch adhesion test that could be used as the basis for a standard. However, what is still needed is a test method that can distinguish between very good coatings as existing methods can only distinguish between good and poor coating adhesion. Teer Coatings has also been involved in a EC funded project to develop standard coatings for use with scratch testers.

Both research and standardisation activities are undertaken by the R&D team in the company and hence the integration of the two is seamless.

4.5.5 Obstacles to the participation in standardisation

Some of the R&D work supported under the Framework Programme provide the basis for developing standards. However, the development of standards move at a relatively slow speed and often the funding of the R&D work does not include full cost for participation in standards committees and often stops before a standard has been developed. Similar problems are encountered in nationally supported R&D

collaborative programs. Time and travel costs can be severe for an SME with tight resources.

Teer Coatings also found that some members of standards committees adopt a theoretical approach that may not be particularly relevant for industry. This is partly because there is not sufficient commercial understanding among some of the other participants from research institutes/universities. This can lead to unsatisfactory outcome from standards committees.

Teer Coatings has identified the need for developing a standard for measuring internal stress in coatings that is very important for performance assessment but this need is not met because the necessary scientific research has not been done. Also, in some areas like tribology testing, it is difficult to develop a universal standard and most commonly used tests give only a comparative analysis. There is a lack of support for pre-normative research to resolve important technical issues necessary for developing robust and valuable standards.

4.5.6 Favourable organisational structures

For an SME, the R and the S interfaces are likely close together and can be managed by the R&D team under the Technical Director effectively. Communication within the company for transferring relevant knowledge is also straightforward. The key issue here is whether the company has the necessary expertise and resources to undertake the standards work.

4.6 SMITH and NEPHEW (medical devices)

Studied organisation	SMITH and NEPHEW
Interviewees	Dr David Farrar- Technology Manager, Bioresorbables at the Corporate research centre, York, UK
Date	January 2006 Draft not yet authorised

4.6.1 Introduction

Smith and Nephew (S&N) is a global medical devices company with three global business units - Orthopaedics, Endoscopy and Advanced Wound Management – specialising in innovative and cost-effective healthcare products. The company, established in 1856, operates in 32 countries, employs over 8000 people and has annual revenue of £1.25 billion (1.8 billion euros).

4.6.2 Baseline organisation characteristics: Core competences and market

S&N is a leader in each of its three specialist markets. Its market is worldwide – 49% in America, 43% in Europe, 4% in Japan and 19% in other countries. S&N trades in

New York and London Stock exchanges with Headquarters in London but reports in dollars. Orthopaedics represents 47% of the business, Wound management 29% and Endoscopy 24%. Product Development programmes are carried out at the Group's principal manufacturing locations, notably in Memphis, Tennessee(orthopaedics), Andover and Mansfield, Massachusetts (endoscopy) and Hull, England and La Jolla, California(advanced wound management).

4.6.3 Baseline industry characteristics

Globally, the demand for healthcare products is increasing and the market offers significant growth potential due to following underlying factors: a) ageing population requiring more joint replacements and treatments; b) patients are better informed stimulating demand and innovation; and c) rapid advances in technology offer big opportunities for innovative and advanced products and treatments with minimum surgical invasion. At the same time there is increasing pressure on healthcare budgets and therefore cost-effectiveness of treatments is critical for success. S&N is pursuing a strategy of higher growth technology- led medical devices business with a focus on markets where it has leadership. The company has been developing constantly with divestments particularly in commodities area such as Elastoplast, and new acquisitions.

The market entry for new products is highly regulated. For example, a new product for hip replacement can be expected to take 2-3 years including development and approval. In the case of tissue engineering, the development cost and time are more like pharmaceutical products - 15 million euros and ten years. Standardisation is not very important for the industry, particularly for established product categories. Thus, there are standards for materials and testing for hip joints and bone cement developed by ASTM that are very helpful and saves time but do not drive the market.

4.6.4 Organisation of R&D and standardisation activities

The company invests around 6% of its sales turnover in R&D. The R&D strategy is based on their knowledge of current market needs, gathered from their close interactions with the hospital consultants, as well as a longer term look at future requirements and opportunities. Short-term R&D is led by individual businesses where the emphasis is more on D than R and the activity is overseen by the Vice-President R&D in the relevant business. Each of its three businesses has strategic responsibility for product innovation and development. In addition there is a Corporate Research Centre in York in the UK with 150 staff, and provides specialized skills and resources to all the businesses. The structure in the organisation can be described as flat. Dr Farrar's reporting line is to the Group Director of Research who reports to the Chief Executive of the Company. The Corporate R&D Centre has three teams mirroring the three businesses and undertakes research with a 3-5 year horizon and report to the R&D Vice President in the business. In-house research is supplemented by work supported at universities and other research organisations primarily in the UK and USA.

S&N are developing radical new treatment and surgical techniques together with technologies and fundamental scientific work that will deliver new products up to 15 years from now. Increasingly, the company is moving from engineering based products to biotech- based products e.g. tissue- engineering and stem cells. S&N have identified a number of Group Significant Technologies, known as Enabling Technologies, with applications across the three businesses and offer the greatest potential for sustained competitive advantage. The R&D Centre receives Corporate funding for Enabling Technologies research with a 10-15 year horizon. This covers research on Cell-based therapies, Biomaterials and Underpinning Biosciences. Approximately 33 members of staff are engaged in these three areas. The company works closely with key academic institutions and passes on at the appropriate stage projects to the businesses for product development S&N combines their research teams with people with knowledge of clinical practice, health economics, marketing and regulations. This enables them to assess whether a potential product is likely to be efficacious; whether it can be manufactured efficiently; whether regulatory bodies will allow the product to be sold in the market; whether it will be an economic success.

The Research Centre applies for external research grants and has recently won nearly 5 million euros from the Regional Development Agency in Yorkshire. They are also involved in collaborative Government R&D Programs financed by the Department of Trade and Industry in regenerative medicine. EU work is not of particular interest because of the need to work with large consortium and complex procedures.

There are various incentives for R&D staff:

a) Bonus scheme for overall performance achieving key deliverables with positive outcome i.e. technology must work;
b) Patent awards bonus when filed and again when published;
c) Special on the spot reward.

The Corporate R&D Centre is not as active in standards activities as it used to be previously when they had a Regulatory Affairs Dept at the R&D Centre. Now individual business units have their own Regulatory affairs Department. Staff from the Regulatory Affairs Departments sits on standards committees rather than R&D people. They consult and seek the help of R&D staff as and when necessary. Currently S&N are involved in BSI and ASTM committees. There is no special incentive scheme for standards work.

S&N operate an intellectual property policy to promote innovation in the business. They protect R&D results of the whole Group by taking out patents and patent protection is sought routinely in the principal markets. Currently the Group has over 2500 existing patents and patent applications. The company has also a policy of protecting the Group's products in the markets in which they are sold by registering trademarks as soon as possible under local laws. S&N vigorously protects its trademarks against infringement. Currently the Group has a portfolio of over 3300 trademarks and design rights.

Principal products of the company are protected by intellectual property consisting of patents, licenses and know-how. Major products are based on a collection of IP thereby reducing the risk associated with failure of any individual element of IP. Furthermore, each individual IP protect a relatively small proportion of the Group's turnover. S&N also has a policy of opposing third party patents and trademarks where there might be a conflict with their business interests.

4.6.5 Obstacles to the participation in standardisation

Research and innovation are seen as high priorities for the company to succeed in an intensely competitive market and grow the business. Technologies based on biosciences are becoming increasingly important and the company is moving from an engineering base to bioscience base to provide a flow of innovative products. Thus investment in future technology opportunities particularly bio-resorbable materials, tissue engineering and non- invasive healing devices has become very important.

At present IPR is much more of a driver for the industry than standards. In fact research activities may be stopped if IPR cannot be gained through own patents or the company cannot secure a satisfactory licensing arrangement. Standards are not perceived to be critical drivers for the business.

Like pharmaceuticals, regulatory approval in the healthcare industry is a major step for any new product and there is a big challenge in reducing time and cost for such approvals. In new areas like stem cells, there is a need to make sure that the regulatory burden is not going to be excessive but this requires a concerted approach by other companies active in the field as well as industry organisations.

Standards could be used to help companies meet regulatory approvals and hence the development of standards could be motivated through regulations. This would be particularly true for test and measurements used by companies to validate efficacy and safety of medical products. However, it is acknowledged that some of the test and measurement methods have a strong IPR angle and companies are reluctant to share information and know how in this.

4.6.6 Favourable organisational structures

The company in recent years has taken the decision to move IPR management, regulatory approval and standards related activities into its three business operating Divisions. This gives the businesses close to the market active control and management of IPR as well as deal with standards issues. For established product lines, where innovation represents natural extension of current concepts and technologies, this seems to work satisfactorily. Standards do not seem to play a major driver in the market.

However, looking to long-term and breakthrough developments based on emerging technologies, it appears that standards could play a very important part. Standards developed for test and measurements could provide significant help in meeting regulatory requirements. This requires a new approach involving the development of anticipatory standards ahead of product and market developments. Good examples of such standards could include standards for nanomaterials and nano-bio technologies. There would be clear advantages in industry, industry associations, regulators and research institutes working together with a common goal to speed up materials and product testing standards for meeting efficacy and safety requirements. To ensure that such work is done to meet the objectives of public good and private company interests, public funding is necessary for in key areas of pre-competitive work.

5 Organizational cases: Synthesis and conclusions

The previous chapters focused on organizations whose stakes in research and in standardization raise the question of how the relevant activities are arranged. Cases were selected in order to explore issues and challenges that arise in a range of contexts, where the case based examples have drawn on interviews and other sources in order to provide empirical information about how the relevant activities are organized in different organizational settings, about the types of challenges that are faced, and, where relevant, about potential ways to improve the coordination of the research and of standardization activities. Although the ten cases are not meant to be representative of the issues and challenges that arise in every context, they provide useful illustration that will complement the output from the survey as well as the project's work more generally.

The ten case studies presented above indicate that there are some similarities and differences in the way different organizations manage the interaction between research and standardization. The main division runs between the situation at the large RTOs that were looked at in Chapter 3 and the various situations found in the different enterprises in Chapter 4. This chapter picks up on some of the salient features of the cases and makes some concluding remarks on this basis. We also provide a brief discussion about the relationship between standards and research in this context.

5.1 Organizational level

The way enterprises organize standardization and research activities involve central aspects of the way firms and, ultimately, the way industries develop. These activities involve an intersection of three general classes of 'routines' in a firm (Nelson & Winter, 1982). These encompass the short-term operating characteristics of a firm, the investment activities, as well as the 'search' oriented activities. The pursuit of R&D investment decisions fall especially under the third as well as second; they essentially involve 'routine guided, routine-changing processes'. The choice to participate in standardization follows from this investment and might be closely associated with the more day-to-day routines of the product-development activities.

In this environment a goal of standards participation is to contend with uncertainty about where technology and the industry is going, either by trying to influence developments through active participation in key standards activities or by merely seeking to improve the firm's information position by monitoring them. A standard that achieves industry-wide prevalence will serve to create costs for firms not readily compliant with it while potentially favouring frontrunners at home with the preferred technology (where there is contention between different technical solutions); a standard, if it is broadly wrought, might even significantly define market conditions in that industry (cf. the GSM standards in Europe).

Standards that become prevalent can influence, sometimes fundamentally, market conditions creating gradients in that industry: based on their for which some actors may be better positioned than others. So, whereas R&D is an expression of adaptive processes that may permeate the firm from the strategic level, standardization activities may be seen in one capacity or another as a bid to keep these adaptations in synch with the adaptations of the market more widely. Activities in the S and R frames thus involve to different degrees of adaptive behaviour by firms to match the position of the firm (‘firm-state’ factors) with the changing ‘industry state’ in the Nelson & Winter description.

The question then turns to how organizations coordinate these choices internally, and what inroads are made from these the firm level activities with activities in the standardization environment. The cases presented above provide novel empirical insight into how the S and R frames are organized and what sorts of concerns arise in different organizational settings.

The following figure illustrates a notional view of the linkages involved between standardization and research within organizations and between organizations and standardization activities.

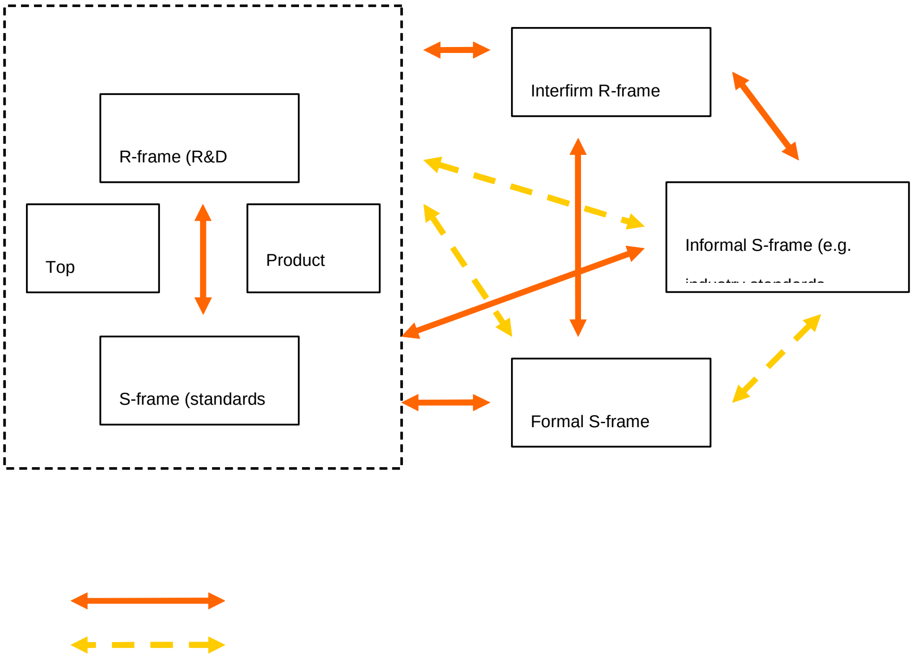

Figure 1: The interface between research and standardisation explored

5.2 Synthesizing observations from the various cases

In looking at the ten different cases, the central division is between the Research Technology Organizations and the enterprises. One crucial aspect of the RTOs is that they do not have a set of commercial product lines around which their research and standardization activities may be organized. In this context, the arrangement of the interrelationship of the R and S frames at large RTO research activities tends to reflect the fact the underlying activities tend to grow out of projects or the expertise of individual researchers. Although fundamentally different, the enterprises cases shared some organizational modes and concerns with these RTOs.

Here we will try to collect some salient aspects from the different cases. We divided these observations as follows:

5.2.1 Organizing principles

Coordinated mode: Researchers can become involved in standardization activities in a variety of ways. In a minority of cases, the organizational links to standardization activities are coordinated by an internal department or layer of the organization. These cases all involved large enterprises, and two of the three cases were large ICT companies where standardization is an essential element of the competitive environment.

One of these cases emphasized the link to the management level, and the importance of having a good interface with overall company strategy. Here the standardisation department works internally to promote participation of the product lines in relevant standards activities and to avoid duplication of efforts. The questions that may be encountered include how to match its R&D roadmap to ongoing standards efforts, whether to modify that roadmap based on such efforts, or if and when to initiate such an effort based on internal developments.

In the other ICT case, the decision on which projects to follow through with and how to utilise the research output is taken by the enterprise-wide technical steering group which consists of both executives who are coordinating the research and standardisation strategy and the resource owners, i.e. research directors. The remaining case involved shipbuilding where many standards and regulations are involved. The case of the medical device company presented a foil to this. Here standards were seen to have large potential for emerging areas but the enterprise did not have a specific approach to standardization. To link practical standardisation and standardisation strategy, the standardisation department involves an internal marketing approach and it the links to other relevant committees and standardisation organisations, thereby fostering the information flow.

Self-organizing mode: In most cases, especially those of all the RTOs, the researchers get involved in the standards activities on an essentially ad hoc basis. Participation is typically motivated by a specific project. In isolated cases researchers can be recruited into national activities based on reputation but mainly RTO researchers´ participation grows out of research for a client. In others, participation can be driven by the particular technical interest of the engineers "as part of their job" and requests from industry associations to have a "neutral expert" on the committee or the delegation of a national representative into an international committee.

Long-term R&D contracting with major actors that have stakes in standardization outcomes provide a good basis for involving researchers in relevant standards tasks. More ad hoc R&D contracts for individual private-sector companies may also provide a good funding basis. So can EU funding under the Framework Programmes of the EU, which was mentioned by several cases as engendering good practice since it encourages participation in standardization activities.

In general the self-organization of participation was seen to provide the necessary flexibility for researchers to link up with relevant standards activities over time. This is important when both the research fields and the standards activities are changing. But it leads to at least two concerns. The first is how to secure sufficient funding in this situation: the second is how to recruit new researchers to standardization activities.

5.2.2 Resources especially funding

The other question associated with organization is the universal concern about the availability of adequate funding and other resources. It was pointed out that under-funded participation often leads to sub-standard participation in the committees. Participants that do not prepare between meetings will generally not be able to contribute to the elaboration phase, contributing to the perceived inefficiencies in the process: the duration of time was especially noted. On the other hand, one case reports on a telecoms enterprise where several people would be involved in in providing input before and during the process and helping to prepare the standard. This includes the review of competitors' technologies.

Standardization costs money, and although the cost of travel is relatively low and although membership fees are geared to participation level, the direct costs related to standardization activities remain high. Finding reliable funding not only for the direct costs but the actual contribution between meetings to the standards is a universal problem. The exceptions were the two ICT company cases. The small firms as well as the RTOs noted that question of cost and of the fact that participation eats into time for other necessary work.

In some cases, researchers found their participation thwarted by national funding agencies that did not recognized the significance of standards-work as part of R&D output. A counter example was that of the EU Framework Program (which is also funding this work). The EU FP was specifically cited as a funding agency that recognized the interrelationship between research and standardization.

Securing adequate funding while providing for the basis of self-organizing is thus a challenge. The interviews mentioned several ways to improve funding conditions:

- Earmarking national public funding to the participation of researchers in standards committees
- Getting branch –organizations more involved in supporting (especially for some technological areas)

5.2.3 *Awareness and Involvement*

One deficit is on the interest of researchers in standardization activities. General awareness of the standardization process, and its merits vis-à-vis the research process, are required at different levels. A lack of awareness or interest in the standards activities either by the actor who commissions the R&D contract or by the researcher can otherwise get in the way of a good cross-pollination between the two frames.

Getting researchers interested in standardization is not easy, and the interviews among RTOs and Enterprises both noted this. Standards are Once knowledge and interested researchers have the opportunity to participate, the key precondition for fruitful involvement depends on financing. One challenge is thus to change the tendency towards short-sightedness about standardization and to better integrate it further into overall operations.

The most common concern is that standardization work is recognized as being important by those commissioning R&D. A lack of awareness and interest among funding agencies for standardization was emphasized in several cases. Funding from EU framework programs is cited here as a vehicle for standards-participation and where standards work is explicitly built into project-design. Whereas the EU FP was specifically cited as a funding agency that was aware and interested, there were many complaints that research programmes are not open for standardisation. Branch organizations, were also suggested to be a type of organization that should become more aware and involved in this area.

5.2.4 *Personal factors*

A list of personal factors that shape the interface between research and standardization was mentioned. Even in cases where standardization efforts were centralized the importance of individuals with knowledge, understanding, drive, and social and diplomatic skills were noted to be central. In many cases the link to standardization will be different from case to case. The importance of engaged and knowledge persons among the clients companies for R&D was also noted as moving along the process. Here the combination of technical knowledge, knowledge of the standards-process and the wider (political and market) contexts, and some social characteristics (such as the ability to work together with others) was seen to promote fruitful participation. In the standardization process, the role of secretariats were also mentioned as crucial.

A related question about motivation is whether participation in standardization is seen as meritorious or not. In many cases, the reaction is ambivalent, but in some cases standardisation was seen as increasing the researcher’s reputation in his own research community. In these cases, the engineers are aware of the reputation building effect of active participation in standardisation bodies. Especially chairing a technical committee has very high reputation effects and high visibility.

The return of the investment in standardisation can be high in certain settings. The participation itself is an opportunity for the researcher to network with potential collaboration partners and clients. It may also have a positive marketing effect among customers and improves and stabilises the relationship to their customers (new standards generate new markets especially for certification services).

5.2.5 The standardization environment

The role of standards bodies was commented on by most cases. In a couple of cases the observation that, in addition to the cost of standardization, the process itself was not efficient was made by some. Many observed that while the development of standards move at a relatively slow speed, the funding of the R&D work covering participation might run out before the standard is developed.

However, none made the case that the way standards bodies function prohibits the uptake of research very strongly. Cases were a little bit split on the question of consensus. On the one hand some cases emphasized the importance of greater efficiency in the standards process. Others however underlined the need to continue to focus on consensus as a goal of the process, despite the difficulties this might pose.

Matters are complicated by the fact that new technologies often encompass several interfaces which are in need of standardisation. Also, there is hardly enough time for a new idea to mature. This is where EU- and other joint projects play a significant role as an incubator. one large EU-funded project on mobile communication of the next generation which involves 40 partners

Many observed about the changing standardization landscape, including on the proliferation of standards bodies and the shift between national and international levels were mentioned. One effect that was noted by the RTOs was that the changing development of the standards 'ecology' was to make tactical participation more important.

5.2.6 IPRs

IPRs were acknowledged as something of a concern by most interviewees with increasing relevance in standards work. The RTOs generally did not see it as a problem but noted that IPRs are becoming more important for the way standardiza-tion works. One specific concern mentioned by an enterprise was that the system had not adjusted to dealing with patent holders that are not engaged in production activities and not interested in cross-licensing deals. The threat of 'patent trolls' was identified as one area which is not adequately addressed in the current environment. Actors interested only in extracting maximum returns on IPRs were seen as a problem.

There were a couple of developments that were mentioned which were suggested to be important. One was The Department of Justice initiative to allow licensing terms to be discussed in standards bodies and the multilateral use of non-assertion covenants. This was seen as a promising initiative which could improve negotiations and ultimately aid the broader dissemination of standards. One aspect of this initiative is that it might promote multi-lateral instead of bilateral negotiations. This could among other things allow greater openness about what constitutes fair and non-discriminatory terms for essential IPRs since negotiations would take place more in the open. But it also raises concerns about the risk for cartelization behaviour.

Part two: case studies on patent pools as a coordination mechanism

6 Introduction

The standards setting process relies to an increasing degree on successfully integrating— or otherwise taking into consideration— up-to-date research and development results (R&D). The successful interaction between research and standards can provide important benefits to society. There is however a number of challenges that are currently hampering the successful interaction at the interface between research and standardisation. One key and recurrent challenge here is the widely noted need to improve coordination between the private interests broadly associated with research investments and the collective interests which standardisation implies. This paper notes that a major concern that has developed at this fault line is how to equitably deal with patents and other IPRs in the standardisation frame. This involves a set of challenges, such as how to deal with the continued rise of cumulative licensing scenarios, how to ensure transparency on royalty rates, how to promote and enforce effective methods for declaration, and, more generally, how to effectively manage the IPR policies of standards development organisations, etc. The paper focuses on patent pools in this context. These are mechanisms in which attempts are made to include all the IPR essential to a standard in a bundle. As a coordination mechanism, patent pools might facilitate access to patent and reduce uncertainty, and thus also may remove a barrier to transferring research results to standards. As such, they may foster innovation - and in particular the diffusion aspect of innovation.

Objectives

By analyzing patent pool that have been established in two different fields, we aim to understand under what circumstances such pools work out and to what degree (if at all) they improve the interface between research and standards. We also aspire to identify the factors that determine the potential success of patent pools and (partly linked to that) the situations in which the establishment of patent pools is appropriate. We also aim to develop a better understanding of the main challenges and trade-offs are, particularly from the perspective of their potential members.

There is also a specific European aspect to this study. In the US, patent pools are been part of a wider discussion (e.g. the FCC 2002 hearings[24]), and comfort letters / clearances showing under which conditions governments allow the creation of patent pools are made public. In Europe, there is considerable less (public) information on patent pools, while the relevant pieces of regulation (particularly the 2004 EC Regulation on Technology Transfer Agreement) do not seem to be particularly clear on patent pools. Despite this unclear situation, Europe does recognise that successful standards (both the creation and diffusion) are or prime importance, not in the least

[24] Department of Justice antitrust division and Federal Trade Commission, hearings on: competition and intellectual property law and policy in the knowledge based economy, Cross-Licensing and Patent Pools, Wednesday, April 17, 2002, Great Hall of the U.S. Department of Justice, 333 Pennsylvania Avenue, N.W., Washington, D.C.

because of the great success of the European standard for mobile telephony GSM, which has managed to capture 75% of the worldwide market and passed the 1,000,000,000 subscribers mark in 2004.

6.1 Research design

To understand the problem of overlapping property rights and cumulative innovations, we turn to what has been called the ‘tragedy of the anticommons’ (see 7.2 for more details). This is a theory that mirrors the well-known tragedy of the commons. The tragedy of the commons refers to a situation where many actors have unrestricted access to a collective good (such as farmland or fishing pools), resulting in a tendency for over-exploitation and exhaustion on the longer term, damaging everyone’s interests. As such, it concerns the conflict for resources between individual interests and the common good. In economics, this reasoning has often been used to argue in favour of privatisation and/or regulation; for instance by introducing property rights. Such an ownership would create an incentive to consider the value of the property in the future. Analogous, the tragedy of the anticommons occurs when rational individuals (acting separately) collectively waste a given resource by under-utilizing it. This happens when too many individuals have rights of exclusion in a scarce resource. As such, this metaphor helps to explain why people underuse scarce resources because owners can block each other. Patent pools may me seen as me mechanism that addresses problems that are created by such an tragedy of the anticommons, caused by overlapping property right. More specifically, in our context, patent pools may serve as a mechanism to (1) reduce the transaction costs (a one-stop shopping system involves considerable less costs than numerous bilateral licenses, (2) to control the total (cumulative) license fee (even if all IPR holders demand a fee that they consider reasonable, the cumulative fee may be prohibitive) and (3) improve access to patents.

Given the nature of the problems and the phenomena we are interested in, this study has an explorative character. In order to collect empirical data to support our analysis, we use a case study approach is used, focussing on three cases. IPR problems and patent pools are most likely to occur in sectors where compatibility standards are at stake: many parties may hold essential standards for one single technology. Moreover, for a patent pool to be legally allowed, it almost by principle needs to be linked to a well-defined technical standard or definition. Building upon earlier research results, we have identified three cases in which many overlapping property rights can be observed: the case of DVD technology (field of Consumer Electronics - CE), the case of second- and third generation mobile telecommunications standards (field of telecommunica-tions), and open document standards (field of computer technology). In the first two cases, patent pools have in fact been established, while in the third case, an interesting alternative was proposed.

We employ a combination of a literature survey, desk research on existing patent pool organisations, and a number of field interviews, where we have placed emphases on high-level representatives from firms that are potential licensors and/or licensees for pools. Since IPRs and patent pools are, to many firms, a very sensitive subject not every firm we approached would agree to have their comments and views written down in way which would allow readers to identify them. To keep this study as valuable as possible, we decided to make the interview results totally anonymous and worked them into the overall analysis. Most often, however, we were able to refer to public sources of information.

On the basis of our study, we aim to draw conclusions on (1) how patent pools may or may not contribute to the creation and diffusion of standards; (2) in what situations patent pools are appropriate, (3) what the main trends in patent pools are, (4) what the main challenges and trade-offs are, particularly from the perspective of their potential members. The paper rounds up with recommendations addressing legislators (the EU in particular) whether and how they could facilitate the establishments of paten pools in order to increase the success of technical standards.

6.2 Structure of part two

Chapter 1 continues by discussing the relation between standards and patenting, and introduces patent pools, including their basics and some examples. As competition law / antitrust law is very important in this field (and actually determines whether patent pools are allowed to be established), we pay attention to regulatory issues in Chapter 8. In Chapter 9, the three selected cases are presented. Finally, in Chapter 9.7 we draw conclusions for the second part of this report.

7 Standards, patenting and patent pools

The relation between standards and patenting can be a troubling one. Standardisation has a public (or quasi public)[25] nature and strives for equal access for all, whereas property rights are more in the private sphere and are meant to give exclusive rights to one party, for a pre-defined period.

This chapter aims to provide a better understanding of the difficult relation between standards and patents, and introduces the phenomenon of patent pools

7.1 Patents in standards: essential and non-essential patents

That the implementation of technical standards in products implies the use of patented knowledge is rather usual these days. It is also not a totally new phenomenon. Philips and Sony license their compact disc patent to hundreds of manufacturers. The widely used IEEE[26] Ethernet standard for local area networks are based on patents of Xerox.[27] In addition, the MPEG[28] audio and video coding standards cover several patents too (see below). In some cases, patents even apply to standards that are referred to in regulatory measures. The use of the patented modular telephone jack, which can be found on virtually any device that can be connected to the telephone network, is obligatory in many situations in the US.[29]

In fact, some modern products based on standards, such as an GSM or UMTS telephone, may be covered by thousands of patents, even if we do not take into consideration that patents on the similar invention are often taken in many different countries. A specific category of these patents, however, is what is usually referred to as ‘essential patents’. In short, a patent is considered essential to a standard when implementation of that standard is only possible using the patented knowledge. In other words: there are no workarounds; anyone that wishes to produce a product compliant to the standard needs a license from that patent owner. It should be noted that determining essentiality is not without problems. Can we really be sure that such workarounds do not exist? What if there are alternatives, but the cost of implementing them (both in terms of money or in technical terms) are prohibitive to be used in this context?[30]

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[25] This is called *quasi public* in this study, because in practice not all parties have equal access to the standard and to the standardisation process.
[26] IEEE: Institute of Electrical and Electronics Engineers.
[27] Hanrahan, 1995, p. 496.
[28] MPEG: Motion Picture Experts Group.
[29] This telephone connector is incorporated in the Federal Communications Commission (FCC) Part 68 Rules and also is the basis of an IEC standard (Hanrahan, 1995, p. 496).
[30] Let’s give an hypothetical example: assume a firm has patent a way of calculating a certain parameter, that is continuously to be computed in mobile phone in its stand-by mode. Suppose that there is also another way of doing that calculation, but that alternative requires 100 times as much computing. Given

It should also be noted that non-essential patents can be very valuable. An example: a substantial part of the buyers of mobile phones seems to attribute great value to so-called predictive text input feature on GSM phones. This feature allows them to compose short text messages more easily. In order to market a successful phone, a manufacturer may feel that it needs to license that patent, even though the standard does not include this feature and the patent in question is therefore has to be considered non-essential.[31]

Nevertheless, despite the observation that non-essential patents can be indeed very valuable, essential patents are a special category on their own. When a firm fails to secure a license to an essential patent, it cannot make and sell any product complying to the standard, and thus is completely barred from competing on the market of the standardized product.

7.2 A tragedy of the anticommons

A situation with overlapping patent rights, as we observance in several standardisation environments, can be characterised with what has been called the 'tragedy of the anticommons'. To explain this metaphor, we first turn to the so-called 'tragedy of the commons', where this analogy is taken from.

The **tragedy of the commons** refers to a situation where many actors have unrestricted access to a collective good (such as farmland or fishing pools), resulting in a tendency for over-exploitation and exhaustion on the longer term, damaging everyone's interests.[32] As such, it concerns the conflict for resources between individual interests and the common good. In economics, this reasoning has often been used to argue in favour of privatisation and/or regulation; for instance by introducing property rights. Such an ownership would create an incentive to consider the value of the property in the future.,

Analogous, the **tragedy of the anticommons** occurs when rational individuals (acting separately) collectively waste a given resource by under-utilizing it. This happens when too many individuals have rights of exclusion in a scarce resource.[33] As such, this metaphor helps to explain why people underuse scarce resources because owners can block each other. The term "tragedy of the anticommons" was introduced by Harvard Law professor Frank Michelman and popularized in the late 1990s by prof. Michael Heller. In one article, he uses the classic example of why many storefronts in Moscow are empty while street kiosks in front are full of goods. His explanation is that many

the power needs for computing power and given the available battery technologies, that would result in a reduction of the maximum stand-by time from a full week to a few hours. Does this imply that the patented technology is essential, or not? Where is the threshold?

[31] This example refers to the popular T9 predictive text input developed and patented by Tegic (an America Online subsidiary) and licensed to may of the world's largest mobile phone manufacturers.

[32] The term is originally from a parable published by William Forster Lloyd in 1833, and was popularized and extended by Garrett Hardin in his 1968 Science essay "The Tragedy of the Commons". (Source: Wikipedia).

[33] Source: Wikipedia.

agencies and private parties had rights over use of store space and that it was difficult or even impossible for a start-up retailer to successfully negotiate for the use of store space. Even though all the persons with ownership rights were losing money with the empty stores, and stores were in great demand, their competing interests got in the way of the effective utilisation of space.[34]

Overlapping rights of exclusion may occur, in particular, when intellectual property rights such as patents and copyrights are at stake.[35] It is a common misunderstanding that patents would give the right to produce something; they merely provide the right from preventing others to do so. But if the production (or implementation) of something that incorporates your own patent but also patents held by others; you still need permission by these others (licenses) to be allowed to produce. A practical example is that of a cumulative invention. Firm A patents the basics of a entirely new process, and after that firm B invents (and patents) a way to practically implement this process. Firm A can only use this implementation if it obtains a license from B; where B can only commercialise its implementation when it gets a license from A. In modern times, such cumulative inventions are increasingly common.

The risks of the tragedy of the anticommons (underuse) grows with the number of overlapping property rights. Apparently, standards are prone to such situations. As explained in the preceding paragraph, any organisation that wants to implement a standard into a product, must ensure access to all essential patents (by obtaining licenses from all the holders of these patents). As a result, a standard that has many essential patents may suffer from underuse (lack of diffusion). It should be stressed that this type of underusage is different than the 'normal' type of underuse that is associated with the patent system (ie. the build-in trade-off in the balance between creation and usage).

Not only the areas that use technical standards but also other sectors have been mentioned as being prone to cumulative rights problems such as the tragedy of the anticommons. One of these is the field of biomedical research by (which has a lot of patented procedures), discussed by Heller & Eisenberg.[36]

7.3 Coordination mechanisms to deal with patent access problems in standardisation

Obviously, standards bodies would like that licenses of essential patents are available to all potential implementers, at reasonable terms and condition. If not, the diffusion of the standard is at risk. To that end, there are several policies that have been adopted by standard bodies.

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[34] Heller, M.A. (1998). The Tragedy of the Anticommons: Property in the Transition from Marx to Markets. Harvard Law Review 112 (3), pp. 622

[35] DePoorter & Paris (2003) used this metaphor in relation to copyright and fair use.

[36] Heller & Eisenberg (1998).

In the **royalty free (RC) licensing** policy, standard bodies (or other organisations) impose that all licenses for essential patents are made available free of charge. If one of the patent holders chooses not to comply, the standard is withdrawn, or a workaround is developed so the standard in question is no more essential (i.e. the standard is changed). Patent holders may be sensitive to this thread: if their IPR is no longer essential to the patent, it may well raise less money, unless there are other good markets for the patent (possible other, competing standards). An additional enforcement is possible if governments require royalty-free patents as part of their procurement rules. Royalty free policies draw heavily on the ideas of the open source community, where developers of software voluntary waive their rights, and developed a license that all other contributors and adopters of their software do the same (e.g. the GNU license). In the field of telecommunications, there have been some attempts to have standards bodies imposing an RC policy, however, to no avail.[37]

The so-called **RAND** or **FRAND** licensing policy establishes that all holders of essential IPR must use (fair,) reasonable and non-discriminatory terms when licensing those IPRs. Usually, members of the standard body in question took the obligation on them to notify the body of any essential patents they are aware of. This obligation is usually part of the in the membership rules (established in the Statutes or the Rules of Procedure). Any holder of an essential IPR (member or not) is urgently requested to issue a statement that it will indeed meet the RAND conditions for its patents that are essential to a specific standard. If this part refuses, the standard body must halt the development of the standard or must find a way to change the standard ion a way that the patent is question is no longer essential.

Both coordination mechanisms have been introduced by standard bodies (and by governments, when procuring). Experience shows that both have their limitations and drawbacks.

Royalty-free conditions has been made part of the procurement conditions in the Dutch Programme for open Standards and Open Source Software in government Ossos[38] and is now taken over for the European Community in their European Interoperability Framework (EIF). This bold move, however, is heavily disputed as it conflicts strongly with the interests of existing market players, which often invested heavily in research under the assumption that these costs could be recovered by licensing income.[39] A royalty-free licensing policy has also been adopted by W3C, among others.[40] The W3C's policy seeks to W3C seeks to its Recommendations that can be implemented

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[37] For details, see section 9.3.1.

[38] See http://www.ossos.nl/index.jsp?alias=english.

[39] A good examples of such critics can be found in CompTIA (2004). White Paper “European Interoperability Framework” ICT Industry Recommendations. Brussels, op te vragen via http://www.comptia.org/sections/publicpolicy/docs/interopwhitepaper0204.pdf. Ook in een recent rapport van EICTA worden dergelijke kritieken geuit. (EICTA (n.d.). Interoperability white paper., op te vragen op www.eicta.org/files/WhitePaper-103753A.pdf).

[40] See “W3C patent policy”, version of 5 February 2005, available at http://www.w3.org/Consortium/Patent-Policy-20040205/.

on a Royalty-Free (RF) basis; this standards body will not approve a Recommendation if it is aware that Essential Claims exist which are not available on Royalty-Free terms. Although the W3C policy is not without any discussion, it seems as if the large majority of players can accept it. This might have to do with the nature of the standards in question, and the norms, values and history of the internet development. It is rather unthinkable that such a policy would be accepted in the field of radiocommunications standards, for instance.

(F)RAND licensing policies have been pioneered by ETSI (see section 9.3.1) and are now quite widely adopted among standards bodies. Also these policies are not without problems, however. Some of the most serious limitations are:

- The terms reasonable and fair are open to different interpretation. What is reasonable? In some sectors (e.g. pharmacy), it would not be unusual for a patent holders to demand a licensing fee of several dozens of percents of the wholesale price of a drug. At the same time, many in the telecommunications sector might find such a fee unreasonable. But what is the definition of that criterion? There is little or no jurisdiction that can help us how fair and reasonable should be interpreted in this context.

- Licensing contracts between parties are, almost by definition, confidential documents. So, for any given licensee, it is very hard to determine whether the non-discriminative clause is met or not.

- The only read threat that standard bodies can make against IPR holders to get them make the desired declaration is that they halt the development of the standard. This is not a very strong menace; the holder of the IPR knows that the consequences of such a move are so sever for the standard body that they will only do this as a very last resort.

- Even if each of the individual IPRs is licensed in a fair and reasonable manner (however we define that), it could be very well that all licenses together would result in an unreasonable high amount. Obviously, the more essential IPRs, the bigger this problem gets.

- Parties that are no member of the standards body obviously cannot be compelled to notify the body of any essential patent they hold. As a result, there is always a risk that a firm stands up and claims an essential patent. Like members, such a firm has the right not to license on RAND conditions, however, this situation is even the more hazardous that this happens a late stage in which changes to the standard (workarounds) have become almost impossible.

In practice, we have seen several conflicts involving these RAND policies. Below, some illustrations are given:

- In late 1998, Qualcomm demands that ETSI meets a number of its demands before it is willing to declare that it essential patents for UMTS can be licensed on RAND terms and conditions. Some felt they were taken into hostage; others insisted that Qualcomm was acting fully within its rights. This is one move in a long-term conflict, which had severe consequences for the development of UMTS (see the case study in section 9.3.2).

- In late 2003, the European Commission ordered ETSI to remove a patent declaration by Sun Microsystems from its online intellectual property database. The justification for this was the commission's own investigation concluding that Sun did not, in fact, have an essential patent, and that the presence of the declaration could distort competition in violation of the EU equivalent of antitrust law.[41]

- Late 2005, a number of large telecommunications players formally complained at the European Commission that Qualcomm had unfairly used its patents on third-generation technologies to squeeze excessive royalties and licensing deals out of the industry.[42] The licensing fees of Qualcomm were said to be "excessive and disproportionate to the role Qualcomm had played in developing the technology".[43] Other complains are that Qualcomm is 'offering preferential terms on royalties on technology patents to manufacturers which also bought their chipsets'.

7.4 Patent pools essentials

Patent pools may help to solve, to some degree, the problems that were observed with the RC and RAND licensing policies discussed above. Following the USPTO, we define patent pools as "[…] an agreement between two or more patent owners to license one or more of their patents to one another or third parties."[44] A patent pool allows interested parties to gather all the necessary tools to practice a certain technology in one place, e.g, "one- stop shopping," rather than obtaining licenses from each patent owner individually.[45] Another useful definition is offered by Robert P. Merges (1999).: *"A patent pool is an arrangement among multiple patent holders to aggregate their patents. A typical pool makes all pooled patents available to each member of the pool. Pools also usually offer standard licensing terms to licensees who are not members of the pool. In addition, the typical patent pool allocates a portion of the licensing fees to each member according to a pre-set formula or procedure [...]"* In

[41] See SCTE Standards Bulletin, Fall 2003, at http://www.scte.org/documents/standards/bulletin/SB_Fall_2003.htm.

[42] Financial Times, 'Groups push for action on intellectual property', 21November 2005.

[43] Moconews.com, 'Qualcomm Unfair With 3G Licences: Rivals', 28 October 2005.

[44] USPTO (2000). The alternative definition, given in the same paper reads: "the aggregation of intellectual property rights which are the subject of cross-licensing, whether they are transferred directly by patentee to licensee or through some medium, such as a joint venture, set up specifically to administer the patent pool.". However, we feel somewhat hesitant about this definition, as it suggest that cross licensing to be a core element, while, in our view, a patent pool could theoretically also exist without cross licensing (i.e. when the pool members do not need access to each other's patents, but when they do form a pool to license it to third parties).

[45] US Patent and Trademark Office, "USPTO issues white paper on patent pooling", Jan. 19, 2001.

this context, we are most interested in what we would like to call *technology-based patent pools*: where a pool is constructed to bundle licensees for a specific technology, such as essential patents for a technical standard.

Patent pools have been used for more than 100 years, and for various reasons. The earliest patent pools were mainly established to (1) clear blocking patent positions and to cease patent hostilities (these pools were often created after government intervention), and (2) for market division among horizontal competitors, naked price fixing and other anti-competitive goals (nowadays, such behavior is considered as a hardcore violation of competition/antitrust regulation, both in the US as in Europe).

Over time, patent pools came to serve other functions. In the current context, where RC and (F)RAND policies show their limitations, patent pools may help to:

(a) bring transaction costs down[46],

(b) control the cumulative licensing costs, and

(c) clear blocking patent positions and lessen access problems caused by opportunistic behaviour.

Other goals of patent pools include the avoidance of costly infringement litigation[47] and assure the interoperability and implementation of technical systems.[48] An often-overlooked aspect is the role of patent pools in that of a mechanism of information or knowledge exchange, e.g. unpatented technical information and information on the essentiality of IPRs.

Typical features of modern patent pools are the following:

- makes all pooled patents available to each member of the pool.
- standard licensing terms to licensees who are not members of the pool; usually a simple, coherent menu of prices and other terms to licensees
- allocates a portion of the licensing fees to each member according to a pre-set formula or procedure
- Consensus to license on FRAND considerations

7.5 Examples of past and recent patent pools

As indicated, patent pools have existed since more than 100 years, but their reason of existence has changed a lot. This sections aims to present an up-to-date overview of such pools. Roughly, we can divide them into two periods:

- Period 1: Market-based patent pools (late 19th century up to the 1990s)
- Period 2: Standard-based patent pools

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[46] Here, we refer to the reduction of transaction costs associated with one-shot agreements in an environment with a repeat-play nature. Note that cross-licensing agreements can have this feature too: they often do include provisions of future IPR held by the contract parties.

[47] See www.essentialinvventions.org.

[48] See www.mpegla.com.

As we will show below, the second period can be further divided into (a) Patent pools established by involved parties and (b) Patent pools established and/or administrated by licensing organisations ('licensing authorities') that aim to develop larger number of pools.

Examples of pools within the two distinguished periods will be further discussed in the two sections below.

7.5.1 Market-based patent pools

The first patent pools date from halfway the 19th century, and at that time such pools were, as indicated, mainly established to:

(1) clear blocking patent positions and to cease patent hostilities; these pools were often created after government intervention (the US-government-induced pools in aircraft manufacture and automobile are good examples of this);

(2) create market division among horizontal competitors, naked price fixing and other anti-competitive goals.

Merges (1999) presents a rather complete overview of 'old' patent pools and their features. Table 4 presents an overview of these (supplemented with pools found in other sources). Note that most documented patent pools were established in the US; we have found only one case of such a pool in Europe (that of the German stereo television technology). There have also been patent pools in sanitary production and glass production (dissolved in 1912 and 1945, respectively).[49] In addition to these better-known pools (that are regularly referred to in papers), Lerner, Strojwas & Tirole (2003) provide an even much longer list of 63 patent pools, most of them established in the 1920s and 1930s. This list is given in Appendix 3.

Table 4: Overview of well-known patent pools[50]

Sewing Machine	One of the first patent pools was formed in 1856, by sewing machine manufacturers Grover, Baker, Singer, Wheeler, and Wilson, all accusing the others of patent infringement. They met in Albany, New York to pursue their suits. Orlando B. Potter, a lawyer and president of the Grover and Baker Company, proposed that, rather than sue their profits out of existence, they pool their patents.
Movie Projector	In 1908, Armat, Biograph, Edison and Vitagraph entered an agreement under which the four firms assigned "all the patents in the early-day motion picture industry." The agreement also specified the royalties that were to be paid into the pool by licensees of the pool patents such as movie exhibitors.
Bed	In 1916, the owners of various patents related to folding beds and other similar devices entered into an agreement providing exclusive license to the Seng Company to manufacture and sell under the pool patents. Of the total royalties, 33 percent was allotted to the Pullman Couch Company. The license contract was signed by the

[49] www.essentiainventions.org.

[50] Sources: Merges (1999), Wikipedia, and www.essentiainventions.org.

	Davoplane Bed Company (7 patents), the Pullman Couch Company (13 patents) and two inventors. The Seng Company paid a fixed percentage to the pool. Pool members split the royalty according to a formula in the pooling agreement.
Aircraft	In 1917, as a result of a recommendation of a committee formed by the Assistant Secretary of the Navy (The Honorable Franklin D. Roosevelt), an aircraft patent pool was privately formed encompassing almost all aircraft manufacturers in the United States. The creation of the Manufacturer's Aircraft Association was crucial to the U.S. government because the two major patent holders, the Wright Company and the Curtiss Company, had effectively blocked the building of any new airplanes, which were desperately needed as the United States was entering World War I.
Radio	In 1924, an organisation first-named the Associated Radio Manufacturers, and later the Radio Corporation of America, merged the radio interests of American Marconi, General Electric, American Telephone and Telegraph (AT&T) and Westinghouse, leading to the establishment of standardisation of radio parts, airway's frequency locations and television transmission standards.
(German) stereo television	In 1980 German manufacturers of television sets assigned the IPRs for stereo television to a body called IGR. This body granted licenses to its members, but refused to grant a similar license to Finnish TV manufacturer Solera, which was therefore blocked from the German market for stereo televisions. Salora complained to the Commission, which obliged IGR to open up its licence scheme to third parties.[51]

7.5.2 Standard-based patent pools

With some exceptions, no new patent pools were established since between approx. 1920 and the 1990s. The explanation for this was the more critical attitude that the US authorities developed towards patent pools: increasingly, they were seen as an example of uncompetitive behaviour, incompatible with antitrust law.

Then, in the 1990s, the first new pools appeared on the scene again. These were rather different types of pools, specifically designed to deal with technologies that were essential to one and the same technical standard. Bay bundling such patent, the access to the technologies needed to implement the standard was facilitated, and thus these patent pools could have stronger pro-competitive than anticompetitive effects. Proposals for such pools were submitted to the US Antitrust Authorities, which in a number of cases issued a comfort letter in which it indicated that, given the information provided, they saw no reason why the pool was incompatible with antitrust law. After such a 'green light', the pool could be established. Best known examples are the so-called MPEG-2 patent pool, the DVD-3 patent pool and the DVD-6 patent pools. The comfort letters in question were made public and have been studied by many, as they provide a good indication which aspects or practices the authorities judge to be acceptable, and which not. The first few patent pools were established on the initiative of the companies involved, and were often administered by one of these companies or by a new legal entity specifically established for this purpose.

Not long after, a new organisation model seemed to come along. In this new model, pools are established by specialist pool administrators, which aim to offer a wide collection of patent pools. These administrators use their experiences to establish and run pools. Firms involved in a standard can turn to such administrators with the request to set up a pool for their standard, but apparently these administrators increasingly take the initiative for pools themselves, issuing calls for IPR that are essential for specific technical standard. Right now, there are two of such administrators: MPEG Licensing Authority (MPEG LA) and ViaLicensing. Their activities and business models seem broadly identical. The MPEGLA was originally established to administer MPEG-2 patents, whereas ViaLicensing is a subsidiary of Dolby, a firm that has a long experience to license out its technologies to other (think of the Dolby noise reduction systems for tape recorders, and Dolby technologies form multi-channel cinema sound).

Table 5 presents an overview of recent, standard-based patent pools, including some pool proposals.

Table 5: Standard-based patent pools[52]

Application area	**Pools patents for the following standard**	**Pool administrator**	**Number of licensors and licensees**[53]
Wireless communications	IEEE 802.11 family (including 'WiFi')	ViaLicensing	6 licensors
Video coding	AVC (ITU H.264)	ViaLicensing	5 licensors
Video coding	AVC (ITU H.264)	MPEG-LA	18 licensors 68 licensees
Video coding	MPEG-2 (the pool itself is often called MPEG-LA, although this organisation now administers other pools too)	MPEG-LA	25 licensors, 134 unique patents 1021 licensees[54]
Video coding (audio part)	MPEG-2 AAC audio	ViaLicensing	5 licensors 126 licensees
video coding (audio part)	MPEG 4 audio standard (also known as MPEG-4 Part 2 and ISO/IEC 14496-3); includes MPEG 4 AAC	ViaLicensing	14 licensors 132 licensees
Video coding	MPEG 4 visual	MPEG-LA	26 licensors 292 licensees[55]
Video coding	MPEG-4 Systems	MPEG-LA	8 licensors 67 licensees
Radio Frequency Identification (RFID)	Electronic Product Code (EPC), 2nd generation (also known as 'GEN2)	A consortium of RFID product providers[56]	Still in the establishment phase. Around 20 firms are involved in setting up the pool.[57]
Mobile communications	Third generation mobile standards, including the UMTS/3GPP standard	3Gpatents (formerly 3G3P)	7 licensors
Television broadcast	DBV, MHP and OCAP	ViaLicensing	Not available
Television broadcast	DBV-T	MPEG-LA	4 licensors 36 licensees
Interactive television directories	TV Anytime forum TVA-1 (is equal to ETSI TS 102 822)	ViaLicensing	7 licensors
DVD	DVD Video, DVD ROM (plus patents for the ' slash' recording standard, that	DVD 6C licensing agency (see 9.2.3	8 licensors (started as six, hence the name)

51 More information is in Temple Lang (1995) and in EC (1991), paragraph 94.

52 Sources: www.mpegla.com, www.vialicensing.com, www.dvd6ca.com, as well as various sources referred to in Sections 9.2.3, 9.3.3, and 9.6.

53 As communicated by the licensing administrator (status per 10 February 2006).

54 Among these licensees there are quite some legal entities that appear to be a part of the same organisation.

55 Ibid.

56 See www.rfidjournal.com/article/articleview/1786/1/1.

57 See RFID Journal (Aug. 10, 2005). "The RFID Patent Pool: Next Steps". Available from http://www.rfidjournal.com/article/articleview/1798/1/1/, and LinuxDevices.com (Aug 12, 2005). "RFID 'patent pool' consortium forms". Available from http://www.linuxdevices.com/news/NS8390642236.html.

	we leave out of consideration here)[58]	for details)	377 licensees
DVD	DVD Video, DVD ROM (plus patents for the ‘ plus’ recording standard, that we leave out of consideration here)	3C DVD patent pool, administered by Philips	4 licensors[59]
Radio broadcast	Digital Radio Mondiale (DRM)	ViaLicensing	9 licensees
Computer communications	IEEE 1394 (FireWire interface”)	MPEG-LA	10 licensors 368 licensees
Video coding	Second generation Source Coding-Decoding Standard – AVS (Audio Video Coding standard working group of China)[60]	AVS patent pool management organisation	[6 licensors]

Table 6: Standard-based patent pools (including recent proposals)

ViaLicensing is currently setting up pools for a number of new standards, including:

- the IEEE 802.16 (‘WiMax’) standard,
- the MPEG-7 standard (a technology for Content Description of multimedia material),
- the ISO 18092 and ISO 21481 standards for Near Field Communication (NFC),[61]
- the ISO/IEC 13818-7 standard, which specifies a Spectral Band Replication (SBR) option for the MPEG-2 standard.

Also MPEGLA has some licensing programmes in development, including:

- The OMA DRM (Digital Rights Management) standard
- VC-1 or VC-9 television standards[62]
- ATSC digital television standard (the American counterpart of DVB-T)[63]
- Blu-Ray Disc, a standard for high-capacity storage on CD/DVD like discs
- Terrestrial Digital Multimedia Broadcasting (T-DMB) and Satellite Digital Multimedia Broadcasting (S-DMB) standards (for use in Korea)

There are some notable observation when looking at these patent pools:

- The two larger administrators (MPEG LA and ViaLicensing) sometimes bundle IPR for the same technological standards.

[58] More details are given in Section 9.2.3.
[59] The firm LG joined at a later stage.
[60] See http://www.avs.org.cn.
[61] This pools seems to be nearly there now; see Electronic News (2/1/2006), ‘NFC Jumps in the Patent Pool’, available from http://www.reed-electronics.com/electronicnews/article/CA6303827.html.
[62] From the MPEGLA website, it is not entirely clear for which standard (or both) this program is developed.
[63] For DVB-T, a pool initiative met considerable resistance. See EEtimes (24 November 1998), ‘Digital-TV patent pool draws fire in Europe’, available at http://www.eetimes.com/futureofsemis/showArticle.jhtml?articleId=18300379&kc=2511. Note that Lerner, Strojwas & Tirole (2003) do mention the establishment of a DVB-T pool (see Appendix 3), but we found mo more data on this.

- The China-based AVS patent pool was established in response to existing (US) patent pools, apparently because their licensing fees were considered to be too high for Chinese industry.[64] The new AVS pool aims is also aimed at the market of video coding but only includes IPR from Chinese firms, and includes the option to differentiate between the tariffs inside China and abroad.

Patent pools have been under fire, though. The 3C DVD patent pool, which includes Sony Corporation, Pioneer Corporation, and Philips Electronics, found itself the defendant in a national class action law suit in 2004, and of another legal suit (this time brought by two Chinese DVD manufacturers) in January of this year - even though the members of this pool had obtained a no action letter themselves.[65] (A more detailed discussion is given in Section 9.2.3.)

7.5.3 Patent pool models

Looking at the examples given in the preceding section, we can distinguish between several models for patent pools, or patent pool types. All fall within the definition of patent pools as we presented above, still there is a fine distinction between the three models.

Pool model 1: Joint licensing schemes. These are initiated by a group of (usually larger) licensors of a particular technology (or standard). One of them may act as an agent for the joint licensing contract. For instance, Philips is the agent for both the DVD3 and the DAB joint licensing scheme. Most of these pools are eventually open to any holder of essential IPR to the standard in question, nevertheless, they started as a activity of a small group.

Pool model 2: Patent pools with a licensing administrator. In this type of patent pools, there is an open call for essential patents for a certain standard by an independent body. Subsequently, the body has a patent evaluation carried out (usually by an independent, third party) to determine essentiality to the standard in question. A priory, the licensors that decide to join such a pool do not know who the other licensors will be that will become a member of the pool. A good example os such a pool is the MPEG-2 pool. The licensing administrator determines whether the patents are in fact essential, sets the royalty rate for the bundles (in dialogue with the licensors), and collects the royalties and redistributes them given a pre-agreed scheme.

Pool model 3: Patent platforms. In this model, an organisational approach is adopted that deals flexible with multiple technologies (standards) and multiple product groups (employing one or more patents that are essential to a certain standard). It also aims to

[64] See Wen Gao (sa), Open Standard and impact to the industry in China, Chinese Academy of Sciences availavble at www.ee.cuhk.edu.hk/ispacs2005/keynote/Gao%20Wen.ppt, and Wenwen Li (sa), The Intellectual Property Issue in the Standardisation Process - A Case Study from China's Experience, China National Institute of Standardisation (CNIS), available at http://www.thebolingroup.com/unifier_divider/powerpoint_slides/wenwenli.pdf.

[65] The following article, written from the Chinese perspective, makes for interesting reading. http://www.consortiuminfo.org/newsblog/blog.php?ID=1849

be more flexible towards the actual agreements between licensors and licensees. In the patent platform, there is one overall umbrella organisation, as well as multiple entities called ‘PlatformCo’, which each develop licensing programmes for specific standards. The aim is to have a standard offer (bundle) available (that the involved licensors cannot refuse). However, within the context of the patent platform, licensors and licensees may also agree upon other arrangements, possible involving cross licensing, the licensing of non-essential patents, and so on. To date, the 3Gplatform (see 9.3.3) is the only example of such an approach.[66, 67]

[66] In Goldstein & Kearsey (2004), the 3Gplatform founders explain the organisations model in detail.

[67] Critical comments concerning patent platforms were expressed in EEtimes, (November 27, 1999), 3G intellectual property licensing strategy comes under fire, available at http://www.eetimes.com/story/OEG19991127S0003.

8 Regulatory approaches towards patent pools

As we have discussed in Section 7.5, there is a ‘gap’ in time between the market-based patent pools (most before the end of WW2) and the standard-based pools (starting in the 1990s). This gap can be attributed to the way regulators looked upon such pooling initiatives.

As any type of coordinated conduct between market parties, patent pools can have anti-competitive effects and therefore are critically watched by competition authorities (Europe) respectively antitrust authorities (US). At the same time, patent pools promote increase technology transfer, which is pro-competitive and benefits economic and social welfare, in much the same way that also licenses for IPR in general are considered to be pro-competitive. Pools may capture the efficiencies that may come from licensing complementary technologies

Over times, regulators have looked in different ways upon the desirability of patent pools. This chapter will first introduce a more elaborate overview of the various pro- and anticompetitive effects of pools (8.1). As the phenomenon of patent pools received much more attention in the US than it did in Europe, we will continue by first discussing the regulatory approach in the US (Section 8.2) and then that in Europe (Section 8.3).

8.1 Pro- and anticompetitive aspects of patent pools

As indicated, patent pools have both pro- and anticompetitive effects. For a regulator, it is important to understand the various effects, their size, and which category of effects will prevail. Pro-competitive effects (depending on the exact conducts concerning of the pool) mostly have to do with the promotion of technology transfer, They include the following:

- (P1) Facilitating equal access to licenses for all potential licensees;
- (P2) Speeding up access to technology;
- (P3) Integration of complementary technologies;
- (P4) Reduction of transaction costs for both licensees and licensors;
- (P5) Possible clearing blocking positions;
- (P6) Avoidance of costly infringement litigation;
- (P7) A potential reduction of the cumulative license fee;
- (P8) Protection against certain strategies of patent holders (such as bundling essential IPRs with non-essential ones);
- (P9) Guaranteed non-discriminatory and equal access to all potential licensees. (At least, if agreed in the portfolio license conditions. See also the MFN clause below);

(P10) A valuable source of information to would-be licensees (For example, the portfolio list must give a decisive answer to which patents of the participants are essential to a standard and which are not.)

The main possible anti-competitive effects include the following:

(A1) Restrict competition between the licensors that participate in the pool, and serve as a price-fixing mechanism. This could especially be the case if substitute patents are in the pool, ultimately resulting in rising the price for products and services that utilise the pooled patents;

(A2) Have anti-competitive effects for licensees, as it could force them to purchase patents that they normally would not have selected (for instance, if a pool were to include two cost-effective but not essential methods to manufacture a display for a mobile phone, a manufacturers would prefer to license only one of them, but the pool would force this firm to license both);

(A3) Have anti-competitive effects for non-participating firms that hold patents that are substitutes to patents included in the pool. Since the licensee of the pool already has to pay for all patents in the pool, it might not select this competing patent, even if the latter is considered to be superior;

(A4) Limit competition in downstream products incorporating the pooled patents, or in other markets that are somehow related to those (for instance, a patent pool for the DVD standard could potentially limit competition in the market for DVD players, in the market for DVD disks, or in the market for content that will be produced for that medium);

(A5) Have anti-competitive effects towards other standards or technologies, as it might reduce the availability of patents that are technically or economically essential for those other standards;

(A6) Remove incentives for further innovative behaviour. If a pool is already there, there is little to gain from developing an alternative (substitute) to one of the technologies in the pool, as licensees already pay for the one that is part of the pool (see A3, above).

Because of these potential anti-competitive effects, competition authorities look with great attention to patent pools and comparable constructions. If these authorities do not find sufficient safeguards that prevent undesirable effects from happening, they will not allow such agreements. Participants will look for ways to include such safeguards. Mechanisms that can be included by the patent pool participants to reduce the risk for anti-competitive effects include the following:

- Include only essential patents. By definition, essential patent rights have no substitutes and thereby it is guaranteed that there only are complementary patents in the pool. This would remove the anti-competitive risks associated with (A2) and (A3) above;

- Ensuring that all the pooled patents are valid and have not expired. If this were to be the case, then competition or antitrust authorities would without doubt initiate an enforcement action;
- Agreeing upon an independent expert as an arbiter of essentiality. This expert should also see to it that all patents are valid and have not expired;
- Include a procedure for deleting patents from the pool when this patent expires, is found invalid by a court, when its holder leaves the pool, or when this patent loses its essentiality, for instance;
- Assure that all patents that are in the pool are also licensed individually by their holder on fair, reasonable and non-discriminatory conditions, also for other purposes than the standard that the pool is intended for. In this way, the pool will not be used to block competitive standards as meant in (A5) above;
- Assure that licenses from the pool are available to any interested third party on fair, reasonable and non-discriminatory terms;
- Including a provision that resembles a MFN-clause[68] to ensure than all licensees pay an identical license fee;
- Assure that licensees are free to make products that do not comply with the standard for which the patent pool has been established;
- Including a so-called grantback obligation. Licensees that hold essential licenses themselves (but do not participate in the pool) are then obliged to license these on reasonable and non-discriminatory conditions to all licensors and licensees in the pool. This further reduces risks for patent blocking.

Also Beeney (2002) has developed a similar list of design issues that maximise the pro-competitiveness of patent pools. Many of the items on his list are similar to those listed above.

8.2 Antitrust regulation in the US

Over time, the US authorities have looked upon patent pools in quite different ways. Up to the end of World War 2, the government itself had been involved in establishing patent pools, mostly to solve patent access issues for applications with a high societal importance (such as the aircraft pool in the war). After the second world war, also in a generally more critical attitude towards monopolies and anticompetitive behaviour, paten pools were more or less banned. This was formalised in the 1970s, when DoJ published a rather rigid approach towards licensing, the so-called ‘nine no-

[68] The Most Favoured Nation (MFN) is used in the WTO, among other organisations, and basically determines that if a country grants favourable terms and conditions for one country, all other countries have the right for that same terms and conditions.

no's'. This was a list of per se violations of antitrust law, in other words: hardcore restrictions.[69]

In the mid-1990s, we can observe an interesting change in US policy. IN the so-called Antitrust Guidelines for the Licensing of Intellectual Property[70], the U.S. Department of Justice (DoJ) and the Federal Trade Commission (FTC) for the first time acknowledged significant pro-competitive effects. By doing so, they followed suggestions by antitrust scholars like Teece and Jorde for a more liberal approach for inter-firm cooperation, also in the field of IPR.[71] Although the new guidelines also confirmed that the DOJ wanted to maintain its vigil over anticompetitive behaviour, it invited firms to think of more innovative approaches. The nine non-no's were formally abandoned in 1986.[72]

Indeed, on the late 1990s, several firms informed DoJ of their plans to establish patent pools. In a so-called Business Review Procedure, DoJ commented on the expected effects of the proposed plans, and indicated whether they believed such plans to be compatible or incompatible with antitrust law. If the first is the case, the resulting letter is referred to as a 'comfort letter' or a 'green light'. Although such a letter does not make a firm immune for any future legal action (for sure, any other firm retains the right to challenge their conduct), it does usually give a firm enough certainty if they know that DoJ, as it is, does not see reasons to take actions against their plans. So basically, it is a commitment of 'no action' by competition authorities. The protection this gives is not perfect (it does not bind private parties), but substantial.

In the late 1990s, three widely circulated business review letters were published: two of them for plans for a DVD patent pool, one for a MPEG-2 patent pool (for details and references to these letters, see Section 9.2.3). These rather detailed letters are very interesting as they discuss, in detail, which aspects the regulator takes into account when judging upon these pools. In 2002, a similar clearance was given to a patent pool initiative for third generation mobile standards (for details and references to these letters, see Section 9.3.3). In the US, there is also one interesting example of a case where a business review letter in fact concluded that a certain pool would be anti-competitive, and thus did now allow its establishment. This is the so-called VISX case. One of the main reasons why this pool proposal was found incompatible with antitrust law was that some of the patents in the proposed pools were substitutes, not complements.

After the above-mentioned cases, however, no similar business review letters seem to have been published afterwards for patent pools.[73] In fact, interviewees suggested

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[69] See Gordon, 2002.
[70] U.S. Department of Justice and the Federal Trade Commission (1995).
[71] See Merges, 1999.
[72] See Beeney, 2002.
[73] See the overview of such letters at http://www.usdoj.gov/atr/public/busreview/letters.htm#06.

that recent pool initiatives have designs that are rather similar to those already tested, making a new assessment unnecessary.

In 2002, the Federal Trade Commission and the Department of Justice organised a set of hearings concerning ‘Competition and Intellectual Property Law and Policy in the Knowledge-Based Economy’.[74] Its goal was to revisit the question of a proper balance of competition and patent law and policy. Many interesting contributions were made by scholars, both economists and lawyers.[75] Also patent pools were discussed in detail. In the opening session, it was said that: ‘In these hearings, we will encourage exploration of a number of broad questions about patents pools, such as whether pools actually result in the competitive problems they are hypothesized to cause and whether the antitrust authorities have focused on the right criteria when evaluating patent pools.’[76] Unfortunately, in the final report on the hearings[77], patent pools do not even make it into the concluding chapter, and the report does not go much further than stating that ‘Panelists also observed that various patent licensing arrangements – cross-licensing, patent pools, and the licensing requirements of standard setting organisations – have helped to mitigate the potential harm to innovation caused by patent thickets.’.[78]

8.3 Competition policy in the EU

Compared to the US, the discussion on IPRs and intellectual property – including phenomenon such as patent pools – is not much in the public domain. In fact, there does not seem to be much literature on the European policy in that field. Until 2004, the European Commission did perform procedures that are similar to the Business Review Procedure in the US.[79] There were two types of letters, so-called Negative Clearance Letters (NCL) (the agreement is totally outside Art. 81) and Exemption letters (the agreement is addressed in Art 81 but meets the exemption terms listed in Art 81.3, basically saying that the agreement is pro-competitive after all). However, none of the two types of comfort letters was made public and the receivers were not authorized to publish them (although a press release by the EC typically discussed their outcome and content). As far as we can track, comfort letters have been sent out to the DVD6C patent pool[80] and to the 3Gpatents pool.[81] As of early 2004, the EC changed its regulation and eliminated the concept of comfort letters (see below).

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[74] Department of Justice antitrust division and Federal Trade Commission, hearings on: competition and intellectual property law and policy in the knowledge based economy, Cross-Licensing and Patent Pools, Wednesday, April 17, 2002, Great Hall of the U.S. Department of Justice, 333 Pennsylvania Avenue, N.W., Washington, D.C.

[75] For an overview, see http://www.ftc.gov/opp/intellect.

[76] James (2002).

[77] FTC (2003).

[78] Ibid, p. 44.

[79] For a comparison between US and EU law, see also Delrahim (2004).

[80] This comfort letter is announced in European Press Release concerning the DVD2 patent pool, Brussels, 9 October 2000. Although this press release also refers to the fact that the 3C DVD firms also pooled their patent, we are not aware of a EC comfort letter for this pool.

In the European Union, patent pools may infringe competition laws (Article 82 in particular). Up to 2004, patent pools are not covered by the 'old' group exemption for license agreements[82], in contrast to several other types of license agreements. In April 2004, a new Regulation on block exemption for technology transfer licenses came into force (EC, 2004, with additional guidelines given in EC, 2004b). Still, this new block exception does not cover patent pools, given preamble 7: *'[This Regulation] should also not deal with licensing agreements to set up technology pools, that is to say, agreements for the pooling of technologies with the purpose of licensing the created package of intellectual property rights to third parties.'* The accompanying guidelines confirm this.[83] In fact, in a press release[84], the European Commission indicates that it does not have the powers to adopt a block exemption regulation for patent pools.

Interesting enough, however, the guidelines do give considerations what aspects of pools the EC believes to be incompatible with competition rules, and what type of arrangements are allowed. In short, the Commission indicates that:

- Pools should only include essential technologies [to a standard] (Art. 219-221)
- Pools should only include complementary technologies, never substitutes technologies (note that if all IPRs in a pool are essential, than this definition is by definition met) (Art. 219-221)
- Pools [with a strong position on the market] should be open and non-discriminatory[85] (Art. 224)
- Pools should not unduly foreclose third party technologies (Art. 224)
- With pools [with a dominant position on the market], royalties and other licensing terms should be fair and non-discriminatory and licenses should be non-exclusive. (Art. 226)
- Licensors and licensees must be free to develop competing products and standards and must also be free to grant and obtain licences outside the pool (Art. 227)
- Grant back obligations should be non-exclusive and be limited to developments that are essential or important to the use of the pooled technology (Art. 228)

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[81] EU (2002).

[82] Block exception on the transfer of technology 240/96

[83] See these guidelines (EC 2004A): 'The TTBER does not cover technology pools. The notion of technology pools covers agreements whereby two or more parties agree to pool their respective technologies and license them as a package. The notion of technology pools also covers arrangements whereby two or more undertakings agree to license a third party and authorise him to license on the package of technologies.'.

[84] See http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/04/470&format=HTML&aged=0&language=EN&guiLanguage=en.

[85] We believe this issue should be interpreted with regards to participation.

In addition, the Commission sets some standards to the institutional arrangement of the pool (preferring a pool established by independent parties over a pool initialised by a limited group of technology owners, among other things), independent expert selection, and addresses the necessary resolution mechanisms.

Goldstein & Kearsey (2004, p. 214), two authors that were closely involved in setting up the 3Gpatent pool, note that the European Commission and the US DoJ do closely coordinate their positions. However, other people still call for more harmonisation. This was also expressed by interviewees. During a recent dialogue at the European Policy Centre, Hisamitsu Arai, Secretary General of the Intellectual Property Strategy Headquarters in Japan called for a more harmonisation between Europe and Japan in the context of patent pools. http://www.theepc.be/en/default.asp?TYP=ER&LV=475&PG=ER/EN/detail&AI=475.

9 The three case studies on patent pools and associated coordination mechanisms

9.1.1 Introduction

The relationship between IPRs and standardization is as tense now as it has been at any point since the late 1980s/early 1990s when the launch of GSM sparked a landmark controversy about incorporating such rights into emerging standards. Current events in the 3G mobile-environment (see ETSI), the Rambus ruling, and concerns in the standards-world about the fate of the Eolas patent are among the ingredients that are currently heightening tensions here. In this context, a widening set of different responses are being tried in order to clarify the changing role of patents in relation to standardization processes which themselves are undergoing change. Among those approaches being tried, patent pools (see cases) make up a notable supply-side mechanism (IP holder). This mechanism, which has a long history, is enjoying something of a renaissance at the international level. It has recently been touted as a good way to coordinate IP of multiple stakeholders more efficiently in relation to standardization activities. On the other hand, the new attempt by ETSI to introduce cap royalty rates represents a more demand-side (IP user) approach (Link).

There are also other mechanisms that are addressing the need for coordinating multi-rights and multi-right-holder scenarios where a potential for ‘hold-up’ or simply for the cost of rights—cumulative or individual—to become prohibitive creates uncertainty. One mentioned in the literature (Graf & Zilberman, 2001) involves ‘patent clearing houses’ which have been forwarded in the field of the bio-agricultural research. The patent clearing house’ approach involves a mechanism for academic researcher institutions to provide for free access to rights that might affect their research. This mechanism however does not seem to be sufficiently widespread in practice yet to affect the relationship between research and standardization.

9.2 Case DVD/MPEG technology

The Digital Versatile Disc (DVD) is currently one of the most important standards in the field of Consumer Electronics (CE).[86] Also, the DVD is one of the areas in which seemingly successful standard-based patent pools were established.

Optical storage in the CE sector first reached high volumes with the outstanding success of the compact disc (CD) in the early 1980s, as successor to the vinyl

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[86] Parts of this case have been presented by INTEREST project team member Stephan Gauch at the SIIT 2005 conference in Geneva, Switzerland.

record.[87] Expectations were high for the high-capacity derivate called DVD, which allowed storage of a video up to the size of a feature film. Around 1998, the first DVD players and discs were introduced in the European market. The development of DVD not only involved optical storage technologies, but also data compression techniques (DVD uses one known as MPEG-2). Although the standard-setting process revealed substantial differences in interests and in technical preferences, the actor managed to agree upon one single standard in the end.[88] However, for the recordable versions, different incompatible variants emerged. Soon, DVD technology will have its successors: Blu Ray and HD DVD are two proposed systems to store high-definitions films on a disc of a similar size.

The interesting dynamics of this field, and the fact that there are successful patent pools, make it an interesting case for this study.

9.2.1 The development of (read-only) DVD technology

To understand the development and different standards for DVD-recordable, and to understand the dynamics of the different standards, it is essential to take a closer look at the history of the DVD standard itself. As will be shown later, the actors who played a major role in that process will later be key actors in the forking of recordable media standards.

When the question concerning a CD technology successor offering enough capacity to hold high-quality multimedia data arose in the early nineties, a technology race between two competing parties began to develop a suitable format. The two formats resulting from this were the Super Density (SD) digital video disk format stemming from the “TAZ” project supported by Matsushita, Toshiba and Time Warner and the MultiMedia Compact Disc (MMCD) format supported by the original CD technology developers Sony and Philips. Both formats differed in technical specifications and capacity. While the SD presented a double-side approach with 5GB of data to be stored per side, the MMCD could hold 3.7GB of data, was single-sided in design and closer to the already established CD technology. Apart from differences in storage capacity technical differences concerned the approach to either use a single substrate layer with a thickness of 1.2 mm or two substrate layers with a thickness of 0.6 mm bonded together by an adhesive. The former proposed in the MMCD format was significantly closer to CD Technology, while the latter proposed in the SD format was radically different from the technology used in CDs.

Apart from technical design both formats differed in the support of highly networked adjacent actors that could influence the success or failure of either technology. Whereas on the one hand the motion picture industry preferred SD, due to a

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[87] The LaserDisc (then called DiscoVision, also known as VideoDisc) was introduced on the market in 1978 by MCA/Philips. That is several years before the CD, that was introduced in most world markets in 1983. Altough the lLaserDisc already employed many of the (optical) technologies that made CD a success, the number of VideoDisc users remained limited.

[88] See, for instance, Taylor (2000).

foreseeable support by Time Warner and the higher storage capacity, the manufacturing industry on the other hand favoured MMCD, since the technology was closer to CD which meant that production facilities needed only slight modifications (Bell, 1996; Lemos, 1995).

This posed a threat to both developer camps. If the movie industry would stick to SD, while manufacturing industry would opt for MMCD, this could lead to a situation in which the supply of content stored on SDs (i.e. movies) would face a possible shortage of playback devices. In the other scenario, which closely resembles the VHS/Beta fiasco, MMCD devices sales would be slow due to a shortage of content. In both situations the utility of the end users would on the whole be sub-optimal to one common standard which could lead to effects of excess inertia (Farrel & Salooner, 1986) in sales of both devices and media. Being aware of those problems both parties initiated a working group consisting of mayor ICT players like IBM, Microsoft, Intel and HP to mediate a solution. By the end of 1995 this group, known as the Computer Industry Technical Working Group (TWG), proposed a unification of both specifications to circumvent the possible danger resulting from two separate standards (CE, 2004). This compromise contained the main assets of both parties adopting the two-substrate approach proposed by SD while implementing the 8/16 modulation of MMCD and was called “Digital Versatile Disc” (DVD). Still the pressure of both computer industry and content providers remained.[89] We will show later that this is one of the factors leading to a forking of DVD recordable standards.

Relevant Actors in the DVD recordable standard-setting process

Before we start to analyze the process of standardisation in DVD recordable technology it is necessary to first examine the relevant actors involved. The constellation of the actors in the different consortia shows a distinct pattern that corresponds to structures in the pre-DVD era, with the MMCD supporters backing the “plus”-standards (DVD+R and DVD+RW) and the former SD supporters backing the “slash”-standards (DVD-RAM and DVD-R). Even though there are numerous consortia that are relevant in the context of promotion of optical technology, four consortia are of high relevance for the standard-setting process of DVD recordables. These four consortia are the DVD Forum, the DVD+RW Alliance, the DVD6C and the Technical Committee 31 of the European Computer Manufacturers Association (ECMA TC31). Apart from the vital role those consortia play in the standard-setting process of DVD recordables, is their membership structure that make them an important factor for the dynamics of standards as they represent the competitive parties in the DVD standard war (DVD6C, DVD Forum and DVD+RW Alliance) and a consortium, the ECMA TC31 that is an A-Liaison partner of the ISO JTC1 and consists of members from both competing parties.

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[89] This is reflected by the fact that the first DVD specification 1.0 proposed in 1996 did not include critical facts concerning copy protection mechanisms since the actors could not reach agreement on that issue.

The DVD Forum

The DVD Forum, an industry consortium founded by the IPR-holders of the DVD technology, is responsible for the approval of the official DVD Books. Like in CD-R(W) technology, those “books” contain the specifications by which the DVD media are to be produced. The books do not contain specifications on how reading or writing devices have to be built and only refer to physical or file system specifications or methods concerning storage of certain data representations (i.e. audio recording, video recording and stream recording). Originally founded by the ten companies holding assets in form of Intellectual Property Rights, the DVD Forum opened in 1997 for other companies from consumer electronics and computer manufacturers, as well as content developers like the movie industry to extend the acceptance of DVD technology and further legitimize their position as the standard-setting consortium for DVD and DVD-related products. The DVD Forum Core Members are Hitachi, Matsushita, Mitsubishi, Pioneer, Philips, Sony, Thomson, Time Warner, Toshiba, and JVC. (Note: an overview of all members of the different relevant organisations is given at the end of this case, in Table 7.)

All specifications to be included in an official DVD technology format are passed to a Working Group which is responsible for developing and in the final instance deciding on the specifications and revisions of standards. The Technical Working Groups for the DVD-RAM format specifications are WG5 (Physical Specifications for DVD-RAM) and WG6 (Physical Specifications for DVD-R(W)) in the case of DVD-R and DVD-RW.

9.2.2 The writable variants: a fork between different standards

Whereas for DVD-video the stakeholders managed to agree upon a single standard, the paths started to diverge for the recordable variants of DVD. Below, we discuss the two main camps, which we will call the ‘plus’ camp (including Philips and Sony) and the ‘minus’ camp (with Hitachi, Matsushita, Mitsubishi, JVC, and others). We will also pay attention to the ECMA Technical Committee, which formally administers the official standards in this field.

The ‘plus’ camp (DVD+RW Alliance)

When in early 1997 the DVD Forum was about to decide on recordable DVD formats, the once unified position adopted in the DVD-ROM standard-setting process seemed to crumple. Even though unanimous agreement had been reached on DVD-RAM as the official standard for rewritable media, Sony, Philips, HP, Mitsubishi, Ricoh and Yamaha officially announced that they had another specification for a rewritable disc, which they named DVD+RW. This specification had been developed without approval of the DVD Forum and announcing it was, from the point of view of other DVD Forum members, out of the question. As a reaction, the DVD Forum announced that the format proposed by those firms would not be supported by the DVD Forum. They even added that the proposed format must not hold the prefix “DVD” since it was not supported by the DVD Forum and hence should be called Phase Change ReWritable

(PC-RW). This position has not changed since then as a notice on the DVD Forum website proves: “Please note that the "+RW" format, also known as DVD+RW was neither developed nor approved by the DVD Forum. The approved recordable formats are DVD-R, DVD-RW and DVD-RAM.” I[90]

A few months later, in June 1998, the DVD+RW Compatibility Alliance, which would later be renamed DVD+RW Alliance, was founded by Philips, Sony, HP, Yamaha, Ricoh and Thomson while at about the same time Philips, Sony and HP started to offer joint licensing of their DVD relevant assets (see section 9.2.3, below). The reason for the split-off can best be explained reverting to pre-DVD time described above. On closer inspection it can be seen that the key players of MMCD are more or less congruent to the major IPR-holders of the DVD+RW Alliance. Apart from Sony and Philips, the other members like Thomson or Yamaha did not hold significant IPR, but ranked as very important allies since they could provide a high amount of manufacturing capacity, especially Ricoh and Yamaha who like Sony and Philips had a reputation for building CD-R devices. The IPR included in the spin-off DVD recordable format proposed by the DVD+RW Alliance did significantly stem from older assets of Philips and Sony – their patents concerning CD-R technology. Reimplementation of these patents held some interesting aspects for Sony and Philips.

With ongoing diffusion of DVD recordable technology and gradual replacement of CD-RW technology as the main storage solution, Philips and Sony could position their “old” IPR which otherwise might have been rendered worthless in the long run, due to declining relevance of CD-R and declining production. So, by re-implementing their IPR assets from the older CD-R technology into the new DVD recordable technology, they “relaunched” the value of their IPR by gathering license revenues from established CD-R technology and the upcoming DVD recordable technology as well. Even “if” CD-R technology would become less important over time and manufacturers abandoned the standard, they would still be left with the revenues from +R(W) technology at the minor additional R&D expense they had to invest to bridge the gap from CD-R to +R(W). Another incentive to split the DVD recordable standard stemmed from the actors who actually hold no IPR assets in DVD technology – the manufacturers of blank media - as they could produce at much lower costs since the +R(W) technology was technically closer to CD-R(W) (Spath, 2003). Thereby the “plus” camp would have the chance to challenge the “slash” camp via the blank media producers entering the market at a lower price which in turn could spur the sales of the recording devices to be produced by Sony and Philips.

Apart from the chance of re-using old IPR assets another factor was relevant in the split-off of the DVD+RW Alliance, namely the influence of the movie industry in the DVD Forum whose representatives massively slowed down the process of large capacity DVD WORM Media by demanding a solution for copy-protection. The

[90] To be found at: http://www.dvdforum.org.

founding members of the DVD+RW Alliance are Philips, Sony, HP, Yamaha, Ricoh, and Thomson. Later, these firms were joined by Dell, Verbatim, and Microsoft.

The ‘slash’ camp

With the DVD+RW Alliance founded in 1998 and Sony, Philips and HP offering joint licenses, the position of the former SD camp shifted. To counter the position of the DVD+RW Alliance, seven companies established a patent pool to simplify the process of licensing (see section 9.2.3, below). As can easily be observed, the DVD+RW Alliance and the DVD6C Patent Pool are completely disjunctive. Another interesting fact is that Pioneer is neither part of the DVD+RW Alliance nor the DVD6C, but is a founding member of the DVD Forum. The Members of the DVD6C patent pool are Hitachi, Matsushita, Mitsubishi, JVC, Time Warner, Toshiba, and IBM.

This patent pool only covered patents regarding the “official” formats supported by the DVD Forum and did not cover the IPR assets of Sony, HP and Philips. “The license does not include +RW recorder patents, and such patents need to be individually licensed by member companies, although +RW function only recorders that have DVD Player function shall be licensed under DVD-ROM/Video essential patents as DVD Players.”[91] This meant that products concerning the original DVD Technology had to be licensed in both camps, while the patents for recordable DVD technology had to be licensed by either the DVD6C in case of the official “slash”-format or with the the DVD+RW Alliance in case of the unofficial “plus”-format.

The ECMA Technical Committee 31

Another important factor for the analysis of the dynamics of DVD recordable standards is the constellation of the Technical Committee TC31 of the ECMA. The ECMA as an industry association dedicated to standardisation in ICT technologies plays an important role in the standard-setting processes of DVD recordables. This is due to the fact that the standardisation processes of DVD recordables follow a unique pattern of consecutive information flows, with the ECMA acting as an intermediary between the consortia level in terms of specifications developed and the formal level of standardisation on international level represented by standards filed with the JTC1 of the International Organisation for Standardisation (ISO). For all the media types analyzed, the same conditions apply, regardless of the consortium the standard is proposed by. The process starts at the basic level of specifications. When agreement is reached in one of the consortia, the standards are proposed to the TC31 of ECMA and in a later process proposed to the SC 23 of JTC1 of ISO. This approach has some strategic reasons since the ECMA is a liaison partner of JTC1 which implies that standards filed with the ECMA can be put forward by the so-called “fast-track” using the Accelerated Approval Procedure (AAP) of the ISO. This procedure allows an ECMA standard to be placed at the Enquiry Stage, leapfrogging early stages of

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[91] Press release DVD6c (19 November 2002). ‘DVD6C Starts to License Recordable DVD License’.

the ISO standard-setting procedure. Taking a closer look at the assemblage of the TC31 one might notice that nearly all core members of the DVD6C and the DVD+RW Alliance are part of this group. Another striking feature is that all ten founding members of the DVD Forum are represented in the TC31.

This structure is important when considered along with regularities of the ECMA concerning the premature stop of a standardisation project, as the statutes of the ECMA stipulate that an ECMA standardisation project can not be stopped as long as three members of a technical committee keep supporting the project. As both camps are represented with at least 5 members, neither camp could stop the other from keeping an ECMA standardisation project running till the project is being finished and an ECMA standard established. Once an ECMA standard is agreed upon, the camp can chose to fast-track it to the ISO. This means that at all times both camps had the chance to formally standardize the full range of their technological achievements. We have to keep this in mind for later analysis.

Before describing the actual changes in DVD recordable standards, it is necessary to clarify the connection of the membership structure of the four relevant consortia, how the actors are linked to the different technologies and how the technologies are again linked to each other. So we have three levels of interrelationship that will prove relevant for the dynamics of standards. The level of a) technology-standards relationship (which technologies are similar and are incorporated in which standard) [92] , the level of b) standard-consortia relationship (which standard is supported by which actors) and the c) consortia-actor relationship (how are the actors linked in the consortia). All three levels are represented in Figure 1. The level of technology-standards relationship is given by the arrows that connect the boxes which hold the different standards.

The level of standards-consortia interrelationship is indicated by the names of the supporting consortia next to those boxes. Finally the level of consortia-actor relationship is indicated by the names of the different consortia members and the membership of the actors in the ECMA TC31 separately indicated.

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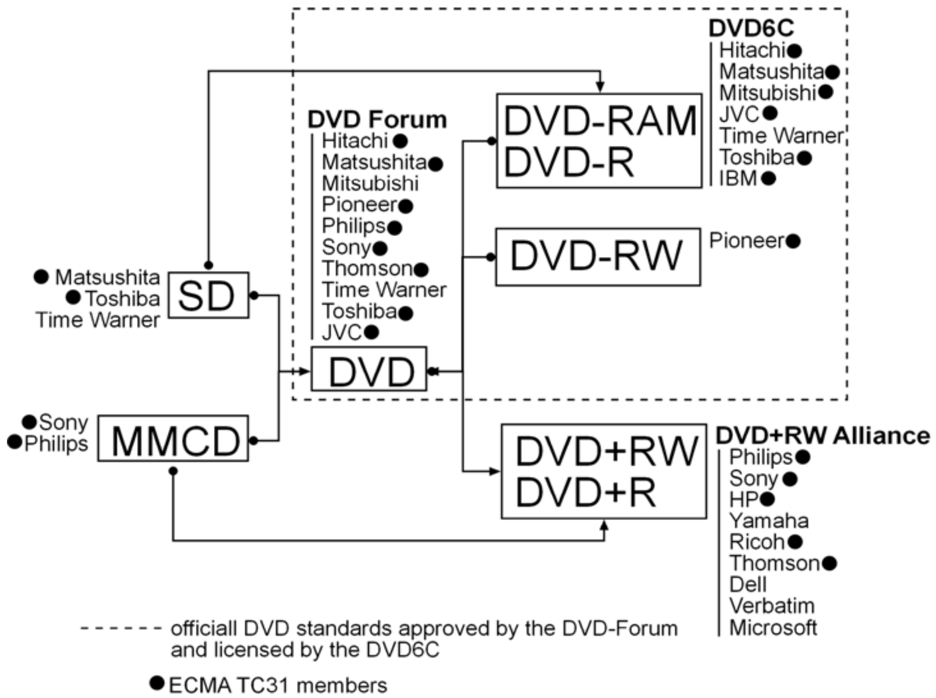
[92] This does not imply that the different technologies are not highly interrelated. Obviously as all those standards stem from the DVD standard by path dependencies and, as we have discussed above, there are significant connections of the different technologies on an abstract level. The point to be made here is that some technical aspects of pre-DVD technology (SD and MMCD) can be found only in either the “slash”-standards while others can be found only in the “plus”-standards.

Figure 4: Relationship of standards, consortia’s and actors in context of DVD recordable standardisation



On the level of the technology-standards relationship we can see that both the MMCD and the SD technology are implemented in the DVD standard. Both technologies have, as mentioned before, been merged into one standard. Moreover, the technology used in the SD approach is related to the technology of DVD-RAM and DVD-R, while the MMCD technology, to be more precise old CD-R(W) technology, is implemented in the DVD+R and DVD+RW standards. This accounts for a “merge-split”-relationship of the standards as SD and MMCD merge into DVD then DVD splits into different DVD recordable standards that reflect the pre-DVD split into MMCD and SD. This merge-split scenario is reflected in the level of standard-consortia relationship with the DVD Forum supporting DVD-RAM and DVD-R as well as DVD-RW, and the DVD+RW Alliance supporting DVD+RW and DVD+R. On the consortia-actor level we can see that the membership structure of the relevant DVD recordable consortia, at least to some considerable extent, represents the pre-DVD split into SD- and MMCD-supporting actors with Sony and Philips, the former MMCD supporters, forming a separate consortium to promote their own standard of DVD recordables. We now have set the initial boundary conditions, to identify the reasons for the dynamics of DVD recordable standards. Later, another important aspect will be introduced which has to be discussed separately. This aspect, the multiple implementation of different standards, will help explain how stable competition structures can lead to an ongoing technology race and thereby to ongoing revisions and dynamic standards. To discuss this we first have to identify the reasons for the dynamics of standards as such and then, by the concept of multiple implementation.

Table 7: Actors in the DVD standard-setting process and selection of membership

	SD	*MMCD*	*TWG*	*DVD Forum*	*DVD6C*	*+RW Alliance*	*EMCA TC31*
Philips		x		x		x	x
Sony		x		x		x	x
Thomson				x		x	x
Dell						x	
HP			x			x	x
Ricoh						x	x
Yamaha						x	
Verbatim						x	x
Hitachi				x	x		x
Matsushita	x			x	x		x
Mitsubishi				x	x		x
Pioneer				x			x
Time Warner	x			x	x		x
Toshiba	x			x	x		x
JVC				x	x		x
IBM			x		x		x
Intel			x				
Microsoft			x			(x)	
Apple			x			(x)	
Sun			x				
Kodak			x				
Compaq			x				
Samsung							x
Sharp							x
Fujitsu							x
Nec							x
Carvennec Consultants							x
Plasmon							x

9.2.3 Patent pools for DVD / MPEG

Producing a DVD player, a DVD disc or other DVD-related products involves many different patents by different owners. Two pools initiatives have been taken to bundle licenses for essential IPRs for DVD. These pools are discussed below, as well as other relevant IPR that is not in those pools.

The '3C DVD' patent pool

In December 1998, Philips, Sony and Pioneer received a comfort letter from the US Department of Justice for establishing a patent pool for DVD-ROM and DVD-Video patents.[93] (Note that all 'DVD-3' patent pool members are key members of the later DVD+RW Alliance.) At a later stage, LG joined the 3C DVD pool. In this pool, Philips acts as a licensing administrator for patents held by all three companies: 115 patents in all for the manufacture of DVD players, and 95 for the manufacture of the discs themselves. At that time, the pool only included patents with filing dates before 31 December 1996. Bundle fees are set as follows: *'Player license per-unit royalty is to be 3.5% of the net selling price for each player sold, subject to a minimum fee of $7*

[93] This comfort letter is available at http://www.usdoj.gov/atr/public/busreview/2121.htm.

per unit, which drops to $5 as of January 1, 2000. The Disc License royalty is to be $.05 per disc sold. […]'.

Though this arrangement is usually referred to as a paten pool, it best first under the heading of 'joint licensing program' of our more detailed categorisation (Section 7.4). On their web page, Philips offers an overview of joint patenting programmes regarding DVD technologies (sometimes in slightly different forms constellations).[94]

The 'DVD-6C' patent pool

In June 1999, the group calls itself the DVD-6C Licensing Agency received a similar comfort letter from the US Department of Justice for setting up and patent pool.[95] At that time, its members were Hitachi, Matsushita, Mitsubishi, Time Warner, Toshiba, and JVC. Again this pool was for the DVD-ROM and DVD-Video formats. IN this case, Toshiba was acting as the licensing administrator, sublicensing the essential patents of others as a bundle. Bundle fees are set as follows: *'The underlying Authorisation Agreement requires Toshiba to charge royalties of $.075 per DVD Disc and 4% of the net sales price of DVD players and DVD decoders, with a minimum royalty of $4.00 per player or decoder.'.*

At a later date, essential patents for newer standards (most notable DVD-R and DVD-RW, i.e. the 'slash' or 'minus' formats) were also added to the pool (in separate bundles). IBM joined as a licensor, but left again when its DVD-related patents were bought by Mitsubishi. In 2005 also Sanyo and Sharp followed this example, raising the number of licensees to eight. By now, there are no less than 377 licensees. Nowadays, Hitachi and Panasonic now act as regional agents for certain world regions, while Toshiba is the licensing administrator ion other regions. In 2003, the pool substantially reduced its fees.[96]

Though this arrangement is usually referred to as a paten pool, it best first under the heading of 'joint licensing program' of our more detailed categorisation (Section 7.4). An interesting overview of similarities but also differences between the two DVD patent pools is given in Kelly, 2002. It is remarkable that the same firms that are in different patent pools for DVD, are all happily together in the MPEG-2 pool (see below).

The MPEG LA pool

The DVD standards, as discussed in this case, essentially describe the way data is stored on the disc. It does not specify, however, how that data is coded, the DVD standards merely refer to other existing coding standards. The most important one in

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[94] See http://www.licensing.philips.com/licensees/patent/dvdrw/.

[95] This comfort letter is available at http://www.usdoj.gov/atr/public/busreview/2485.htm.

[96] The reader is referred to http://www.dvd6cla.com/news.html for details.

this context is MPEG-2. In fact, every DVD video player will need to implement MPEG-2 to be able to play regular DVD videos.[97]

For MPEG-2 (which in fact has wider use than DVD discs only), a patent pool has been established as well. In contrast to the joint licensing programmes of DVD-6C and 3C DVD, this is a Patent pools with a licensing administrator (subbed pool model 2 in Section 7.4). It was an independent, external organisation, known as the MPEG Licensing Authority, that set itself the aim to develop a patent pool for this standard. This organisation published a open call, inviting any party that believed to own patents essential to MPEG-2 (in fact, the video coding part only) to join the program.

In June 1997, the MPEG LA received a comfort letter from the US DoJ, to establish a patent pool for the MPEG video standard.98 Take-up was quick, and now the pool includes 25 licensors, 134 unique patents and 1021 licensees.[99] After establishing the MPEG-2 pool, the same licensing authority started calls for other (sometimes related) standards too, and currently administers pools for six different standards, and has pools for another five standards in the making (see Section 7.5.2 for more details). As such, it seems to have developed a repeatable and sustainable model of establishing pools, which as been followed by ViaLicensing, that has developed into a similar of licensing authority now.

Other relevant patents for DVD

Apart from the pools mentioned above, there are a other patents relevant for producer of DVD-related products. Dolby offers licenses for those that wish to implement Dolby Digital in their DVD players. Both Thomson and DiscoVision own patents involving optical disc technology, and each is looking to collect separate royalties. There is also a licensing fee for a copy protection system used within a DVD player[100], and the DVD Format/Logo Licensing Corp collects licenses for those using the DVD logo's.[101]

Nevertheless, if we look at the pool and take their focus into consideration – essential patents for the DVD standards (excluding possible audio/video coding systems), then we have to conclude that by far, the large majority of relevant patents is inside one of the two pools.

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[97] Theoretically, the MPEG coding functionality could be left out if it concerns a DVD-ROM drive only and the user does not wish to be able to play standard DVD videos from it.

[98] The review is available at http://www.usdoj.gov/atr/public/busreview/1170.htm.

[99] Among these licensees there are quite some legal entities that appear to be a part of the same organisation.

[100] http://www.nerd-out.com/forum/viewtopic.php?p=76179&sid=b83eed6530c14555980d6d1e36a78b58.

[101] http://www.dvdfllc.co.jp.

Pressure on the DVD pools

But even when designed with care, and having received a comfort letter, patent pools can still be attractive targets for litigation. The 3C DVD patent pool found itself the defendant in a national class action law suit in 2004, and of another suit (this time brought by two Chinese DVD manufacturers) in January 2005.[102]

Underlying reason is that manufacturers in countries like China find the current total license fee of approx. 20 US$ for a DVD player too high.[103, 104] There are also concerns from DVD replicators, as articulated in 2002.[105] DVD-6C seemed to have responded to such urges to lower prices more than 3C DVD. In March 2006, The International Optical Disc Replicators Association (iODRA) has lodged a formal complaint with the European Commission over the royalty rates charged by DVD patent holders. In its submission to the Competition Directorate-General, the trade association cites three patent pools: the DVD6C, DVD3C and MPEG-LA licensing agencies.[106]

Such pressure is not unique. The MPEG-4 pool also was criticized (See also Note 166, below) and the company 2on legally challenged the MPEG-4 pool.[107]

9.3 Case Second- and third generation mobile telecommunications (2G/3G)

Telecommunications can be seen as a prime example of a market where interoperability is at stake. As we will see, there is nowadays an intensive patent activity in this sector, possibly making it an interesting sector to implement patent pools. As telecommunications is a broad sector in itself, and most patent-related academic studies are about mobile telecommunications, we will also focus on that sub-field. In fact, the field of mobile telecommunications is perhaps the field in which problems with patents in standards have been the most visible. Given the European perspective of this study, and the fact that Europe has shown to particularly

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[102] See Sony Corporation, Pioneer Corporation, Philips Electronics and the 3C DVD Patent Pool (22 June 2004), available at https://www.lawyersandsettlements.com/case/sony2; Lawsuit Filed on DVD Patent Pool, (China Daily January 20, 2005); http://64.233.179.104/search?q=cache:Tbqd14-_xdUJ:www.china.org.cn/english/BAT/118335.htm+%22patent+pool%22+dvd&hl=nl&gl=nl&ct=clnk&cd=9; The Register. 'Chinese manufacturers sue DVD patent pool' (25th January 2005). http://www.theregister.co.uk/2005/01/25/chinese_dvd_maker_lawsuit/; and Appliance magazine (29 December 2004), Complaint Filed Against DVD Patent Pool, available at http://www.appliancemagazine.com/news.php?article=7901&zone=0&first=1.

[103] Note that this fee can also involve non-essential IPR, or essential IPR that is not included in the patent pools.

[104] http://www.china.org.cn/english/BAT/118335.htm.

[105] See International Optical Disc Replicators Association (2002), 'Royalties Payments Concern Replicators', available at http://www.iodra.com/news_stories.php?news_id=4.

[106] http://www.cdrinfo.com/Sections/News/Details.aspx?NewsId=14929

[107] http://www.on2.com/pressreleases.php3?qs1=on2_chalenges_existence_of_mpeg4. A position paper of the challenging company is at http://www.on2.com/news_position_paper.php3.

successful in that market, we will also focus on the European standards for mobile telecommunications, GSM and UMTS.

Below, we will first discuss patenting for second and third-generation mobile telephony systems (section 9.3.1 and 9.3.1, respectively). In 9.3.3 we discuss pool initiatives for mobile telecommunications.

9.3.1 Patents in GSM, the European second-generation mobile technology

Patents were very important during the earliest days of telecommunications, but they lost most of their significance in the period between approx. the second world war and the 1990s. (For a more elaborate introduction to this, the reader is referred to Appendix 1). The re-introduction of patents in this field is linked to the advent of GSM Europe's second-generation standard for mobile communications.

In the second half of the 1980s and the first half of the 1990s, GSM was developed and introduced. This technology is generally considered to be one of the largest technological successes in European history. The technology has been successfully exported to almost all world regions, accounts for approx. 75% of all the worldwide market and early 2004, the number of GSM subscribers passed the 1,000,000,000 mark.[108] It is widely recognised that a number of European manufacturers as well as network operators (notably Vodafone) have benefited greatly from the GSM standard.

It was also the development of GSM that totally changed the role of patenting in the telecommunications sector. That is the main reason why we will focus on this technology here. While we do not want to deny that patent-issues were relevant for other second-generation mobile standards too (e.g. D-AMPS, PDC, cdmaOne), the GSM story learns us most of the issues at stake, and is also the best documented development in that context. In this section, we will briefly discuss the issue of IPRs in GSM. We assume that the reader is already acquainted with the main phases in the development of the GSM standard; those that are not, are referred to Hildebrand (2002) and Bekkers (2001/2001a). When considering IPR in GSM, we can broadly define five different phases:

- Early concerns about IPRs in GSM (1980 – 1987)
- Attempts by operators so secure access to IPRs by procurement contracts (around 1988)
- The bilateral licensing progress and the exclusive club of GSM manufacturers (1990-1992)
- Adoption and revision of ETSI's IPR policy (1993 - 1994)
- Broadening access to patents, as well as surfacing new patent claims (1995 and later)

We use these phases to structure our discussion below. After that, we conclude with an analysis.

[108] Data from the GSM Association (www.gsmworld.com), consulted 9 December 2005.

Early concerns about IPRs in GSM (1980 – 1987)[109]

The initiative for GSM was taken in the so-called Conférence Européenne des Administrations des Postes et des Télécommunications (CEPT), an organisation that comprised all European incumbent telephone operators. Manufacturers initially regarded this development with fear. They dreaded the risks associated with the high development costs, and feared Japanese competition if a common standard would be defined. Network operators therefore realized that they needed to reduce the perceived uncertainties of the suppliers. Fourteen network operators then signed the so-called GSM Memorandum of Understanding (MoU), committing themselves to procure GSM networks. As a result, the reluctance of manufacturers changed into enthusiasm when the potential market size of this standard became apparent.

Research indicated that digital technology would best fulfil the capacity and cost/performance demands of the operators, although the final decision for a digital system was repeatedly postponed. Germany and France strongly subsidized the development of suitable technology, hoping to ensure a leading position for their national industry. In an attempt to create a head start for their national industries, Germany, France and Italy signed an agreement for the adoption of an identical, digital standard. This way, they were forcing the CEPT to adopt a digital standard, and they expected that such a standard would be based on one of the technologies developed by German and French suppliers.

However, actors from other countries presented technically less challenging designs that better suited networks in areas with medium traffic densities, whereas the German-French proposals were designed with high traffic densities in mind. After laborious technical discussion, comparing various proposals, the operators finally rejected the German-French proposals, and decided upon a system that was largely based on a proposal that had been submitted by Ericsson. However, this choice was difficult to accept for the governments of Germany and France, and political talks on the highest level were held to prevent those two countries from stepping out from the GSM project altogether. These talks, and diplomatic arrangements between suppliers that secured that certain German and French suppliers could also play an important role in the selected technology eventually made the technology choice acceptable for these two countries.

During the period of the development of the various technical proposals, actors became increasingly aware of the imminent danger of IPRs. One of the reasons for the rejection of the German-French proposal was indeed that it was considered to be ‘too proprietary’.[110] In 1988, under great pressure from the EC, the GSM project was transferred from the CEPT to the newly established European Telecommunications

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[109] Parts of the following text are drawn from Bekkers, 2001.

[110] Cattaneo (1994, p. 63). It is not clear whether she refers to property rights owned by members of the SEL/Alcatel consortium, or more generally to the head start that consortium members would have if this technology was selected. Nevertheless, both situations were undesirable for other actors (see also Iversen, 1999, p.93).

Standards Institute (ETSI).[111] ETSI aimed for a general policy concerning IPRs, but this came too late to serve the GSM project.

Attempts by operators so secure access to IPRs by procurement contracts (around 1988)

Aware of the risks that IPRs could constitute for them, the main European operators issued an invitation to equipment suppliers in 1988 to tender for network equipment. These operators, acting together in the GSM MoU, produced a draft procurement procedure in which manufacturers were essentially forced to give up all their IPRs and to provide for free world-wide licenses for essential patents (Garrard, 1998, p. 139, Cattaneo, 1994, p. 64, Good, 1991, p. 402, and Wilkinson, 1991, p. 97). This arrangement was found to be unacceptable by many manufacturers and resulted in a dispute that threatened the entire GSM program. Especially Motorola from the US, which was heavily involved in the development of GSM, stood up against the attempted imposition (Garrard, 1998, p. 140, Wilkinson, 1991, p. 197). Under pressure of the manufacturers, the intended provisions of the operators were dropped. However, in a Musketeer's Oath approach, a number of operators required the suppliers of their network to sign a declaration in which they agreed to serve the whole GSM community, both suppliers and operators, on fair, reasonable and non-discriminatory conditions. Companies that decided not to accept this condition, as Motorola did, were not entitled to supply equipment to those operators, but thereby prevented a restriction of their rights.

The bilateral licensing progress and the exclusive club of GSM manufacturers (1990-1992)

In the early 1990s, however, when the first networks were being supplied to the operators, the IPRs problem peaked when Motorola refused to grant non-discriminatory licenses for its sizeable portfolio of essential patents that turned out to be essential for GSM. Motorola was only prepared to enter into a limited number of cross-licenses with selected parties, and also limited the geographic scope of such licenses to Europe. For the companies involved in these agreements, this cross-licensing reduced market risks. However, for those not involved, it created barriers to enter the market. Several companies, including Matra from France and Dancall from Denmark, made unsuccessful attempts to secure licenses. Of the many Japanese

[111] The European Community recognized that the GSM standard would greatly facilitate the strongly wished harmonisation in this sector, but regarded the CEPT not as the most appropriate body to set such a standard. One reason was that the CEPT was only open for network operators, not for other actors involved in GSM such as manufacturers and candidate privately owned operators. The CEPT and its member states reacted by transferring the standardisation to the ETSI: a newly established standards body that meets all the requirements of the EC. With this new body, the GSM standardisation moved to a more institutionalized and more transparent environment.

companies that showed very promising prototypes of GSM terminals around 1992, almost none succeeded to get all the necessary licenses within the first few years of commercial success of the GSM standard.

The behaviour of Motorola strongly influenced the supply market structure in the sector, but could not obstruct the success of the standard. European regulations resulted in two or more GSM operators in each EC member state, and GSM subscribers grew tremendously in all countries, especially from 1994 onwards. On the supply side, virtually all equipment was supplied by the companies that took part in the cross-licensing scheme: Ericsson, Nokia, Siemens, Alcatel, and Motorola. Many countries world-wide expressed their preference for GSM, and this forced Motorola to lift the regional restrictions in its licenses. With the use of IPRs, Motorola succeeded in having an interesting revenue stream even though it could not offer switching subsystems and even though it knew that its market prospects were restricted. With the internationalisation of GSM, non-European suppliers such as Lucent (former AT&T) and Nortel started to play a more active role, but never surpassed the success of the five champions. In the late 1990s, a number of non-European firms (especially from Japan) finally managed to obtain all the necessary licenses to build GSM terminals, but it will be difficult for them to catch up. For suppliers, the participation in cross-licenses turns out to be essential to obtain a strong market position. First of all, companies that do not succeed in securing all the necessary licenses simply cannot market products. It is generally held that this kept many potential Japanese and smaller European suppliers from the GSM handset market.[112] This is also the case for many smaller European suppliers.[113] Secondly, those firms that do succeed in getting all the necessary licenses, could be forced to pay a premium price for them. Sometimes, IPR holders are only prepared to sell a full bundle of patents that in fact only contain a few essential ones. Our own research has indicated that the cumulative fee paid for GSM handset licenses is very high, and this was recently confirmed by the actor director of the ETNO[114], who revealed that royalty fees make up to 29% of the costs of GSM handset.[115] Such prices make competing very difficult for those companies that are not participating in the cross-license fees.

[112] Cattaneo G. (1994). The making of a Pan-European network as a path-dependency process: The case of GSM versus IBC (Integrated Broadband Communications) network. In G. Pogorel (ed.). Global Telecommunications Strategies. Amsterdam: Elsevier Science, p. 68, Garrard, G.A. (1998). Cellular communications: Worldwide market development. Norwood, MA: Artech House, p. 140, and Donegan, p. (1995). A priority for the EU review (editorial). In Mobile Communications International, September/October 1995, p. 3.

[113] For example, one of the first companies to develop a GSM handheld phone, Dancall from Denmark, is reported to have filed a complaint with the Commission of the EC, in a desperate attempt to eliminate its competitive disadvantages. Pelkmans, J. (1999). The GSM standard: Explaining a success story. Manuscript submitted for publication.

[114] ETNO: European public Telecommunications Network Operators' association.

[115] 3G patent initiative devised to avoid ‘Qualcomm-type’ disputes. (19 June 2000). TotalTele. Retrieved 4 july 2000 from the World Wide Web: www.totaltele.com.

Adoption and revision of ETSI's IPR policy (1993 - 1994)

The GSM experience made painfully clear that is was not obvious anymore that any party holding IPRs for telecommunications standards, drawn up by official bodies, would be prepared to license these IPRs to all interested parties, under terms and conditions that are undisputed. Knowing this, ETSI members started to exert pressure on this standards body to develop an IPR policy that would prevent what they considered to be abuse of patents. Although the development of this policy is, strictly regarded, not specifically linked to the GSM standard, it was clearly induced by problems that had surrounded GSM, and designed to prevent such problems to repeat themselves. However, looking back, the development of this policy is still typical for the period of 2G communications systems, and therefore included in this section of this report.

ETSI started working on the a patent policy around 1990, and very early drafts of what is known as the ETSI IPR Policy and Undertaking were rather extreme, including compulsory licensing, among other things. They were drawn up in the direct aftermath of the GSM dispute, and may therefore be regarded as an overreaction to this experience. The Commission of the EC, stressing that such practices could be incompatible with both the Paris Convention of 1883 and with WTO rules, exerted pressure on ETSI to come to a more acceptable policy.

In March 1993, ETSI brought its IPR Policy and Undertaking to vote on the General Assembly of its members. The policy in question is best characterized as 'licensing-by-default': unless specific actions are taken, an IPR holder automatically agrees to license on fair, reasonable and non-exclusive conditions. This is in strong contrast with the practices from other standards bodies, where a firm must explicitly agree to license its IPR.[116] The policy was approved by a large majority. It should be noted, however, that the voting structure in ETSI was such that the voting national delegations were often dominated by national operators (usually not owning IPRs themselves). The European manufacturers present in ETSI did not want to antagonize these operators, because they were heavy dependent of sales to these operators.

The approved policy, however, met a lot of resistance worldwide. Many actors pointed to weaknesses and undesired effects on the short and of the longer term. The US government started an intensive lobby to have the ETSI IPR-policy annulled, and the policy became the subject of trade negotiations. The European Commission was hesitant to provide the requested clearance to ETSI that the policy was not incompatible with European competition law. A powerful US trade body, CBEMA, filed a formal complaint with the EC Commission Competition Authorities, and more than a dozen ETSI members informed ETSI that they would terminate their membership if the policy were to be implemented. Given the growing pressure, the General Assembly of ETSI decided not await the verdict of the Commission and

[116] For the main provisions of this policy, see Bekkers, 2001.

abandoned its original policy. It adopted a less far-reaching policy, known as the 1994 IPR Policy, which is still the basis for the current policy. This new policy requires members to notify IPRs they are aware of, but does not oblige members to license their IPR under RAND conditions. If a members refuses to license, even after several requests of ETSI to do so, ETSI has halt the development of standard, and look for ways to circumvent the use of that particular IPR.

Broadening access to patents, as well as surfacing new patent claims (1995 and later)

In the second half of the 1990s, GSM turned out to be increasingly successful outside Europe. In the US it competed with two other 2G standards (D-AMPS and IS-95 CDMA), but its market share vis-à-vis these competitors kept growing. GSM was also adopted in numerous other countries across the globe. This made it relevant for more and more telecommunications systems suppliers to include GSM products in their portfolio. As revenue generating opportunities increased, GSM license holders became more relaxed to license other firms. Over time, more and more manufacturers managed to license the necessary IPR, including American, Japanese and Korean firms in particular. Although some of these firms have managed to win considerable shares of the market (think of Samsung in the GSM handset market), it did not annul the head start that the firms had that managed to secure access to all necessary IPRs right from the beginning.

Incidents with GSM-related IPR do show, however, that the situation is still delicate. For instance, years after the first GSM products entered the market, InterDigital Technology Corporation (IDC) from the US claimed to own patents that were infringed by GSM products. In April 1995, the US Federal Court, however, ruled the claims invalid, making mobile telephone manufacturers around the world breathe a sigh of relief. By that time, InterDigital had already collected seventy million dollars from royalties. One year later, however, German Federal Patent Court upheld one of the InterDigital patents that was found invalid in the US. A more recent clash occurred more recently, when a firm challenged that certain Sun patents would be essential to specific ETSI standards. The firm claimed that it developed technology that was able to meet the standard but did not infringe on the Sun IPR. Sun, nevertheless, refused to withdraw its claim of essentiality in the ETSI IPR database. The European Commission urged ETSI to remove the Sun claim from the patent database, while ETSI quite understandably said that this was not within her power, and that Sun should withdraw its statement itself.

Analysis: what we learned from IPRs in GSM

The development of GSM was accompanied by the first large-scale patent disputes in telecommunications standards. The GSM case shows us that:

- Changed circumstances, both in general as in the telecommunications market in general, have lead to the more aggressive use of IPRs and to more pronounced IPR strategies.
- It is not obvious anymore that IPRs relevant to formal standards are available to everyone and at terms and conditions that are acceptable by everyone.
- Access to patents does, to a large degree, determine the ability of firms to compete on the market, especially in the earlier, most profitable period.
- Standard bodies are, for a variety of reasons, not in a position that allows them to adopt effective IPR strategies.

9.3.2 Patents in UMTS, the European third-generation mobile technology

The success of GSM, that in may ways by far exceeded the expectations at the various early stages during its development, set high expectations for UMTS. This does not mean, however, that during all stages all involved parties were very involved, and that the development proceeded without glitches. Again, IPR issues turned up high on the agenda of those involved.

Whereas the way GSM developed is widely known and often recorded, such information on UMTS did not (yet) reach a larger public. For the convenience of reader, a more detailed account is included as Appendix 2. Table 8 summarises that account by presenting a brief timeline of the UMTS development.

Table 8: UMTS timeline

Time	*Event*
Between 1990 to early 1995	Explorative R&D is conduced. The EU-funded RACE research programme output shows outline of UMTS technology (though no specific choices yet made)
1995 - 1996	EU is disappointed by the relatively low interest in UMTS by most commercial actors; the EU induces establishment of UMTS Task Force and UMTS Forum
1996 - 1997	Japan takes over the lead by a swift development and procurement of an experimental 3G network
1997	Renewal European interest as a response to the Japanese move; now also operators welcome a more energetic UMTS development
Dec 1997, January 1998	After fierce competition between several proposals, ETSI members manage to agree on the technological basis for UMTS. ETSI teams up with ARIB, TTC and other regional bodies and establishes 3GPP in order to make their regional efforts mutually compatible. A similar setting called 3GPP2, however, is developed for the competing MC-CDMA ('cdma2000') standard.
Early 1999	The ITU attempts to decide upon a single, worldwide 3G standard but fails to do so.
1999	The Operators Harmonisation Group manages to get the diverged 3G standards much closer, facilitating roll-out and interworking. They also solve some industry disputes, clearing the way for the roll-out of networks
Late 1999	Release of first full, stable version of UMTS: Release 99
2000-2001	Auctions or beauty contests are held for UMTS licenses in most European countries
2000 - now	Improving and refining the UMTS standard, new releases
2000 – now	Commercial product development and network procurement

When considering IPR in UMTS, we can broadly define three different phases:[117]

- Choosing the main technology basis for UMTS;
- Attempts to define IMT-2000 - a harmonised global 3G standard;
- Afterplay.

As with GSM, we use these phases to structure our discussion below. After that, we conclude with an analysis.

Choosing the main technology basis for UMTS

Having the IPR conflict with GSM in mind, all actors were very much aware that UMTS had a large potential for IPR problems too. Property right issues were widely cited as the most contentious problem that was foreseen with third-generation standards. European actors already are very much aware of the strong patent position of the US firm Qualcomm for CDMA technology, and expect this company to demand high license fees.[118] Some actors feared fees in excess of 10%.[119] Another interesting observation is that already before the decisions upon UMTS technology, the firms Ericsson and Qualcomm are already involved in a lawsuit concerning CDMA patents in the United States District Court for the Eastern District of Texas.

In late 1997 and early 1998, ETSI made the fundamental decision concerning the technological basis for UMTS. After preparatory work, five proposals had been developed, based on different technologies. The two most promising proposals were the so-called Alpha proposal, a DS W-CDMA technology backed by Ericsson, Nokia, Lucent and Motorola, among others, and Delta, a TD/CDMA system backed by Siemens, Alcatel and Nortel, among others. Both had their basis in earlier (pre)competitive European research projects, and the support for the two standards was, not surprisingly, strongly related to involvement in that research. Also, the Alpha proposal was very close to the technology already selected by Japan, and Ericsson and Nokia were involved in those Japanese activities as a supplier. Siemens and Alcatel were not, and would not benefit from such a head start if Alpha were chosen.

At the time of the technology selection, much attention was paid to the fact that a number of companies failed to provide ETSI with the requested IPR declarations and the possible consequences of this. In fact, industry experts warned that *‘If forced to pay stiff royalties, Ericsson and Nokia may be unable to afford the cost of developing and manufacturing third-generation W-CDMA systems’*.[120] At its SMG #24 meeting in Madrid, ETSI refrains from deciding upon the technology for UMTS, among other things because of unsolved IPR issues with the various proposals, and with the *alpha* proposal in particular. At the pivotical ETSI SMG 24*bis* in Paris on 28 and 29 January 1998, Qualcomm stated it believes to have a strong IPR position in both the Alpha and the Delta concept of UMTS. Siemens states that its investigations did *not* identify any Qualcomm IPRs for the *delta* concept. As discussed in more detail in the Appendix 2, the final technology selection was finally made on that same ETSI SMG 24*bis* meeting. The day right after the technology selection, 29 companies from around the world issue an IPR declaration in accordance with Clause 6.1 of ETSI’s IPR policy, thereby stating that they are prepared to grant irrevocable licenses on fair, reasonable and non-discriminatory terms and conditions. However, Qualcomm did not sign such a declaration.[121]

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[117] Note that we have chosen different phases here from those in Appendix 1, in order to focus particularly on IPR issues. One of the reasons for this choice is that during the period of the pre-competitive research, there is little to comment on IPR issues.

[118] A representative of Alcatel said at the ETSI SMG24*bis* meeting ‘*[...] in the case of one certain company outside the IPR pools [of alpha and delta] asking for 6% [license fee], a pool license agreement of other companies to keep license fees at 1%, would result in 7% license fees of total’* (ETSI, 1998f, p. 3). Without any doubt, this ‘one certain company’ here is Qualcomm.

[119] Sometimes called ‘double-digit’ fees.

[120] Quote given in *Mobile rivals prepare for Paris take-off. (19 January 1998). CommunicationsWeek International.*

[121] *Qualcomm hold out on 3G could stymie key ETSI agreement*. (30 January 1998). Total Telecom.

Quite soon after, it became rather clear that there were going to be serious problems: in a letter to ETSI in April 1998, Qualcomm states it was not prepared to sign ETSI's IPR statement concerning the IPRs it holds for the development of UMTS. The letter is a response to ETSI's request for clarification of Qualcomm's licensing position. At around the same time, thee were signals that backers of the competing cdma2000 technology (developed by Qualcomm) want the chip-rate of W-CDMA (set at 4.096 Mchips/s) to be identical to that of cdmaOne and cdma2000, i.e. 3.6864 Mchip/s.[122] This chip rate is a technical parameter that is quite at the hard of the system, and is the ' master clock' that times all operations in the system. The relevance of Qualcomm's desire is that when two systems have an identical chip rate, it would be much easier to develop chipsets and components that could support both technologies. Qualcomm could be interested in becoming a supplier of such chip sets (both for its own cdma2000 standard as for possibly for UMTS).

Now one of the firms holding an essential patent (and apparently even a lot of them) refuses to licenses on RAND conditions, the ETSI *ETSI's Rules of Procedure* determine that work on UMTS based on the selected W-CDMA (Alpha) technology had to be ceased,[123] [124] and ETSI would have to opt for a TDMA-based third-generation standard.[125] Nevertheless, in the months that followed there were no indications that ETSI actually did work towards a TDMA solution.

All, in all, by the summer of 1999, there is a clear deadlock: UMTS is strongly based on CDMA technology, while one of the biggest holder of IPRs for this technology is not prepared to license its patents to UMTS manufacturers.

Attempts to define IMT-2000 - a harmonised global 3G standard

In the summer of 1999, the ITU attempted to converge the different 3G developing techniques (partly also linked to different world regions) and to set a single, harmonised world standard (see the development account of UMTS in Appendix 2 for

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[122] *US locks swords over GSM successor*. (5 May 1998). Total Telecom.

[123] The ETSI Rules of procedure state that *'Where a member notifies ETSI that it is not prepared to license an IPR in respect of a standard, the General Assembly shall review the requirement for that standard and satisfy itself that a viable alternative technology is available for the standard which: (1) is not blocked by that IPR; and (2) satisfies ETSI's requirements. (Clause 8.1.1).* Where*, in the opinion of the General Assembly,* no such viable alternative technology exists, work on the standard shall cease*, and the Director-General of ETSI shall request that member to reconsider its position. If the member decides not to withdraw its refusal to license the IPR, it shall inform the Director-General of ETSI of its decision and provide a written explanation of its reasons for refusing to license that IPR, within three months of its receipt of the Director-General's request.*' (ETSI, 1998b (Rules of procedure), Clauses 8.1.1 and 8.1.2. Emphasis added.). Besides that, it is widely believed that Qualcomm holds essential IPRs for *any* implementation of CDMA technology.

[124] This is also confirmed by ETSI in a letter responding to US criticism that ETSI favoured European manufacturers: Open letter to Chairman Philip M. Crane, Retrieved 2 October 1999 from the World Wide Web: www.etsi.org/ press/ETSIOpenletter180898.htm.

[125] This conclusion was also taken by other observers; see, for instance, *ETSI responds to US criticism in adopting wireless standard*. (26 August 1998). Telecom A.M.

more details). To that end, they formally invited actors to submit candidate (radio) technologies. The invitation of the ITU for proposals was taken very seriously by all actors involved. All standards bodies that were developing third-generation standards took care they could timely submit a proposal. The ITU process also attracted wide attention from the public. ITU also made it clear that for any proposal to be accepted, it needed to be clear that licenses would be unconditionally available for RAND terms and conditions.

But what was supposed to be a masterpiece, came out as a big disappointment, mainly due to IPR issues. At the end of the day, the ITU was not able to decide. When in March 1999, the deadline was reached, two important firms, Ericsson and Qualcomm had still failed to declare that their licenses would meet those conditions. Unfortunately, despite insistence from the ITU, the ETSI and from mobile network operators all around the world, Qualcomm and Ericsson did not reach an agreement before this important ITU meeting. Despite enormous pressure from the ITU, the ETSI and from mobile network operators all around the world, Qualcomm and Ericsson did not reach an agreement before this important ITU meeting. As a result, the ITU was not able to make any real decision, and had to drop its ambition for a single world-wide standard, and also had to drop its less far-reaching ambition to harmonise the various standards as far as possible.

However, if fact only a few days after that deadline and the ITU giving up, the two firms did reach an agreement. [126] In sum, the companies agreed that Ericsson would purchase Qualcomm's infrastructure unit, enter into a series of cross-licenses agreements, settle existing litigation, and that they both would issue the requested IPR statement to the ITU, declaring that licenses would be available under fair, reasonable and non-discriminatory terms and conditions. As a part of the arrangement, both parties agreed to withdraw their patent blockings for third-generation standards. After this agreement was made public, Qualcomm stated that it would focus on its core business, developing CDMA terminals and designing chipsets. Although Qualcomm's infrastructure division was sold to Ericsson for an unspecified sum, it was generally known this division was unprofitable, and many observers believe that gaining access to Qualcomm's IPR was very costly for Ericsson.[127]

This move, however, cam too late for the ITU to realise its ambition of a single global standard. In the following years, still considerable work was necessary to have the different world standards growing closer to each other, to prevent unnecessary and high costs at the implementation stage. The Operators Harmonisation Group, in

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[126] The deal was reached even before the ITU issued its press release. This resulted in a rather strange press release, which for the largest part seems to have been written without the knowledge that there would be a deal after all. See International Telecommunications Union. (25 March 1999). *ITU approves key characteristics for the radio interfaces of third generation mobile systems* [press release]. Ericsson later confirmed that behind the scenes it had already been negotiating a peace with Qualcomm, starting in Spring 1998. (Source: Westmand, 1999, p. 28.).

[127] See, for instance *Ericsson & Qualcomm settle differences and back single 3G standard*. (25 March 1999). Total Telecom.

particular, was instrumental in convincing all parties to adopt a single chip rate in the end.

Afterplay (1999-2006)

Whereas it seemed as patent problems were largely solved by mid-1999 (with Ericsson and Qualcomm both agreeing to license their IPR at RAND conditions), these problems kept the mobile business society busy for the years to follow. This expressed itself by various proposals how to deal with 3G patents including patent pools (more on that below), as well as reports about patent conflicts.

These reports reached their (tentative) peak in late 2005. In October of that year, a number of leading 3G players including Ericsson, Nokia and Panasonic each filed a complain at the European Commission, asking it to investigate what they call the anti-competitive conduct of Qualcomm.[128] These firms refer to the RAND statement that Quamcomm has issued to ETSI, among other bodies, and state that Qualcomm is breaching these by (1) refusing to license some firms, especially potential chip set manufacturers, and (2) charging excessive and disproportionate fees for its essential UMTS patents, when compared to its fee for cdma2000 patents.

At about the same time, a number of operators publicly criticized ETSI's IPR policy, claiming that it leaves companies exposed to unattainable and excessive demands for royalties.[129] A few months earlier, in June 2005, the EU already announced that is was investigating ETSI to determine whether firms can exploit this body's rules to pull off a so-called 'patent ambush'.[130], [131] In response to this, ETSI established an IPR committee to study possible changes in the IPR policy.

In March 2006, ETSI announced that it is working on a radical revision of its IPR policy, under pressure of operators.[132] The new plan is designed to get all relevant patent-holders to sign up to a pre-agreed cumulative cap of approximately 5% for royalties on the cost of all equipment based on certain new standards.

The consequences of the planned changes to the ETSI IPR policy are difficult to predict but are likely to be far-reaching. Eventually, they may introduce the certain end of ETSI as a relevant telecommunications standardisation body. On the short

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[128] "Leading mobile wireless technology companies call on European Commission to investigate Qualcomm's anti-competitive conduct". Press release of Broadcom, Ericsson, NEC, Nokia, Panasonicv and Texas Instruments, dated October 28, 2005.

[129] Financial Times, 'Groups push for action on intellectual property', 21November 2005.

[130] Financial Times, 14 June 2005, " EU watchdog to investigate telecom patents regulations".

[131] A patent ambush, also called submarine patenting, is a strategy where the IPR holder does not notify its essential patent and at a relatively late stage of the development suddenly confronts all other with its patent claims.

[132] Informa (1 March 2006), 'ETSI acts on unfair, unreasonable and discriminatory IPRs'. Available at http://www.informatm.com/itmgcontent/icoms/whats-new/20017339277.html;jsessionid=635AF81F5BE0812FE0361EFE6656449B.

term, some parties (especially those that pressed for these changes) may benefit from affordable license fees for future extensions to UMTS/3GPP. Manufacturers that have already vested interests in these standards will be forced to stick with that standard and accept the new terms and conditions. However, on the longer term, given the high number of essential IPRs in telecom standards and the very diverse stakes and business models of their owners, it seems very unlikely that ETSI will succeed in getting all (or even most) parties to agree to contribute their IPR under the new condition, eventually forcing ETSI to halt the development of new standard or losing its most relevant contributors/members. Obviously, there is no way of forcing unwilling members – let alone outsiders – to agree to such conditions, and ETSI might also find it very difficult to design a mechanism how to distribute the price cap among IPR contributors – then one has to get into some type of valuation of IPRs. ETSI might eventually find itself in a very, very undesirable role which in the end limits its abilities to operate as a successful standards maker.

IPR in UMTS

In total, some 73 firms claim to own patents essential to UMTS. Table 9 shows these firms, as well as where they notified that they believed to own such patents. The ETSI IPR notification database currently seems one of the most reliable sources of actual patents for UMTS. A recent version of that database, ETSI special report SR 314 of April 2005, 13,106 essential UMTS patents are notified. Many of these are however the same patent in different legislations. A recent analysis of this database by Bekkers & West (2006) identified approx. 1,227 unique essential patents. In this sense, UMTS could be regarded upon as a special case: both the number of right holders and the total number of essential patents are much higher than for any other single standard known to us.

Table 9: Essential IPR claimed for UMTS according various sources

Notifications at:	**ETSI online IPR database (1)**	**ETSI SR314 (2)**	**ARIB(3)**	**ARIB(4)**	**ATIS**	**Current 3G patents pool members (5)**	**ETSI online IPR database (1)**
Concerning: (6)	**UMTS**	**UMTS**	**UMTS**	**UMTS**	**UMTS**	**UMTS**	**GSM**
Aepona	x	x					
Alcatel	x	x					x
ASUSTeK	x	x					
Axalto	x						
Bijitec	x	x					
Broadcom	x						x
BT							x
Bull CP8							x
Canon	x	x	x				
Casio			x	x			
CCETT	x						
CCL/ITRI	x	x					
Cellnet							x
Cisco Systems	x	x					
Coding Technologies	x	x					
DDI				x			
De Te Mobil							x
Ericsson	x	x	x				x
ETRI (Korea Telecom)	x	x				x	
EVOLIUM	x	x					x
France Telecom	x	x					x
Fujitsu Limited	x		x	x		x	
Gemplus							x
Golden Bridge Technology	x		x	x			
Hitachi	x						
Huawei Technologies	x						
Hughes Network Systems	x						
Innovatron							x
Intel	x						
InterDigital	x	x					x
IPR Licensing	x	x					
Italtel Spa	x	x					
KDD			x				
Kineto wireless					x		
Kokusai			x				
KPN	x					x	x
Lucent/AT&T	x	x			x		x
Lupa Finances							x
Matra							x
Matsu-shita/Panasonic	x		x	x			
Media Farm	x	x					
Mitsubishi	x	x	x	x		x	x
Motorola	x	x	x	x			x
NEC Corporation	x	x	x	x		x	x
Nokia	x	x	x	x			x
Nortel Networks	x	x					x
NTT	x		x	x		x	x
NTT DoCoMo							
OKI Electric Industry	x	x	x	x			
Omnipoint	x	x					x
Orange	x						x
Philips	x	x					x

Notifications at:	ETSI online IPR database (1)	ETSI SR314 (2)	ARIB(3)	ARIB(4)	ATIS	Current 3G patents pool members (5)	ETSI online IPR database (1)
Concerning: (6)	**UMTS**	**UMTS**	**UMTS**	**UMTS**	**UMTS**	**UMTS**	**GSM**
Qualcomm	x	x	x	x			x
Robert Bosch	x	x					x
Rockwell							x
Salbu Research & Development	x	x					
Samsung	x	x	x	x			x
Schlumberger Systèmes							x
Sharp			x				
Siemens	x	x	x	x		x	x
Sony			x	x			
Sun Microsystems	x	x					x
Tantivy Communications	x	x					
Télédiffusion de France	x						
Telia	x	x					x
Telia Sonera							
Texas Instruments	x	x		x			x
Toshiba	x	x	x	x			x
University de Sherbrooke			x				
Vodafone/ Libertel/ Airtouch	x						x
VoiceAge	x	x					
Voicecraft			x				
Wi-Lan	x	x					
Total number of firms notifying	52	37	22	17	2	7	36

Notes:

(1) *IPR in ETSI deliverables, as available from www.etsi.org, as of September 28th, 2005.*
(2) *ETSI SR 000 314 V1.14.1 (2005-04) Special Report, Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards.*
(3) *Notifications in document ARIB STD-T63 Ver 1.00 "List of Essential Property Rights (IPRs) for ARIB STD-T63 " IMT-2000 DS-CDMA system" (probably from October 2000)*
(4) *Notifications in "Japan's Proposal for Candidate Radio Transmission Technology on IMT-2000: W-CDMA", ARIB, June 1998*
(5) *Firms that agreed to license via W-CDMA Patent Licensing Programme*
(6) *GSM refers to any GSM, GPRS or DCS-1800 patents; UMTS refers to any UMTS/3GPP patents*

9.3.3 Patent pools in mobile telecommunications

As shown above, patent issues were very problematic for UMTS. Already during early stages, people thought of ways of dealing with these. Working groups were established, and also the idea of creating a patent pool for UMTS was considered more and more seriously.

In January 1998, the proponents of the *alpha* proposal in ETSI, including Ericsson, Nokia, NTT DoCoMo, NEC, Fujitsu, Matsushita (Panasonic) and Mitsubishi, announce activities concerning a patent pool. Representatives of the *delta* group report similar activities too.[133] Qualcomm says that it is interested in discussing a

[133] ETSI: European Telecommunications Standards Institute. (1998f). *Consensus decision on the UTRA concept to be redefined by ETSI SMG2* (ETSI SMG (98)1 Annex 6). Sofia Antipolis, France: Author.

pooling concept which might simplify IPR handling, but that it wanted time to study the matter further.[134] In the summer of 1998, the UMTS IPR working group, an independent grouping of forty companies involved in UMTS (operators, equipment manufacturers and chip vendors) publishes its first report, studying various ways to deal with UMTS IPR issues including, in particular, patent pools.[135] In January 1999, the same group publishes a report based on extensive consulting of involved parties.[136] The report pays attention to various license models and recommends an arrangement called a 'patent platform' that has features in common with both a patent pool and a patent forum. However, it is remarkable that this group consulted virtually every player that is involved in third-generation patents, except Qualcomm.

When the final decision was taken on the UMTS technology, ETSI's press release also indicated activities that could be interpreted as ideas to set up a patent pool or something similar: "[the 31 companies that made the proposal leading to this new solution] will work together to provide agreed guidelines for the handling of IPRs essential to the UTRA specification which result in reasonable cost for the manufacturers.".[137, 138]

Now the pivotal technology decision was taken, the UMTS IPR group took the responsibility to establish what was to become known as the 3G patent platform (also called 3G3P for a while).[139] The UMTS IPR WG worked within a legal entity called the UMTS Intellectual Property Association (UIPA). The 3G Patent Platform specification was first approved and published in June 1999 by the UIPA General Assembly. After its establishment, the 3G patent platform has adapted itself to "ensure compliance with antitrust regulations and […] better understanding of industry requirements.".[140]

When looking at the main drivers for this patent pool initiative, we can find the usual motives such as improving access/availability of licenses, and a timely arrangement for the cost effective management and administration of all the concerned essential patents. More interesting, however, is that price control was one of the basic aims of the initiative. In fact, the UMTS IPR working group has described a patent pool as '[...] a one-stop clearing house with a cap on the maximum royalties.'.[141] This explicit aim makes the 3G pool different from many other pools, including those in the CE market. This goal is also reflected by the title of 3Gpatent's press release of 9 January 2002: 'Commercial launch of the 3G Patent Platform services to limit maximum royalties for 3G systems'.

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134 Ibid.

135 UMTS IPR Working Group (1998).

136 UMTS IPR Working Group (1999).

137 ETSI press release, 29 January 1999, "Agreement reached on radio interface for third generation mobile system, UMTS (Universal Mobile Telecommunications System)".

138 Although the work ' pool" is not mentioned here, one may argue that the general guidelines on IPR are already decided upon by the standard body as such, and thus such an initiative by firms is likely to be a further-reaching agreement on IPR, not unlikely in the form of a patent pools.

139 See "Background History of the 3G Patent Platform" at www.3gpatents.com.

140 Ibid.

141 UMTS IPR Working Group (1998).

There are also other design differences that set this pool apart from other pool. Witnessing various critics that were expressed in journal articles in 1999, the 3G pool was lacked the clout of a full patent pool or licensing agency.[142] In particular, according to these sources, the licensees will pay royalties *directly to the companies holding the corresponding licenses*. Patent holders and licensees are free to negotiate deals to meet their business requirements. Also, by the same time, observers note that ‘Qualcomm has dug its heels in opposition to any of the proposed 3G patent arrangements’.[143]

In November 2002, a positive business review letter from the US DoJ was received for the 3G patent platform.[144] Similar clearances were received from the Japanese Fair Trade Commission (Positive view on the Consultation Pursuant to Prior Consultation System relating to Patent and Know-How issued, 28 June 2002) and the European Commission (a positive "comfort letter" published 11 November, 2002). These regulators studied a patent pool design as laid out in (3G3P, 2002). The reviews of regulators to prepare their comfort letter took rather long: it is noted that the EC review took two years (which is quite long given the developments in the mobile telecommunications market).[145]

Despite the overall aim to develop a platform for multiple technologies, having so-called Platform Companies developing licensing schemes for each of these (UMTS, CDMA2000, EDGE), only one came to see the light of day. In 2004, a ‘W-CDMA Patent Licensing Programme’ was established for UMTS FDD patents.[146] A total of 7 licensors offered their patents as a bundle to prospective licensers.

Over the years, the number of participating firms in the 3G Patents initiative dropped rather steeply over time. Table 10, below, shows the number of parties involved at four key moments in the history of the patent pool.

At this moment, it looks like the 3Gpatent pool is not very successful. Despite the broad aims, a license programme for only one single standard was developed, and this licensing program only covers a small fraction of the total IPR for that standard.[147] It may be too early, however, to judge on the possible success of 3Gpatents; some interviewees noted that it can take a rather long time. Also, the patent platform model does seem to be rather flexible and promising. Possible, in another sector, and without the explicit price control aim, such a platform would work very well. Interesting

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[142] See EE Times (21 May 1999), “Possible 'showstoppers' shadow 3G patent pool” (http://www.eet.com/story/OEG19990521S0014) and EE Times (November 27, 1999), “3G intellectual property licensing strategy comes under fire”.

[143] EE Times (November 27, 1999), “3G intellectual property licensing strategy comes under fire”.

[144] This letter is available from http://www.usdoj.gov/atr/public/busreview/200455.htm.

[145] Goldstein & Kearsey (2004, p. 210).

[146] Note that the ‘platform specification’ published by 3Gpatents includes the following text: ‘The scope of the services cover the 3G systems standardized family of technologies defined in the ITU within the framework of IMT 2000, plus any regional adaptation defined by 3GPP and 3GPP2, approved and published by the recognised standards bodies (e.g. ARIB, ETSI, TIA, TTA, TTC, CCSA, etc.).’.

[147] At the time of writing (14 March 2006), their website www.3gpatents.com also went dead.

enough, two people that have been very closely involved in establishing this pool, Larry Goldstein and Brian Kearsey, have shared their ideas and experiences in a book.[148]

Table 10: 3Gpatents membership or associations over time

	European	*Asian*	*North American*	*Total*
Entities that participated in some or all of the definition activities of UIPA (June 1999 - April 2002	24	14	11	49
Companies associated with the 3G Patent Platform Partnership (3G3P) during the period September 1999 to December 2002	10	15	0	25
Notifying partners for EU antitrust clearance	8	10	0	18
PlatformWCDMA initial members, as of summer 2004	2	5	0	7

If we now look what share of the total number of essential patents for UMTS is (currently) covered by the pool, this is rather limited. Table 11 shows an overview of all essential UMTS patents, on the basis of a recent study by Bekkers & West (2006). The total number of patents in that data set amounts to 1227. From the table, it shows that the pool covers no more than approx. 5% of all patents.

Table 11: ETSI notified essential patents by firm

Firm	*Claimed number of unique essential patents*
Nokia	248
Ericsson	244
Qualcomm	228
InterDigital	168
Samsung	86
Motorola	54
Philips	45
Siemens(*)	38
Asustek	23
Alcatel	20
Mitsubishi (*)	18
Nortel	15
Toshiba, ETRI (*), Voiceage, France Telecom, Evolium, Sun Microsystems, OKI, Tantivy communications, IPR licensing, Salbu research & development, Cisco systems, Robert Bosch, Canon, CCL/ITRI, Media farm, Aepona, Bijitec, Wi-lan, Telia	Each claiming 5 or less patents
Coding technologies, Italtel, Lucent, NEC, Omnipoint, Texas Instruments	Blanket claim

Source: Bekkers & West (2006). Note: *Firms market with an (*) agreed to license via W-CDMA Patent Licensing Programme*

[148] Goldstein & Kearsey (2004).

9.4 Case OpenDocument and XML Reference Schemas

In the final case, we turn our focus to another mechanism to coordinate the involvement of IPR into standards. This case focuses on 'non-assertion covenants' (NAC) which make up another approach that has recently emerged to reduce uncertainty about IPRs in the standards environment. We explore the use of NAC as demonstrated in the case of open-document format, an arena where there are two competing standards supported by two dominant players. Here we draw out some of the central aspects of the NAC case as recently exhibited in the area of open-document file standards. We point to some ways in which this mechanism focuses on some fundamental questions related to the rationale of IPRs in the standards environment, and we highlight the affinity of this case to other initiatives that address the IPR concerns.

First of all, we introduce what non-assertion covenants are. In brief, 'Non-assertion covenants' are familiar bilateral agreements which accompany licensing agreements. (see Philips). When used as a unilateral agreements initiated by dominant players with large IPR holdings, they can significantly affect the licensing dynamics of a technology. In this case, they are used to signal to potential adopters of the standard (and to regulatory authorities who might be interested in the 'openness' of a given standard) of their intention not to assert such rights in as far as they overlap the area of an emerging standard. The covenant is based on the principle of reciprocity, meaning that it provides the strong incentive for other rights-holders to follow suit (see below). The successful NAC can thus defuse the IPR question altogether, both for parties to the standards activities as well as for third-parties. At the same time, the NAC can also serve to promote the adoption of the standard since it signals strong backing while it reduces uncertainty about what the terms of licensing are likely to be.

9.4.1 Non-assertion covenants

The case we look at here involves the multilateral use of 'non-assertion covenants' (NAC) in the area of open document standards. This is an area in which two standards have emerged— or are emerging— and have come into conflict. Here, the focus is on the recently ratified OASIS standard called Open Document Format for Office Applications (OpenDocument). Oasis is a consortium which includes IBM, Adobe and Sun Microsystems, and this standard bills itself as, "offer(ing) users and providers true freedom-of-choice with a royalty-free, XML-based file format for text, spreadsheets, presentations, formulas, and business charts."[149] Here it is noteworthy that Sun had earlier initiated an unsuccessful attempt to standardize document formats to head off Microsoft's dominance in the area.

OpenDocument Format is now being actively promoted especially among public administration around the world. The recently formed ODF Alliance has for example

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[149] http://www.oasis-open.org/committees/office, 2006

grown out of the standards activity in order to promote and advance the use the standard:

> *As documents and services are increasingly transformed from paper to electronic form, there is a growing problem that governments and their constituents may not be able to access, retrieve and use critical records, information and documents in the future. To enable the public sector to have greater control over and direct management of their own records, information and documents, the ODF Alliance seeks to promote and advance the use of OpenDocument Format (ODF)*.[150]

The standard primarily targets governments and can also be seen as a response to the call of governments (such as in France) to promote a migration of public-administration documentation away from proprietary office formats (read Microsoft) to ‘open’, non-proprietary platforms. Public administration represents a large and influential market for office applications. The list of public-administrations that have linked their procurement strategy to platforms that reference ‘open standards’ processes has grown, representing a direct challenge to Microsoft’s dominant position in this area. This dominance has been built on a de-facto standards process.

In addition to French ministries, the standard has been endorsed in Singapore, Brazil, and by the European Commission. The OpenDocument standard therefore represents a move into the territory held by Microsoft. This tendency among large document users is one factor that has helped Microsoft to change its policy of not contributing to standards processes. In this important area, Microsoft has taken its technology to a standards consortium, the European Computer Makers Association (ECMA), to roll its XML Reference Schemas into an international standard, which then can be migrated to the recognized ISO system.

This step seems to satisfy the requirement mandated by public legislation that file systems should be the result of an open standards process and should themselves be open. However, observers have questioned the degree to which the ECMA channel represents an open process in the sense called for by the relevant public guidelines. Andrew Updegrove, publisher of Consortiuminfo, laid out the basic concerns in an interview with SearchOpenSource.com, when he said: "At Ecma, the XML Reference Schema working group is tightly constrained by a charter that commands it to produce a specification that is tightly locked on Microsoft Office in its current and upcoming versions." [151]

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[150] The ODF Alliance’s webpage. The ODF Alliance was recently launched (March 2006) and includes diverse industry partners, associations,
NGOs and academic/research institutions. http://www.odfalliance.org/about.html

[151] Loftus, Jack.(2006) OASIS gives Microsoft Office another punch with ODF Adoption Committee. 08 Mar 2006 | SearchOpenSource.com.
http://searchopensource.techtarget.com/originalContent/0,289142,sid39_gci1171615,00.html

In late 2005 the confrontation between ODF and Microsoft office applications as referenced in the emerging ECMA work was taken to the US, in Massachusetts home of MIT, Harvard, and the W3C. The confrontation has centred on the procurement by the State of Massachusetts of file software to store and access public records, where the decision was made to adopt ODF for all digital documentation in 2007. The decision to adopt ODF has been highly contentious both inside the state administration and in public debate. It has been accompanied by a stream of headlines, a public resignation, and statements by the governor. What role do the Non-Assertion Covenants play in this setting?

9.4.2 The emergence of two Non-Assertion Covenants

Non-Assertion Covenants have emerged against this background both in conjunction with the ODF and with the XML Reference Schema. The appearance of NACs on both sides has highlighted the question of how 'open' the competing standards are. Sun Microsystems issued its NAC to the OASIS consortium of which it is a member[152]. The NAC spells out Sun's intentions not to charge licensing fees, provided other parties don't enforce theirs for the standard, either for the current version of the ODF or any subsequent version which it is involved in elaborating.

The NAC represents a commitment by Sun to the standards consortium and to potential adopters of Sun's intention. This commitment can be seen to be binding since it carries the weight of Sun's member contract with the consortium.[153] Whatever its legal merits, the role of the NAC is significant in helping to lay the basis for the OpenDocument standard's outward presentation as unequivocally 'royalty-free'. This helps to dispel uncertainty about the licensing status of the standard, which after all involves major players with large patent portfolios, such as IBM, Sun, and Adobe. The signal that the NAC conveys both for this version and upcoming versions reduces the uncertainty of potential adopters on this important point.

The public declaration also challenges the ECMA standards process, pointing up ingrained uncertainty about how open Microsoft will address licensing of its intellectual property. As a result, Microsoft responded in kind in November 2005 with a Covenant Regarding Office 2003 XML Reference Schemas. This Covenant was published to its website, and reads similarly to the Sun Covenant but with some important differences. These differences, including the fact that it is posted to a website which Microsoft controls and which is of doubtful legal consequence, are pointed out by Updegrove, who is also a lawyer with open support for ODF.[154]

The key aspect of the NAC is the reciprocity clause which is akin to a cease-fire. This is a key feature of open-standards (see discussion below) and, according to

[152] The chairman of OASIS is a Sun employee.

[153] See Andrew Updegrove's interpretation of this in his blog, cited extensively here at: http://www.consortiuminfo.com/newsblog/blog.php?ID=1762

[154] See blog, and links including an interview with a Schema proponent, for Updegrove's observations: http://www.consortiuminfo.com/newsblog/blog.php?ID=1762.

Updegrove (op cit.), is commonly called a "defensive suspension" term. It is noted that this term only kicks in where a party requires licenses of the author of the covenant, unless otherwise stated. In the comparison between Microsoft's and Sun's covenants, Updegrove points out a major difference. Microsoft only implies the defensive suspension term where it, or one of its affiliates, is subsequently sued or otherwise required to license. In the Sun case, the defensive revocation right extends to 'any implementation of "Sun has reserved the right, if it wishes, to be a "patent policeman" that could assist any implementer of ODF."[155]

The idea of a 'patent policeman' is an interesting development and raises questions about how the regulation of the IPR question will develop in future.

9.5 Issues and observations

The relationship between intellectual property rights and standardization activities remains tense. The empirical work here and in the cases in section 1 acknowledged the need to find better ways to deal with those IPRs that may be deemed 'essential' to the functioning of a standard. There are some general IPR related challenges. These include concerns about the quality of patents in general, about their applicability in software, about their potential to encumber interfaces, as well as about the way different actors use them. The emergence of Non-Assertion Covenants can be seen against this backdrop. And it can be seen in relation to other initiatives in this area as well, including the IPR policies of individual standards development organizations (SDOs) and to the open standards moment.

One of the concerns of SDOs involves the timely disclosure of essential IPR. Here the successful NAC actually moves a significant step beyond merely getting the holders of 'essential' IPRs to disclose in a timely fashion. Disclosure is a primary step to address the threat that IPR royalties pose to the development of a standard, and it has been addressed both in the courts since at least the early 1980s[156] and since then by standards bodies. It is topical here to recall the practice introduced by ETSI to get IPR holders to commit to a disclosure of any relevant IPRs in an area of a known standardization activity (see Iversen, 2000). The ETSI approach had the advantage over the previous approaches of standards bodies in that it actively encouraged IPR holders to disclose their relevant rights, a list of which ETSI then published in the interest of transparency. Though a step ahead for standards bodies and the way they addressed IPRs, the ETSI approach however could not ensure the accuracy of that list nor could it ensure that the terms offered by the licensor would in fact fulfil its insistence that they should be 'reasonable and non-discriminatory'. (see recent probe by the Commission).

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[155] http://www.consortiuminfo.com/newsblog/blog.php?ID=1762

[156] See the FTC vs Dell, 1996. the earliest case identified is 1981 in the US. See Iversen, Østersjøen, Thue Lie (2005). …

The NAC is the initiative of one IP holder who unilaterally acknowledges that it has rights which might be viewed as essential for the standard at hand; and it, as a matter of public record, states its intention not to claim royalties for those rights provided reciprocity from other right-holders. Of course this action by a single actor does not mean that all rights will be disclosed by all other rights-holders or that they will follow suit in licensing terms. But it does force the hand of recalcitrant rights-holders and it ideally can set a standard for the way other all rights holders behave for purposes of the given standard. Failing that, playing the NAC card may be advantageous since it would tend to flush out any royalty-bearing rights at a relatively early stage.

9.5.1 IPR policy at standards body

One reason that the ETSI approach is topical here is that the NAC holds an affinity to an approach—the IPR Undertaking—that ETSI was forced to jettison when it elaborated its current IPR policy in 1993-4. That likeness is only superficial, since the form (contractual guidelines established by standards body versus a declaration by a single rights holder), the immediate objective (to create rules for standards body members versus to make known the licensing intentions of that rights holder), the level (multilateral versus unilateral), and the setting (a newly hived-off body whose membership then had little in the way of IPRs versus the position of a single recognized rights holders) are all very different. But there remains an affinity in that the intended outcome of the two is similar: both initiatives aim to dissuade supporters of a standard under normal circumstances from leveraging their rights on the back of the standard and thereby to reduce adoption risks of the standard. This promotes the take-up of the standard.

This general approach to encourage licensing on free and non-discriminatory basis except under special circumstances (in the ETSI case this was the ‘crown-jewel’ exception; in the NAC, special claims for royalties then would become part of a normal cross-licensing procedure) is also in keeping with the current focus on ‘open standards’ where there are some direct links as well.

9.5.2 Open standards

Sun Microsystems is here a direct link, being the author of the NAC, a proponent of the standard, as well as a proponent of ‘Open Standards’.[157] In line with its long term commitment to interoperability, Sun has increasingly stressed open standards as a way to counteract the drift in the standards ecosystem away from some perceived fundamentals. This drift includes the tendency for standardization to move closer to implementations (as opposed to interfaces), for standards processes to move from earlier ideals of ‘due process’, for the quality particularly of software patents to be

[157] See also Sun case in Part 1.

wanting[158] and for patents and other IPRs to be used more opportunistically in standards processes (cf. FTC versus Rambus).

Open Standards is a term with many definitions. In terms of its position statement on "Common Criteria for IT Interoperability"[159], Sun follows Kretchmer's presentation of the ingredients of a standard that might accurately be called 'open'. In particular, Section 7 and 8 of this declaration set out the conditions that required licenses should follow in a so-called open standard. Sun here emphasizes the importance of open standards to, "provide a level of protection against economic and legal uncertainty, as the process by which they are developed is clear about intellectual property rights."[160] What is emphasized here is reciprocity, timely disclosure, uniformity in licensing terms according to an established understanding of 'reasonable royalties' and their terms.

Interviews with Sun (see Part 1, the Sun Case) emphasized that in the software area a defensive approach to 'essential patents' is in most cases the one defensible approach for the standardization environment. Here the rationale for standards should be to find solutions that address collective problems in the best manner and not to leverage standards by maximizing royalty rates on IPRs. Cases such as the 'crown jewel' one, in which IP is central to the business model of the (in particular, small) firm participating in the elaboration of a standard, require that provisions are included to allow the IPR holder to secure reasonable royalties while also allowing the standards committees to look for alternatives that circumvent the technology in question.

The problem emerges when such exceptional cases become the rule. When multiple stakeholders, holding multiple rights, use the standard as a vehicle to cross-license their technologies among themselves, it becomes difficult to distinguish between what rights are really essential to the standard, what fair and non-discriminatory licenses are, and what the cumulative royalty burden will eventually be for all implementers, etc. Patent pools, showcased in the following two cases, represent an approach to manage these sorts of questions. But, there is still a deeper question about what is required to get the best technology into the standard specifications. To keep balance between the interests of the rights holders and the collective rights of the standard as a whole requires clear guidelines about the time disclosure of rights and clarity about the licensing process. A standard that is over-encumbered by a bandwagon of license claims is not likely to be successful among adopters. In Sun's words, "successful Open Standards define a common technology baseline that encourages the industry to compete on innovations, not the basics….Open Standards provide the assurance to both vendors (large and small) and consumers that innovation and value will continue." (ibid; p 2).

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[158] See Lee Patch's statement before the USPTO, 1994

[159] See http://www.sun.com/software/standards/overview.xml

[160] http://www.sun.com/software/standards/overview.xml, p. 2. (2006)

9.6 Analysis and discussion of the patent pool and other coordination cases

In the preceding sections, we have looked in detail at a number of product markets, and attempts to deal with IPR issues by introducing patent pools. First, we need to recognise that the appropriateness of any solution or coordination mechanism is strongly related to the exact context. Nevertheless, in this section we attempt to draw more general conclusions regarding the success and appropriateness of patent pools in different situations.

In short, we observe that the studied patent pools in the DVD case are successful, whereas the pool in the mobile telecommunications case is not. This is not to say that the DVD pools are without any problems (as we discussed, some are under fire of allegedly high pricing). Also, this is not to say that the 3G platform pool for mobile telecommunications is without any success: it is there, it operates, but failed to attract the IPR holders that own the lion's share of IPR for the standard in question.

In Table 12, we conclude by summarising a number of key issues concerning the patent pools in this case study, and the most important environmental factors. From our DVD/MPEG technology, treat the two DVD pools as a couple (as they differ not that much in this context), as well as the MPEG-2 pool. As such, we now compare four coordination examples.

Table 12: Comparison of the studied patent pool and other coordination mechanisms

Case	**DVD/MPEG technology**		**Second- and third generation mobile telecommunications (2G/3G)**	**Open document standards**
IPR coordination initiative	3C DVD patent pool and DVD-6C patent pool[161]	MPEG 2 patent pool (MPEG-LA)	UMTS pool (3Gpatents)	Competing Non Assertion Covenants
Coordination mechanism (subtype)	Patent pool (joint licensing program)	Patent pool (Patent pool with a licensing administrator)	Patent pool (patent platform). Particularity: original ideas was that all licensees and licensors would still get into bilateral license agreements	Non assertion covenants with a ‘patent policeman’
Administrator	One of the licensors	Independent licensing agency	Independent licensing agency	Dominant IPR holder
Main drivers for setting up mechanism	Promotion of the standard and the technology	Combination of promotion and reducing transaction cost	Price control, ensuring access	Ensure royalty free licensing. Signal to adopters Response to regulatory concerns
Interests of actors	Single worldwide standard agreed (at least for DVD)	Mixed, though still possible to align	Difficult to align, worldwide/regional issues	Promote the adoption of the standard
Competition	Within standard	Between standards	Between standards, between technologies	Between standards and approaches
Business models issues	Mainly production-driven business models (though this might change)	Mixed. Also issue of licensing base calculation	IPR-driven business models as well as production-driven business models	Market with a dominant player; regulator issues involved
Standardisation mode	Forum/consortia type standardisation, with no pre-agreed IPR procedures in place	(Semi-)formal	Formal bodies, IPR procedures in place	Consortia
Pool initiator	A grouping of the large licensors themselves	Independent licensing agency	Independent body (though initiative is from standardisation scope)	A set of computer and computer program companies
Setting up procedure	Closed start, later allowing other licensors to join	Open call	Open call	Unilateral
Outcome	Two pools for the same standard	For some standards: two competing licensing agencies, together offering a rather comprehensive coverage	Single pool proposal, but limited coverage (no more than approx. 5% of all essential patents)	Two standards with two NACs vying for recognition by regulators and the market. Currently in play
Relation to standardisation	Weak	Weak. Acting only after the standard is all set	Strong. It was from the standardisation sphere that the idea for a pool started	Strong. The standard forms the basis for the NAC
Number of patents	Low (few dozens)	Low to medium (few to several dozens)	Very high (>1000)	High

As indicated, this is an explorative study and on the basis of three cases. Two of these look at patent pooling approaches while the third looks at innovative uses of

[161] For this comparison, we only take the pool into account as far as it relates to DVD-essential patents. The patents on other standards, such as the ‘dash’ and ‘ plus’ standards for recordable CD’s are not taken into account

Non Assertion Covenants to resolve potential conflicts with essential patents. Thus, the cases do not provide the basis to draw rigid conclusions. Nevertheless, the following observations can be drawn particularly from on patent pool cases, as well as the input from interviews:

- The RAND model of licensing shows severe limitations (see Section 7.3). Some recent formal complaints at the European Commission (including that of a number of key 3G players against Qualcomm, see Section 9.3.2) will be the proof of the pudding; but even if the defendant is found guilty of breaching some competition rule (e.g. discriminating amongst licensees) this still does not solve the many problems.

- The NAC case attempts to circumvent this tangle of issues by using the IPR position of a dominant player to ensure the standard will remain Royalty-Free.

- Patent pools do indeed save on transaction costs, by creating a single point of access. They increase transparency, reduce uncertainty, and lower search costs. They may also lead, as an effect, to lower (total) fees. However, some interviewees stressed that such a price control should not be a goal as such for a pool; as it seriously reduces its chances for success by pushing parties out (see below).

- Patent pools that are established in order to promote a standard or a technology, and that might lead to a substantially larger market, have good chances to succeed. The higher penetration (larger market) may offset the typically lower income per license of pools compared to bilateral licensing. When such a promotion of a technology is the key objective of the parties involved, this trade-off is acceptable and a patent pool makes sense.

- Patent pools whose main driver is price control, not promotion and larger market size, are not very likely to be successful. There will be too many IPR owners who will conclude that joining a pool will not satisfy their expectation for licensing income. In addition, they some control over their IPR, limiting their ability to use it as ‘bargaining chips’.

- As for now, the 3Gpatents pool seems to enjoy a very limited success. Many firms have already signed bilateral contracts.[162] Some of the interviewees attributed this failure to the price cap, which kept out many players – by joining the pool, they would not meet their commercial targets for their IPR. As such, this price control had a negative effect on the pools success. Still, it is too early to decide whether the 3G3P pool is successful. For comparison, for some other pools it also took a rather long time to become a success (for instance in the CE market)

- The growing number of ‘technology-only’ firms (firms with a business model to exploit IPR rather than produce) is a challenge to pools. We have already seen examples in the telecommunications market, but also firms in the CE market expect to see more of such firms in their sector too.

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[162] Although there apparently there are still many instances where no agreements have been made yet (even tough products have already been sold).

- The third-generation mobile telecommunications case is a special case, in the sense that the total number of essential patents for this single standard is apparently much higher than for any other single compatibility standard, and that there are more different IPR holders than with other standards.[163] This increases potential problems with a too high cumulative license fee. Also, patenting is (even) more strategic than in other areas: many patents seems to be technically very, very close, suggesting that their holder deliberately tries to get multiple patents on what could be considered as one single invention. The unique example of the NAC effectively attempts to cut this Gordian knot.

- Standards bodies do not seem well positioned to get involved in patent pools or in related activities (such as access or price control). They do not have the skills or the competences, and the risk of a conflict of interest (especially given their standardisation tasks) is large. There are several examples of pools whose initiative was closely related to the standardisation process and that failed.[164] Some interviewees stressed that they even should not promote pools: if there is a rational for a pool, the market will establish one itself. But what standard bodies could do, is provide information about the standards and the (known) IPR positions.

-The NAC case is one in which the Standards body and the strategic use of the NAC are strongly aligned. Here the legal bond of the member company to the standards body provides some of the credibility of its commitment not to enforce its IPR. At the same time, the existence of this NAC helps the standards body to bill the standard as 'royalty free'.

- There is a trend of including more and more rather different functionalities in one single device: 'the device formerly known as the mobile phone' now has an electronic agenda, a portable MP3 music player, a photo camera, a web browser and video playing capabilities. Another example is the set top box for digital television, which may cover DVB-T receiver technology, MPEG video coding technology, and MHP[165] or any other type of comparable interactive platform in order select material and interact. Such an accumulation of different technological areas drives up the (relative) costs of IPR even more. One important question is then whether it is reasonable of producers to demand that the fees *for all these technologies* stay below a certain limit.

- There is also a trend of having more than one pool for one single standard. On the one hand, there is a good thing about this. It offers a certain freedom for licensors to

[163] As a comparison: the patent pool for DVB-T (proposed in 1998) covers 12 essential patents (that apparently are all essential patents) and four IPR holders and seems to cover all. (see http://www.eetimes.com/futureofsemis/showArticle.jhtml?articleId=18300379&kc=2511). Many other pools (as discussed in Table 6) have much lower number of IPR holders than in 3G too.

[164] The 3G pool came out of the IPR Working Group, which was closely related to UMTS standardisation activities. The original proposal for an DVB-T pool came from the so-called 'IPR module', that was closely related to the standardisation activities of DVB. The first pool is not very successful, and for the second pool, it was eventually decided to have a pool for DVB-T in MPEG-LA.

[165] MHP: Multimedia Home Platform.

choose, and might also be a good solution if the expectations of two groups of IPR holders are too difficult to me met in one single pool (two pools could each have their own way of establishing a bundle fee and their own way of distributing that among the right holders). On the other hand, having more than one pool obviously decreases the benefit of the phenomenon of pooling. It seems undesirable that there are two or more pools for each standard, but in specific cases it may be appropriate.

- Especially in the last two years, litigation of patent pools is rising. Some interviewees comment, however, that that is a natural thing and does not threaten patent pools as such. Like any tool, patent pools must make sure that they develop according to the changing needs, if necessary. And it is inevitable that some companies will want to test the limit of any (licensing) agreement, including patent pools.

- Regulators can, for example through procurement practices, affect the resolution of IPR considerations (as in the NAC case).

- It is not unusual that a pool gets the blame when a standard does not spread. For instance, the MPEG-4 pool was in some ways controversial when it was set up, because it introduced service provisioning fees.[166] MPEG-4 took up rather slow, and the pool was blamed for that – but that is a sheer overestimation of the effects of a pool. There are definitely other factors at stake that have influenced the take-up of MPEG-4.

- There is an interesting development of independent licensing administrators that have developed patent pools processes, including open calls and external assessment of essentiality of the patents in the pools. Using a similar pool design for each time, they do not need to go through the business review process over and over again, saving time and costs. Although this process increases the risk of having several pools for a single standard (see above), they do seem to benefit both licensors and licensees and thus also society as a whole. In fact, some pools that were initially reported to be established by one of the licensees (the joint licensing programme model as discussed in Section 7.5.3) were instead brought to one of these independent license administrators.[167]

9.7 Preliminary conclusions and policy implications

Given the explorative character of these case studies, it is not possible to draw generally applicable conclusions from it. The results however do help to clarify the possible role different approaches to pooling can have, their success factors, and their relation to standards. Moreover the case studies introduces the important

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[166] See Technolgy and Business (6 March 2002). 'Stop. Pay toll. Download.', available at http://www.salon.com/tech/feature/2002/03/06/mpeg/index.html?x. Another critical article is: MPEG-4 License Fee Under Attack http://www.hive4media.com/news/html/breaking_article.cfm?sec_id=2&article_ID=2757.

[167] For instance the DVB-T pool, see http://www.eetimes.com/futureofsemis/showArticle.jhtml?articleId=18300379&kc=2511.

question of how such coordination mechanisms might be shaped to improve the interaction between standards and research.

The work here supports the proposition that more attention is necessary on to IPR issues for modern compatibility standards. As IPRs develop into one of the largest single cost factor for many new technologies, and access problems to IPRs may have far-reaching consequences for adoption of standards, the work thus far on this front indicates that one cannot study adoption and implementation of standards without considering the IPR dimension.

This works suggests that patent pooling mechanisms offer a promising approach to overcome a number of contemporary problems effecting standards adoption. These problems particularly include the sheer number of patents (Shapiro’s patent thicket) and the transaction costs that invokes. Pooling mechanism can also increase transparency, lower uncertainty, lower search costs and speed up access. Since some of recent problems are worsening, there may be good reasons to support certain pooling approaches. But this will continue to depend on the individual pooling approach in its individual context.

The use of Non Accession Covenant unilaterally illustrates the fact that new mechanisms are being tried in order to resolve the sorts of problems that can arise when a standard involves the IP of an unknown number of patent holders. That approach attempts to return the relationship between standards and patents to a time when patents were employed defensively. This approach appeals to users in the public sector, and emphasizes the importance of support In this case, the advantages of a standard that is widely adopted outweigh the added prospect of royalty income. But this is a special case, as are all three cases, and one where the markets structure, the legislative climate, and the type of technology all influence the equation.

In general the case work suggests that patent pools can aid the diffusion of standards. As such, indirectly, they can also improve the interface between standards and research, as the more likely standards are going to be, the higher the incentive to bring research results into them. Also, with the outlook of a pool (and thus better accessibility of the IPR of others), it makes it easier for a firm to bring patent research results into a standard.

However, patent pools do not eliminate all problems. The two patent pool cases indicates that especially the most crucial problem, that of conflicts of interest,[168] is not likely to be addressed successfully by pools. Also the problem of controlling the cumulative license fee is not likely to be solved by establishing pools. Although pools may have the effect of bring down these fees, this is only to the degree that the pools at the same time increase the total market size (by the promoting function of the pool). Pools that are established with the main goal of bring down the cumulative fee

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[168] Especially those between (1) business models that are dominantly based on market shares vs. business models dominantly based on licensing income and (2) conflicts resulting from stakes in different, competing technologies.

(e.g. using price caps) are likely to fail, as long as one may not expect the total market to grow substantially as a result of the creating of the pool. Finally, pools also do not seem suit to cope with the question of unwilling IPR holders, patent ambushing / submarine patenting strategies, patent trolls, etc.

The situation is somewhat different in the Non Assertion Covenant case as presented. Here a major IPR holder in effect seems to take on the role of a ‘patent policeman’ to make sure that all parties, both those involved in the standards activities and 3rd parties, will not enforce their patents for the purposes of the standard..

On the basis of this limited study we, however, may conclude that the patent pools are not very successful as a coordination mechanism to control cumulative costs (e.g. with t price cap), The pools that seem to be established primary for those reasons, failed.

In Europe, patent pools have not been a matter of much public discussion. In the US they were, and a consensus seems to have developed that, if well designed, the pro-competitive effect of pools outweighs the anti-competitive ones. Although we think that the market will benefit more from an (even more) harmonised international regulatory approach towards pools than from divergent regulatory approaches, more attention to pools is needed.

Patent pools are increasingly attracting attention from economic scholars and policy makers. At the same time, there are many gaps in our knowledge and further study should be made, not least from a standards (or network economy) policy point of view. In particular, it would be extremely valuable to initiate a larger, more in-depth study into the various successful (and not successful) standards pools, involving representatives from both these pools as well as other stakeholders (licensors, licensees, standards bodies).

Appendix 1: A bit of history – patents in telecommunications up to the mid-1980s

If one focuses on patents, the history of telecommunications went through several interesting phases. We can distinguish between one from around 1880 to 1950s, and one from the 1950s until the 1980s. As we believe that understanding these first two phases is essential to understand what happened in the 1990s with patents and standards in (mobile) telecommunications, we will briefly summarises the first two phases below.

First phase: Private market with eminent role for patents (1880s to 1950s)

From the earliest days that telegraphy, radiotelegraphy and telephony were born, patents were considered to be extremely important. In 1937, three different inventors demonstrated the world's first telegraph systems. Among those was the needle telegraph of Cooke & Wheatstone. They demonstrated a 2.5 km telegraph line in London, and also obtained patents for the concept of telegraphy in several countries. Soon after, Samuel Finley Morse improved telegraph systems by introducing a new and practical code system, storing the results directly on paper and by lowering the overall costs of a system considerably. In 1840, Samuel Finley Morse was granted a US patent on his telegraph system. In 1865, upon its adoption by the ITU, the Morse system became the first official technical standard of its kind.[169] In fact, this shows us that the first telecommunications standards ever already 'featured' essential patents to it. Gugliemo Marconi's pioneered the field of radiotelegraphy and also his work was heavily protected by patents.

The exiting invention of the telephone was accompanied by a well-documented patent race between American technical researcher Elisha Gray and his fellow-American and teacher for the deaf Alexander Graham Bell. The latter filed a patent for telephony on 14 February 1876, and although the validity of this patent was questioned by many, it became the basis of the telephone, as it is known now.[170] Bell managed to defend his patent, and numerous enhancements to it, successfully in court and thus was able control the entire US telephony market.

Between 1900 and 1930, several important inventions were done that improved the usability and quality of telephone systems. Whereas the first telephony systems could not span more than a few miles, the so-called Pupin allowed long-distance telephone lines. It was patented by its inventor, professor of mathematics at Colombia University. Siemens from Germany bought the European rights to this invention. Its founder, Werner von Siemens, told the inventor that '*As far as I know, this is the*

[169] Verhoest, Vercruysse & Punte, 1991, pp. 50, 49. ITU: International Telecommunication Union.
[170] A complete account of this race is given in Brooks (1975).

highest price that has ever been paid for a mathematical formula; it goes far beyond the hundred oxen for Pythagoras.'.[171] The next important technological improvements were that of automatic dialling and its accompanying automatic *switching systems*. Several different systems competed here, the most important ones being the Strowger, the Panel, and the Rotary system. These technologies were strongly protected by patents too. In fact, the licensing strategies of the owners determined which telecommunications firm was able to compete in which world market.

Second phase: PTT era with hardly any role for patents (1950s to 1980s)

After a rather turbulent period of private telephone operators, many countries evolved to a nationalized telephony and telegraphy operator, usually referred to as PTT. One important result of this was that the importance of standards grew considerably. In order to facilitate cross-border communications, PTT's became heavily involved in international standard-setting organisations, including the worldwide ITU and the European CEPT. Another effect of the emergence of the PTT era was that the importance of patents totally faded away. Exclusive relations between the operator and its suppliers, and the procurement practices that were used in the following period, resulted in a very limited competition, thus restricting the potential of IPR. Usually, the operator would specify in detail the equipment it wanted to buy from its suppliers.

During the PTT period, manufacturers did not protect their research results extensively either. In fact, patenting was deliberately avoided.[172] When a supplier received an order of an operator to develop equipment, they also charged all development costs to this operator.[173] It can be argued that the property right that arose from such projects were more due to the operator than to the manufacturer. In any case, manufacturers were not in a position to demand licensing fees from the operator that asked them to develop a particular system. And because it was difficult to sell to non-domestic, protected markets, manufacturers were not in a position to demand high license fees there either. Thus, there was relatively little incentive to protect the results of their work. In addition, supply contracts often stated (and still do) that any infringement of an IPR, owned by the supplier or a third party, is the responsibility of the supplier. Patenting by manufacturers can only prevent other manufacturers from copying the innovation, or can be used to license other manufacturers who wanted to use the innovation. However, in turn, many companies wanted to license back other innovations. This would have resulted in a large-scale cross-licensing, making it more beneficial not to go through the whole, costly patenting procedures at all. Also the fact that operators would often force suppliers to license their patents to other suppliers at no cost, in order to have multiple suppliers using the same technology, did not stimulate manufacturers to apply for patents either.

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[171] Noam, 1992, p. 73.
[172] Iversen, 1999a, p. 94.
[173] This made domestically-developed equipment often much more expensive than foreign equipment.

Research, a possible source for the generation of property rights, was not only carried out by manufacturers but also by the national operators, who all maintained extensive research laboratories. Often there was close co-operation in this field between operators and their suppliers, and sometimes the research facilities were even jointly-owned.[174] Since national operators faced no competition from each other, they felt little need to protect their research results. Organisations such as CEPT even provided in large-scale co-operation among operators in the field of research, trying to prevent costly overlap.

To summarise, neither operator nor supplier would benefit greatly from protecting research results. The mutual interests of operators and suppliers did not call for comprehensive arrangements of property rights. A situation grew in which it was considered to be improper for manufacturers to demand licensing fees to operators, and to a certain extent also to other manufacturers.

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[174] An example of a jointly-owned research institute is the Swedish Ellemtel, subsidiary company of operator Televerket (now Telia) and manufacturer Ericsson. Ellemtel designed the AXE telephone switching system.

Appendix 2: UMTS history overview

This appendix aims to give a brief description of UMTS and its development path. It also introduces three important phases in the technology's development. These phases are summarized in Table 13. We will also not pay attention to spectrum issues – they are important but deserve full article to be treated in a sufficient extend. Fore more detailed information, readers are referred to the accounts in Bekkers, 2001 and Hillebrand, 2003.

Table 13: UMTS development phases

Period	*Time frame*	*Main activities*	*Landmark event concluding this period*
1. Early research into 3G	around 1990 to early 1995	• Explorative R&D only	RACE research programme output shows outline of UMTS technology (though no specific choices yet made)
2. Drafting the UMTS standard and worldwide alignment	early 1995 to late 1999	• R&D • EU induces establishment of UMTS Task Force and UMTS Forum • Japan takes over the lead • Renewal European interest and UMTS technology choice • Worldwide alignment	The so-called Release 99 version of the standard is the full, first stable version and allows developers to design actual equipment
3. Implementation and further development of the standard	from late 1999	• Improving and refining the UMTS standard • License auctions • Product development and network procurement	n/a

Phase 1. Early research into 3G (around 1990 to early 1995)

The success of GSM, that in may ways by far exceeded the expectations at the various early stages during its development (Bekkers, 2001), set high expectations for UMTS. This does not mean, however, that during all stages all involved parties were very involved, and that the development proceeded without glitches.

The first activities relating to what is now called UMTS started around 1990. Even before GSM was completed, it was envisaged that work on a next generation system should already commence to be ready at the end of GSM's live cycle. Although it was not yet clear what the exact system requirements would look like, and which services would have to be supported, it was evident that a next-generation system would have to offer much higher capacity per user in order to allow other services than plain voice, and would have to be more flexible in the sense that the bandwidth per user or communication could greatly vary. The first research activities took place in the context of EU-funded R&D programmes. The RACE-1 programme, which ran from 1988 to 1992, was mainly focused at fixed network technologies but also included a project on Advanced TDMA. As the name indicates, it focused on a higher capacity version of the time slot technology that GSM uses. It studied a design based on 96 time slots, in contrast to GSM's eight time slots per carrier. In the second phase of RACE (1992–1995), the mobile element gained importance. It had became apparent that other technologies were also feasible for third-generation networks, and would possibly outperform TDMA-based systems. In RACE-2, two major projects for mobile systems were included: one focusing on new CDMA technology (this project is known as CoDIT), and one that elaborated on the above-mentioned advanced TDMA. In 1995, there was an attempt within the RACE program to select one of the proposals as the basis for UMTS, but no decision could be taken. This attempt was done by SIG 5, a special interest group in RACE. It compared both proposals in different radio environment and service environments, and found no clear winner (Buitenwerf, 1994). It should be noted that, apart from those involved in the mentioned research programs, almost no other actor was really involved in any activity relating to 3G. This is quite understandable, as GSM had still to prove to catch on. In particular, the developments were largely ignored by network operators, who were more concerned with their GSM subscriber numbers (Garrard, 1998, p. 478). The outcome of the RACE programme could be seen as the landmark event concluding this first phase. Although one could not yet decide upon the exact technology to be used for the successor of GSM, it clearly showed the order of magnitude of capacity that would be appropriate for a successor, and the basic properties it could have. The RACE outcome also had an important signalling function: it showed other actors than those involved in the research itself that the quest for deciding upon a next generation standard had started.

Phase 2. Drafting the UMTS standard and worldwide alignment (early 1995 to late 1999)

After the relative silence in the first phase, many actors got involved in the UMTS development from around 1995. Again, research was performed, now with the objective to define an actual proposal for UMTS. It took place in the FRAMES project (starting in 1995 and part of the wider, EU-founded ACTS programme). The apportioned budget of 100 million ECU to FRAMES shows that, by this time, the development of a European third-generation standard had received a high priority on the EC agenda. Contracts were awarded to several firms, including Ericsson, Nokia, Siemens, France Telecom, and CSEM/Pro, with participation from several European universities too. Again, both TDMA and CDMA-based systems were studied. FRAMES resulted in two elaborated proposals for an UMTS air interface, known as FMA 1 and FMA 2 (for details, see Bekkers, 2001). These to proposals closely relate to two outcomes of the earlier-mentioned FRAMES programme, although now some CDMA technology was also integrated into the TDMA proposal. During this phase, also other activities than research started to take shape. The EU, inspired by the growing success of GSM and at the same time worried by the apparent lack of involvement in its successor by many actors, set up a UMTS Task Force in 1995. This Task Force presented its system recommendations (e.g. transmission speeds), spectrum needs and timeline for the system in a widely-attended workshop in March

1996. Although these recommendations were still relatively modest, they still met strong resistance from established parties, including GSM operators, ETSI, and ERO/CEPT (Garrard, 1998, p. 479). Basically, these parties did not want to get forced into a new system (and having to acquire new licenses) and wished to add functionalities to the existing GSM standard (particularly phase 2+ additions such as GPRS). As recommended by the Task Force, a UMTS Forum was established, but its goals were modest compared to the UMTS task force recommendations by political lobbying and bargaining.

The attitudes within Europe started to change drastically when it became apparent that Japan was planning to take over the lead. Having failed to benefit from the success of 2G technologies (Japanese firms did not manage to export their own PDC technology, and had a hard time getting access to GSM markets – see Bekkers 2001 and Bekkers et al, 2002), the Japanese were determined to change their luck for 3G systems. In addition, they were already suffering capacity shortages in their densely populated home market. Where the work on UMTS in Europe stumbled along, Japan took progressive steps for the introduction of third-generation mobile networks, and spent huge resources on developing and introducing third-generation networks. In short, the Japan's Ministry of Post and Telecommunications (MPT) set up a study group in 1996 to formulate the countries' contribution to the standardisation of third-generation systems. The study group included all Japan's wireless operators and manufacturers, as well as some large non-Japanese manufacturers such as Motorola, Ericsson, Nokia, Samsung, Nortel, Qualcomm, IBM, Lucent, and LG of Korea. Even before the study group concluded upon its technology choice, Japan's largest mobile operator, NTT DoCoMo (at that time the world's largest mobile operator) placed an order with ten vendors for an experimental third-generation network, and announced a very aggressive further roll-our scheme. Doing this, NTT DoCoMo confronted other Japanese actors with a fait accompli. However, it seems that those other actors have easily reconciled themselves to this situation. The Japanese standards bodies ARIB adopted the NTT choice and was made further responsible for the development of the standard. NTT specified a technology that was largely identical the European FMA-2 proposal (a W-CDMA technology, based on a 5 MHz channels and a chip-rate of 4.096 Mchip/s). Furthermore, NTT DoCoMo placed its order for its experimental network not only with Japanese companies such as NEC, Fujitsu, Matsushita and Mitsubishi, but also engaged non-European firms, including Ericsson, Nokia, Motorola, and Lucent. By involving foreign suppliers, it tried to increase its chances of having the W CDMA technology adopted in other world regions. Especially the involvement of Ericsson and Nokia turned out to be essential.

In 1997, the sluggish development of UMTS was shaken up by Japan's ambitious plans concerning third-generation networks. Suddenly, many actors supported the plans of the Commission's Task Force to speed up the development and introduction of UMTS. Being the formal European standards body for the telecommunications field, ETSI claimed the role to complete the UMTS standard. The European development was further fuelled by the issue of Decision 1999/128/EC by the

European Union. This decision, adopted in late 1998, is addressed to the EC member states and urges then to take all necessary actions for the introduction of UMTS services (e.g. frequency reservations) and to establish a licensing system no later than 1 January 2000.

What followed then was a battle for the technology basis for UMTS. Ericsson and Nokia, two important European GSM players, had strong interests in the W-CDMA technology (broadly identical to 'FRAMES FMA-2'), because they used it as well for the experimental system they delivered to NTT DoCoMo. Alcatel and Siemens, among others, preferred the TD/CDMA technology (broadly identical to FRAMES FMA-1, with some CDMA spreading components added). Its proponents rather strongly rejected W-CDMA, because they claimed it would give some competitors an unfair head start. Apart from this, proponents of the various technologies claimed a large variety of technical/economical advantages of their proposals. The selection of the technology, performed within ETSI, proved to be extremely troublesome. At a landmark ETSI meeting in December 1997, with a record attendance, none of the proposals could attract the necessary 71% of the votes, and the meeting was postponed. In the following months, the fight between the two camps heated up further, including efforts to discredit opponents. The lobbying was also intensified, and parties tried to attract public attention to their point of view. In Paris, in 28 and 29 January 1998, a new meeting was held, in which a final decision had to be taken for the UMTS technology. Now, W-TDMA managed to attract some more votes, but still feel short of the necessary 71%. During the meeting, a compromise was developed, integrating elements of both the main contenders. The ETSI members finally to agree upon this compromise, which in fact is much closer to the W-CDMA proposal than to the TD-CDMA proposal. Japan soon indicated that it would align its own standard to the ETSI choice, and not long after that the foundation for 3GPP were laid: a partnership of various national and regional standards bodies that would harmonize their 3G technology.

At this stage, the fight was by no means over. Worldwide, other proposals were also striving to gain market. The most relevant one was cdma2000: a further development of the 2G cdmaOne standard and backed up by Qualcomm from the US in particular. Just as UMTS was developed in 3GPP, cdma2000 was developed in another partnership project, called 3GPP2. In fact, membership of both partnership often coincided. In addition, China and some other countries promoted their own technologies. In March 1999, the International Telecommunications Union made an final attempt to come to one single, worldwide 3G technology. Although not new to 3G systems (ITU started its first 3G activities in 1985, even before the European research), this was a high game – ITU had not been able to achieve important standards for mobile telephony systems. Its project was called IMT-2000 (International Mobile Telecommunications for the year 2000). All relevant regional standards bodies submitted what were called candidate ratio technologies to the ITU. The stakes of many actors were very high. But what was supposed to be a masterpiece, came out as a big disappointment: due to IPR issues, the ITU was not able to decide. For some of the most promising proposals, firms failed to declare that they were willing to license essential IPR on RAND conditions. This all happened in the context of two firms, Ericsson and Qualcomm, quarrelling over IPRs (see below). The ITU had no choice than to drop its ambition for a single world-wide standard.

Where the ITU failed to reach agreement, operators managed to bring 3GPP (UMTS) and 3GPP (cdma2000) closed together. In 1999, many operators were still unhappy with having many, substantially different standards for third-generation networks. Neither the developments made by the standards bodies (ETSI, ARIB, TIA, etc.), nor both partnership projects (3GPP and 3GPP2), nor the IMT 2000 process of the ITU came up with solutions meeting their needs. These operators were facing massive investments if they wanted to deploy third-generation networks, and therefore they felt a globally acceptable set of solutions was needed. In a final attempt to come to acceptable third-generation standards, the Operators Harmonisation Group (OHG) was established in early 1999. OHG is a world-wide group of major operators, operating second-generation networks based on all different standards. After inviting all manufacturers in its discussions, it achieved a number of agreement. The most important one is that it finally convinced ETSI to lower the so-called chip rate of UMTS from 4.096 Mchip/s down to 3.84 Mchip/s. Though this might sound quite cryptic to some readers, the essence of this is that now two competing technologies (UMTS and CDMA2000) have an identical chip rate which makes it much easier to develop common platforms and components, and which greatly facilitates the design of terminals supporting both technologies. In the section below, on IPRs in UMTS, we will pay some more attention to this issue of the chip rate. The OHG activities bring an end to a rather complex and dynamic standards developments. A sketch of the events that we covered here are give in Figure 5. Note that, apart from UMTS, this sketch also includes some other 3G technology proposals.

After this rather restless period, ETSI started to draft its first complete version of UMTS. At the end of 1999, it was able to finalize the so-called UMTS Phase 1, commonly known as ‘Release 99’. This is a first full version of the standard. This was not yet a version to be used for commercial devices: everybody knew that, once firms started to develop products, improvements and corrections to the standard would be necessary. Nevertheless, Release 99 allowed suppliers to design and build their first product series, knowing that later firmware upgrades would be sufficient to adapt them for later versions of the standard. Also, operators could start to procure networks on the basis of these specifications. The presentation of Release 99 is the landmark event that concludes the second phase that we distinguish for UMTS. Not only does it define the standard, this point in time is also very interesting for our patent analysis: all patents applied for after its release concern technologies that are not part of the core of UMTS, but rather to additions and improvements.

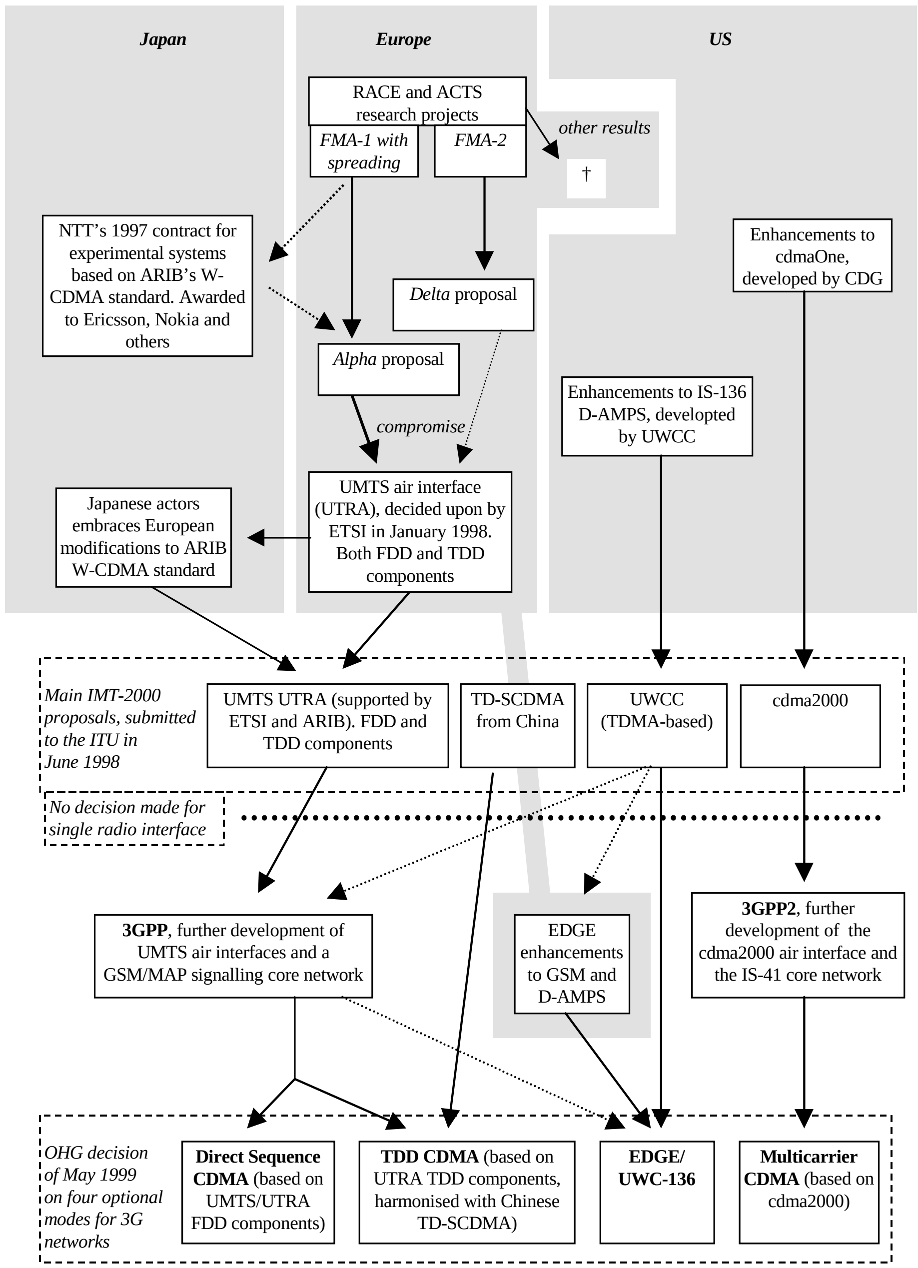

Figure 5: Overview of standardisation of third-generation networks, plus the subsequent world-wide alignment attempts

Phase 3. Implementation and further development of the standard (from late 1999)

Starting in around 2000, countries granted licenses for UMTS networks. EU-law does not specify the allocation mechanism, and both beauty contests and auctions were used. Commercial expectations were very high, and in April 2000 the UK auction brought in the astonishing amount of 37.5 billion Euro for five licenses, at that time the biggest auction ever. A few months later, the German auction raised no less than

50 billion Euro. With these astronomic sums, people started to wonder how operators could ever earn these back, also given the fact that the roll-out of networks and services would also require considerable investments. In the following years, expectations lowered and some operators already decided to hand back their costly license, writing off its enormous costs. Other operators continued to plan and build their networks, often not at the pace that they once planned, but by now most operators have build UMTS coverage in most of their GSM markets. Handset sales and UMTS services are just starting to impact the market at the time of writing, though it remains to be seen how quickly the actual take-up will be. To many consumers, a nice phone feature such as an camera or a music player is much more recognizable than something like UMTS support.

After the publication of Release 99, ETSI (and 3GPP) continued to work on the standard and published new releases (since 2001 simply numbered and not indicated by the year). Some of these releases include more than trivial additions to the standard. For instance, Release 4 specifications supports the use of an all-IP core network; Release 5 focuses on HSDPA to provide higher data rates (up to approximately 10 Mbps), and Release 6 is expected to bring so-called MIMO (Multiple Input Multiple Output) to the standard, which will support even higher data transmission rates up to 20 Mbps.

Appendix 3: Patent pools overview

The table below is adapted from Lerner, Strojwas & Tirole (2003).

Pool Subject Matter	Year of formation	Initial pool member-ship	Nations represented	Source of contract[175]
1. Pneumatic Straw Stackers	1895	3	U.S.	NAR
2. Duplicating Machines	1912	2	U.S.	NAR
3. Automobiles	1915	146	U.S.	USC
4. Railroad Couplers	1916	6	U.S.	NAR
5. Aircraft	1917	8	U.S.	USC
6. Braking Systems	1924	2	U.S.	NAR
7. Plate Glass	1924	4	U.S.	NAR
8. Sand-Spun Pipe	1924	7	U.S.	NADC
9. Dyestuffs	1925	11	Ger.; U.S.	USC
10. Magnesium	1927	2	U.S.	USC
11. Metal Dies	1928	2	Ger.; U.S.	USC
12. Cast Iron Pipe	1929	4	U.S.	NADC
13. Coated Abrasives	1929	9	U.S.	NAR
14. Petroleum Refining-JASCO	1929	4	Ger.; U.S.	USC
15. Petroleum Refining-Hydro patents	1930	4	Ger.; U.S.	USC
16. Water Conditioning Apparatus	1930	3	Ger.; U.K.; U.S.	NAR
17. Grinding Hobs	1931	3	U.S.	NAR
18. Magnesium Alloys	1931	2	Ger.; U.S.	USC
19. Rail Joint Bars	1931	3	U.S.	NAR
20. Railroad Springs	1932	3	U.S.	NAR
21. Hydraulic Oil Pumps	1933	3	U.S.	NADC
22. Machine Tools	1933	4	U.S.	NAR
23. Petroleum Refining-Gray Processes Co.	1933	5	U.S.	USC
24. Petroleum Refining-JUIK Group	1933	5	U.S.	USC
25. Phillips Screws	1933	2	U.S.	NAR
26. Television/Radio Apparatus-Australia	1933	2	Australia	NAR
27. Beryllium	1934	3	Ger.; U.S.	USC
28. Electrical Equipment	1934	3	Ger.; U.S.	NAR
29. Lecithin	1934	5	Den.; Ger.; U.S.	NAR
30. Petroleum Refining-Fractional Distillation	1934	5	U.S.	USC
31. Polymeric Acrylic Acid	1934	2	Ger.; U.S.	USC
32. Variable Condensers	1934	3	U.S.	NAR
33. Acrylic Acid For Laminated Glass (Plexigum)	1935	2	U.S.	NAR
34. Dyestuffs	1935	5	Switz.; U.S.	USC
35. Petroleum Refining-Gas Polymerisation	1935	5	U.S.	USC
36. General Chemical	1936	3	Can.; U.K.; U.S.	USC

[175] DOJFOIA = U.S. Department of Justice Freedom of Information Act request; FTCFOIA = U.S. Federal Trade Commission Freedom of Information Act request; NADC = U.S. Department of Justice files in the National Archives (Suitland, Maryland); NAR=District court docket files in the regional facilities of the National Archives (Boston; Chicago; Kansas City; and New York City); POOL = provided directly by patent pool administrator; USC = published hearings or unpublished files of the U.S. congressional investigations.

37.	Male Hormones	1937	4	Ger.; Switz.; U.S.	NAR
38.	Wrinkle Finishes	1937	2	U.S.	NAR
39.	Dropout+Cutouts	1938	2	U.S.	NAR
40.	Inductive Heat treatment	1938	2	U.S.	NAR
41.	Opthalmic Frames	1938	2	U.S.	NAR
42.	Petroleum Refining-Hydrocarbon	1938	5	Ger.; U.S.	USC
43.	Pour Depressants	1938	3	U.S.	NAR
44.	Slip Covers	1938	3	U.S.	NADC
45.	Petroleum Refining-Alkylation	1939	4	U.K.; U.S.	USC
46.	Dyestuffs	1940	3	U.K.; U.S.	USC
47.	Television Equipment	1942	3	U.S.	NAR
48.	Television/Radio Apparatus-Canada	1943	4	Can.; U.S.	NAR
49.	Alginate (Dental) Impression Powder	1947	3	U.S.	NADC
50.	Plastic Artificial Eyes	1948	2	U.S.	NAR
51.	Television/Radio Apparatus-Great Britain	1948	5	Neth.; U.K.	NAR
52.	Tractor Cabs	1948	3	U.S.	NAR
53.	Daylight Fluorescent Pigments	1949	4	U.S.	NADC
54.	Glass Fibers	1956	3	Jap.; U.S.	NAR
55.	Sewing Machines	1956	3	It.; Swed.; U.S.	NAR
56.	Laser Eye Surgery	1992	2	U.S.	FTCFOIA
57.	MPEG-2 Digital Video	1997	8	Jap.; Neth.; U.S.	DOJFOIA
58.	DVD-ROM, DVD-Video	1998	3	Jap.; Neth.	DOJFOIA
59.	Wireless Personal Area Networking-Bluetooth	1998	9	Fin.; Jap.; Swed.; U.S.	POOL
60.	1394 Digital Data Transfer Interface	1999	6	Japan; Neth.; U.S.	POOL
61.	DVB-T - Digital Broadcasting	1999	4	Fr.; Jap.; Neth.	POOL
62.	DVD-ROM, DVD-Video	1999	6	Jap.; U.S.	DOJFOIA
63.	3G-Mobile Communications	2001	19	Fin.; Fr.; Ger.; It.; Jap.; S.K. ; Neth.	POOL

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