Content

My inaugural speech is dedicated to Prof. dr. ir. Jan Simons, who passed away in November 2009. Jan was the first holder of the endowed chair of standardization which was inaugurated in May 1994.

1. Background

Dear Rector Magnificus of the Erasmus University,

Dear Executive Board of the Erasmus University,

Dear Dean of the Rotterdam School of Management,

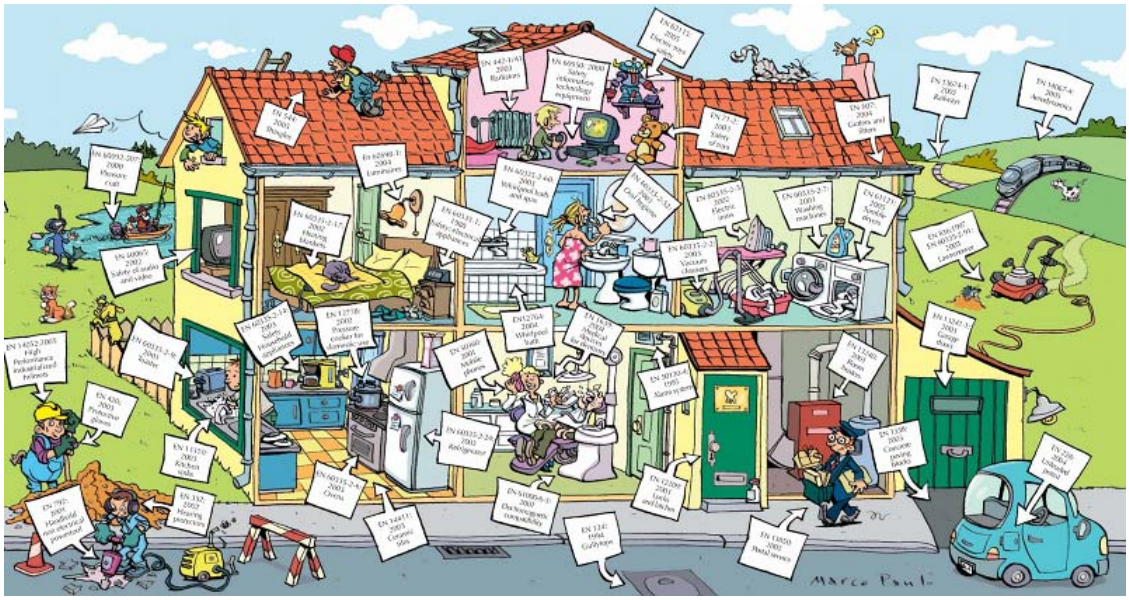
Dear Members of the Board of the Chair on Standardisation Foundation,

Dear Members of the Supervisory Board and Management of the Nederlands Normalisatie-instituut NEN,

Dear family, friends, colleagues, students and other attendants

Standards form the basis of our professional and private life (Figure 1) and innovation is the major source of growth and welfare for our economies. The challenge, we face, is an effective and efficient use of standardisation to promote innovation.

Figure 1: Standards as basis of our professional and private life (Source: CEN)



The traditional view has always been that standards and innovation contradict each other. This perception has some negative implications for the integration of standardisation both in innovation management and innovation policy. Here, we observe a strong focus on public funding of research and development and on IPR as instruments of innovation policy and business strategy. However, commercial and economic implications from research results can only be realised through their successful transfer into innovative products and processes. Unfortunately, standardisation is not yet the powerful technology transfer channel it could be. Standards are also important elements in

the framework conditions for future research, development and innovation. Increasingly research results are protected by intellectual property rights (IPR), especially patents. Standards can play an effective leveraging and diffusion mechanism for IPR. However, this might also create possible conflicts between the actors involved. Finally, user driven innovation strategies and consequently demand driven innovation policies have recently been promoted, but standardisation as a tool to coordinate the preferences and actors of the demand has not been considered.

In summary, there is a large potential for standards and standardisation to promote innovation both for policy makers and businesses. Recently we have observed some policy initiatives, such as the Lead Market Initiative of the European Commission and national innovation strategies now focusing on standardisation as a crucial innovation policy instrument. Company management and innovation strategists are also showing an increasing interest in standardisation.

2. Definitions

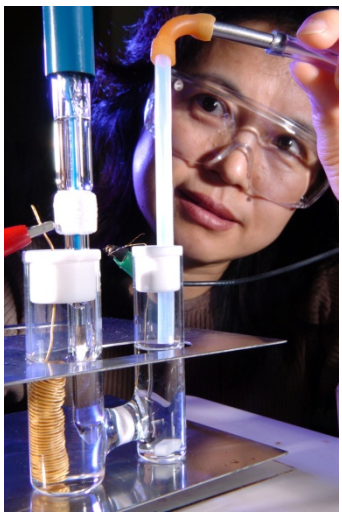
2.1 Innovation

Since there are many definitions of innovation and I am an economist by academic training, I will rely on the OECD-Eurostat definition (OECD, Eurostat 2005). According to the Oslo Manual, “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations (either new to the firm, the market or the world).” Innovation activities cover “all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations.”

2.2 Catalyst

To be precise, I have to clarify that a catalyst is anything that increases the rate of a process derived from Greek καταλύειν, which means "to untie“, Catalysed processes are “reactions that are accelerated by substances that remain unchanged after the reaction”. Nowadays, a catalyst in chemistry is a substance that initiates or accelerates a chemical reaction without itself being affected. In common parlance, a catalyst is something that causes an important event to happen. In our daily life, we know catalyst from our car or from laboratories, where e.g. platinum cathode electrocatalyst's stability is measured.

Figure 1: Catalyst from a car and an electrocatalyst (Source: Internet)



2.3 Standardisation

Facing the current controversial discussion about the European standardisation system, we make use of the official ISO/IEC definition of standardisation as producing documents “by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context” (ISO/IEC Guide 2004). Summarising the available sources, Henk de Vries developed the following more comprehensive definition of standardisation as “activity of establishing and recording a limited set of solutions to actual or potential matching problems directed at benefits for the party or parties involved balancing their needs and intending and expecting that these solutions will be repeatedly or continuously used during a certain period by a substantial number of the parties for whom they are meant.” (de Vries 1997).

The key point is that standardisation is a voluntary process for the development of technical specifications based on consensus amongst the interested parties themselves: industry in first place, but also a variety of users, interest groups and public authorities. Standards, as result of standardisation, have the following characteristics. They are made available to the public free of charge or for a fee. Implementation is free or in some cases subject to the payment of compensation to owners of related IPR. Finally, the usage of standards remains voluntary. Formal standardisation includes the following organisations. Standardisation bodies such as NEN are the institutions responsible at the national level. At the European level, the European Standards Organisations CEN, CENELEC and ETSI have been established for the general, the electrotechnical and the telecommunication related standardisation areas. Correspondingly, the international standards organisations, ISO, IEC and ITU, share the standardisation work at the international level. In general, I will focus on standardisation in these formal standardisation organisations and will not address rather informal standardisation consortia and fora.

3. Types of standards and their economic effects

In Europe alone there are around twenty thousand standards. In order to structure them and to classify their positive and negative economic effects, Table 1 provides an overview of the four types of standards.

Table 1: Types of standards and their economic functions (Blind 2004)

Type of Standard	**Positive Effects**	**Negative Effects**
Compatibility / Interoperability	• Network externalities • Avoiding lock-in • Increasing variety • Efficiency in supply chains	• Monopoly power
Minimum Quality/ Safety	• Avoiding adverse selection • Reducing transaction costs	• Raising rival's costs
Variety Reduction	• Economy of scale • Critical mass in starting industries	• Reducing choice • Market concentration
Information	• Facilitating trade • Reducing transaction costs	• Raising rival's cost

In summary, the positive effects outweigh some possible negative impacts of standards. These can be prohibited, if standardisation processes are open, transparent and consensus based.

4. Areas of standardisation as catalysts for innovation

In the following section, I will elaborate on the role of standards to promote innovation, but not necessarily to generate innovations themselves in the narrow sense. Standards not only reduce the time to market inventions and innovative technologies, but in the first place allow their marketing, e.g. by creating critical masses or collecting the support of all relevant stakeholders. They also help to accelerate the diffusion of innovations.

I would like to focus on three areas in which we can observe at least one of the two innovation promoting functions of standards. On the supply side, we will first look at the interface between research and standardisation, and secondly we will focus on those research results, which are protected by intellectual property rights (IPR), and the benefits of their integration into standards. In addition to these supply-side related areas, we will finally address the role of standards in innovation promoting public procurement processes.

All three selected areas are structured as follows. First, I describe the interfaces between standardisation and the three innovation-related areas. This is followed by a discussion about the catalytic functions of standardisation and finally the business implications including the challenges and solutions are derived.

4.1 Research and standardisation

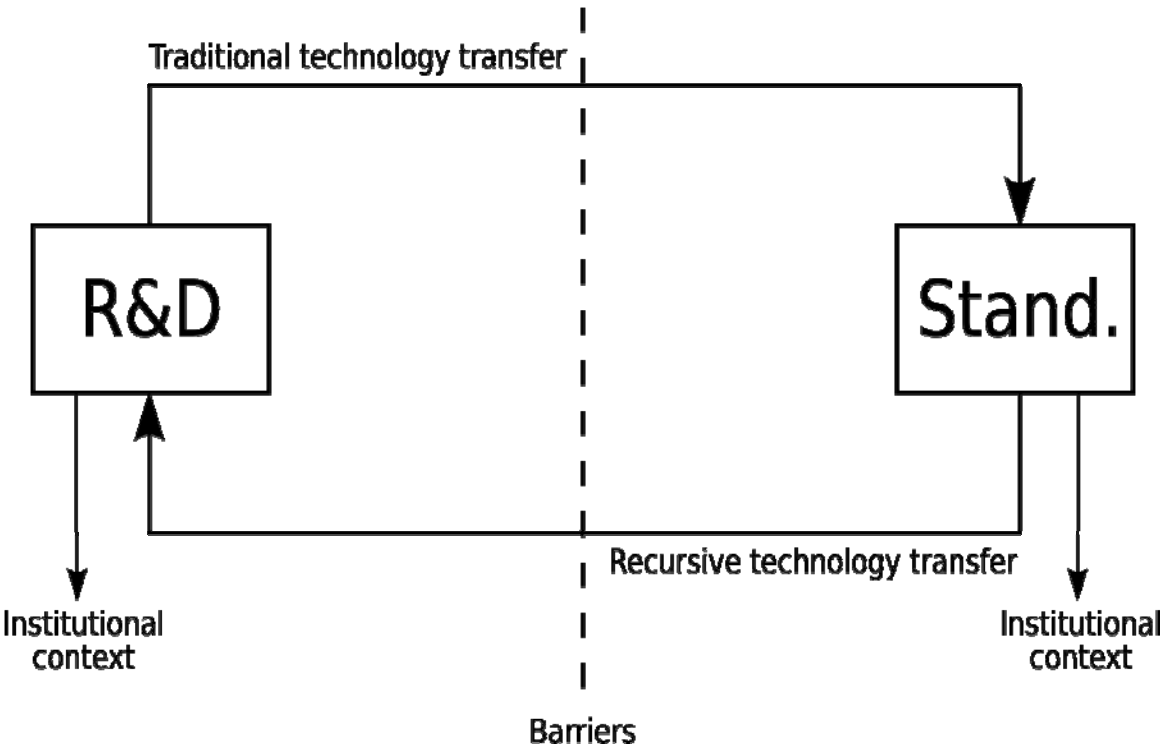
4.1.1 Background

Research and development (R&D) is the focus both of innovation strategy in business and consequently also of innovation policy measures by OECD countries. However, the commercial success and economic impact of R&D results will only be realised by a successful transfer of these results into innovative products and processes. Consequently, manifold support mechanisms for technology transfer have been implemented, but standardisation as an instrument of technology transfer has not been widely recognized. For example, Germany has achieved a top-class position in nanotechnology research world-wide. However, there has been a delay in national standardisation activities, which has led to difficulties in leveraging this excellent starting point into a leading position in European and international standardisation.

4.1.2 Recursive interdependence between research and standardisation

As illustrated in Figure 2, besides the traditional transfer channel from research to standardisation there is also a recursive transfer flow from standardisation back to research.

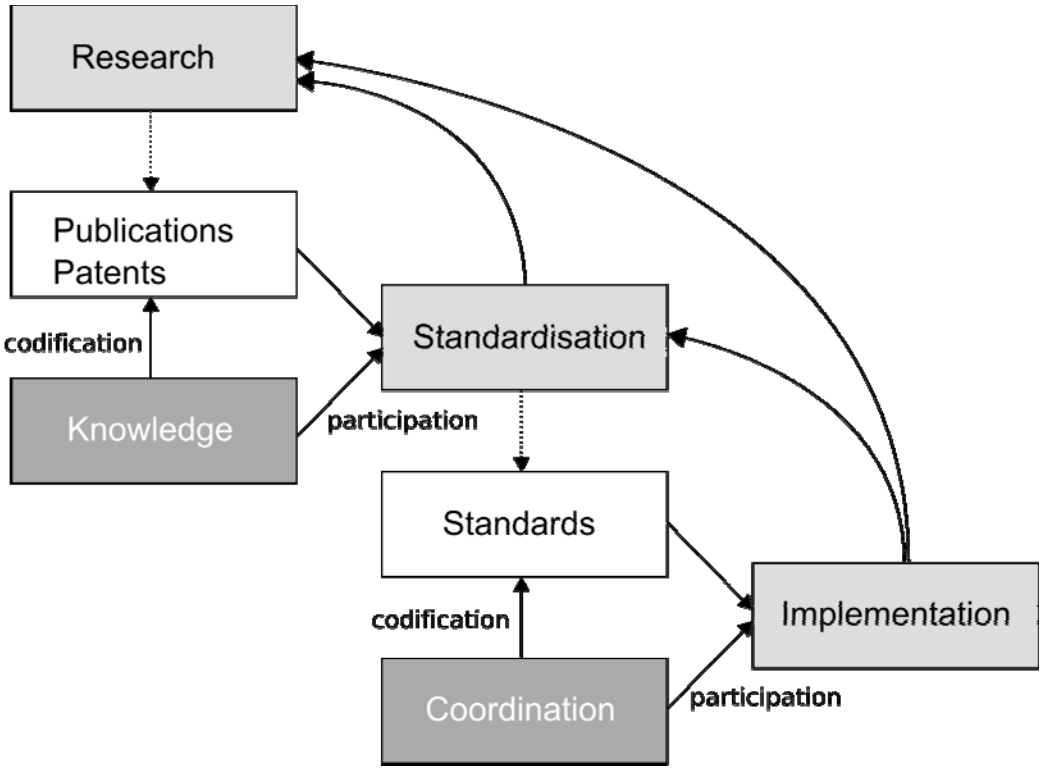
Figure 2: Research and Standardisation (Blind, Gauch 2009)



Bozeman's (2000) conceptual transfer model does not consider standardisation as a transfer channel but regards standards as the transfer object. More precisely, standards are a knowledge and technology transfer channel for knowledge integrated within a consensus process. The selection and prioritisation of knowledge and technologies leads to the bundling of resources and avoids fragmentation. In addition, this is accessible for all actors in industry, research, the public sector and society. Maximum economic efficiency is realised if publicly funded R&D results become public goods via standards. These standards, in contrast to patents, are accessible to everybody at low cost and are more likely to be broadly implemented because all (interested) stakeholders have reached consensus. Furthermore, standardisation is a cooperation and transfer process, because it is a common platform for actors with heterogeneous backgrounds, i.e. research, industry, public administration, social interest groups, e.g. consumers. Besides the codification of knowledge in standards, an exchange of tacit knowledge takes place during the standardisation process. Finally, there is also an

integration of inputs from heterogeneous sources, especially of knowledge from implementers of technologies and consumers. Therefore, taking all these aspects together, standardisation is a catalyst for the practical implementation of research results in innovative technologies, products and services.

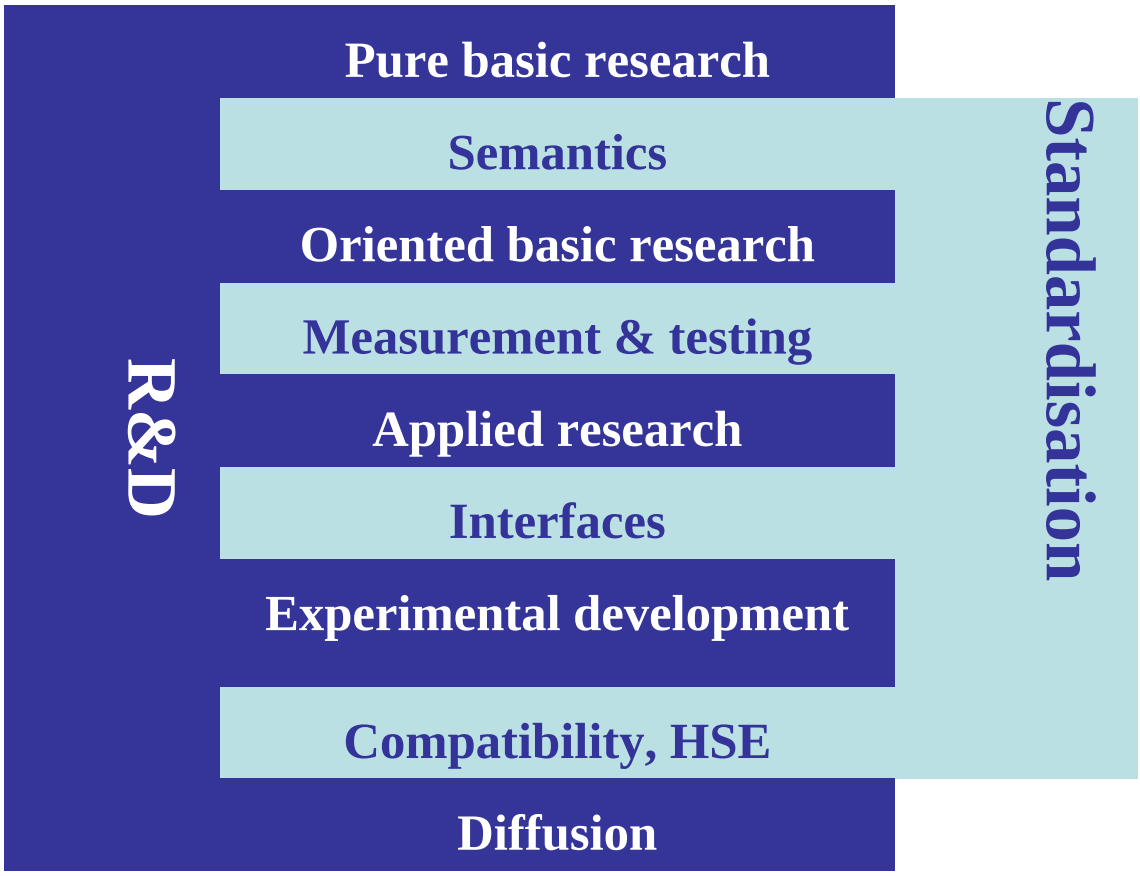
Figure 2: Research and standardisation in a simple technology transfer model (Blind & Gauch, 2009)



4.1.3 Various roles of standards in the research and innovation process

In addition to the transfer of technological knowledge from research to standardisation, standards themselves can serve as framework conditions for future research. This is especially the case for terminology and classification standards related to basic research, metrology, and measurement. Testing standards are crucial for applied research, quality, safety standards are relevant for market introduction and finally compatibility standards are elementary for the diffusion of technologies and products especially in network industries. Across all these dimensions, standards can supplement or complement governmental regulations. For example, in early stages of emerging research and technology fields, self regulation via standardisation allows stakeholders to set flexible framework conditions, which can later be transferred into governmental regulations

Figure 3: Various roles of different types of standards in the innovation process (based on Blind & Gauch, 2009)



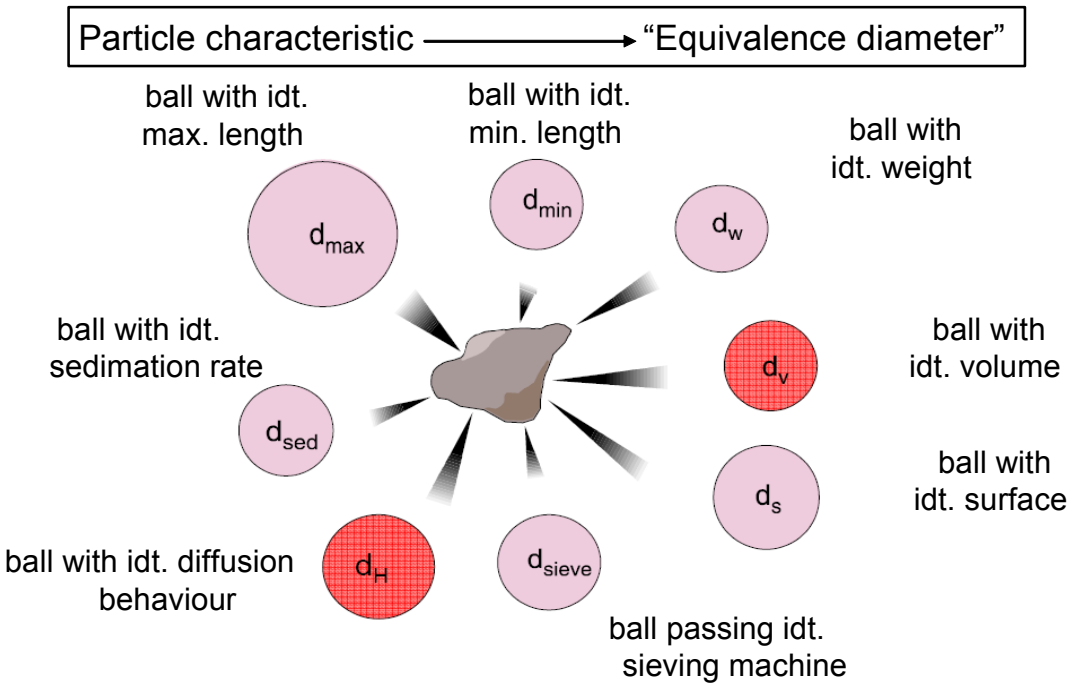
4.1.5 Example: Nanotechnology

The relevance of standardisation in new technologies can be illustrated by the ISO activities on terminology and nomenclature in TC229 Nanotechnology, which led to the following basic definitions:

- nanoscale: size range between 1 nm and 100 nm
- nano-object: material confined in one, two, or three dimensions at the nanoscale
- nanoparticle: particle with three dimensions at the nanoscale
- nanoplate: plate-like object with one characteristic dimension at the nanoscale
- nanocylinder: cylinder-like object with two characteristic dimensions at the nanoscale
- nanotube: tube-like object with two characteristic dimensions at the nanoscale

Besides basic definitions, the challenge for research and development in nanotechnology is the measurement of nanoparticles. Figure 4 illustrates the various measurable characteristics of nanoparticles and shows that metrology standards are essential.

Figure 4: Measurable characteristics of nanoparticles (Source: Malvern GmbH)[1]



In addition to metrology standards, there are various approaches to measure particle characteristics. They range from sieving machines, to electromicroscopy to laser scanning. Again, measurement standards are needed to define these methodologies.

4.1.6 Business implications

In contrast to the needs for standards in research and development, there is still little awareness about the benefits of standards and standardisation among researchers. Due to the broad accessibility to standards – in contrast to scientific publications and patent applications – the connected free-rider problem has resulted in too few incentives for researchers to become actively engaged in standardisation, especially in new fields of research and technology. In general, a better integration between research and standardisation activities including planning, performance, and assessment, is needed. In addition, the coordination between research and standardisation departments within companies should be improved. This also includes an alignment of incentive structures for researchers and standardisers. Finally, standardisation can be used

1 idt. = identical

as innovation strategy, especially for small companies, substituting or complementing own R&D. This requires a more flexible and faster standardisation process. The standardisation community also needs to acknowledge that the expertise of researchers is relevant for the standard-setting process.

4.2. IPR and standardisation

4.2.1 Background

Research results are increasingly protected by intellectual property rights (IPR), especially patents, driven by policies and strategic motives to patent (Blind et al. 2006). In addition, IPR institutions such as patent offices, have incentives to award IPR also in new fields such as software (Blind et al. 2005). Consequently, there are more discussions regarding the quality of IPR, e.g. patent thickets, patent trolls etc. and as a result we face an enhanced interaction between IPR, especially patents and standards (Blind et al. 2002; Blind, Thumm 2004).

4.2.2 Economic rationales of IPR

Before we consider the interaction between IPR and standardisation, we need to address the basic economic rationales of IPR. First, IPR have an incentive function by awarding a (temporary) monopoly in order to foster investment in R&D. Second, the disclosure function is implemented by requiring the publication of the protected content in order to promote diffusion of (technological) know-how. Finally, IPR have a coordination function by requiring the disclosure of the protected content and by awarding a (temporary) monopoly to avoid duplication of research and to foster licensing and sequential innovation.

However, besides these crucial benefits, we have also to consider the costs of IPR regimes caused by permanent monopolies, patent thickets, patent races and patent information overflows.

4.2.3 Economic benefits of IPR in standards for innovation

The integration of IPR, especially patents, into standards generates a series of benefits both for the holder and for those interested in implementing these standards.

First the incentive function allows rights holders to leverage their temporary monopoly generated by awarded IPR via their integration into standards, which generates additional incentives for investment in R&D. A second, indirect incentive emerges that often technologies, products and services are based on platform standards, which create

additional incentives for investment in R&D complementary to the R&D necessary for the development of the technology required for the platform standard.

A direct positive implication of the integration of IPR, especially patents, is the pooling of patents into standards. This reduces transaction costs both for the patent owners and the standard implementers, but also generates additional licensing revenues for the former due to the diffusion effects of standards and reduces licensing costs for the latter. Finally, IPR integrated in standards can benefit from economies of scale due to variety reduction and positive network externalities via standards. This does not only further increase the incentives, but also promotes the diffusion of the standard and consequently also of the incorporated IPR.

This leads us to the second dimension, the diffusion function. The general use of protected technologies, which extend depends on the licensing regime, via standards promotes the diffusion of integrated IPR. However, the diffusion of the content of the IPR already starts during the standardisation process in the standardisation committees.

Finally, the coordination function of IPR benefits from their integration into standards threefold. First, the inclusion of IPR in standards reduces significantly the parallel developments of standards due to the combination of IPR protection with the network externalities of standards. Secondly, standards facilitate the transition from old to new technologies and therefore consequently also from previous to subsequent IPR protected technologies. The integration of IPR into standards is also an instrument to reduce inefficiencies of too rapid transition periods to new technologies, i.e. excessive momentum.

4.2.4 Economic costs of IPR in standards for innovation

Besides the numerous economic benefits of IPR in standards, we also have to consider the costs for innovation.

Regarding the incentive function, the combination of IPR and standard-based network externalities may lead to a monopoly lasting longer than the maximum length of patent protection, which creates inefficiencies e. g. by higher prices and market structures with a low level of competition. In addition, such dominant positions may also promote lock-ins in the long term into inferior outdated standards. In contrast to the tendency towards monopolisation by the integration of IPR into standards, this rather strong incentive may generate fierce standard wars with wasting of resources due to overinvestment and duplication of efforts.

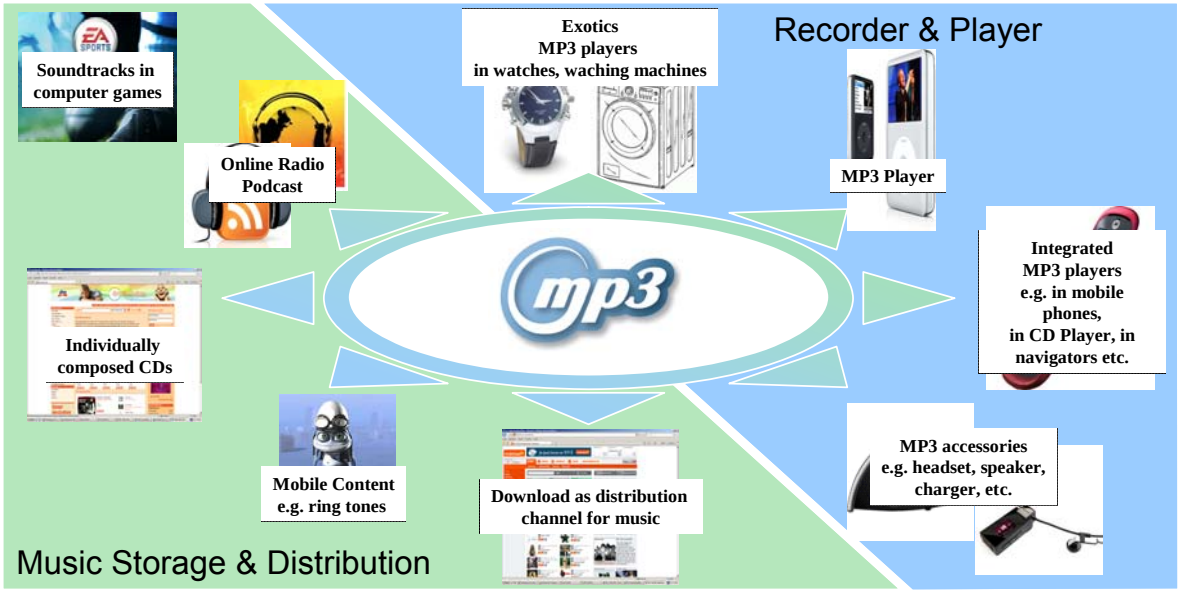
These arguments make obvious that there might be significant negative effects of integration IPR into standards, which have to be taken into account when considering the benefits.

The interaction between IPR and standards could lead to possible conflicts between the two and as a consequence could result in more costs. There might be a negative influence of patenting strategies on standardisation (Blind 2008b), e.g. blocking standardisation activities by withholding IPR essential for the content of the standard. Besides these strategic activities, the implementation of a standard can lead to an unintended infringement of IPR not known to be part of the standard. Such an infringement can also be caused by strategic ex post disclosure of IPR by submarine patents after completion of standardisation processes. Finally, if we assume no infringements, the licensing of IPR integrated into patents needs to be considered. IPR and especially patents integrated into formal standards released by NEN, CEN or ISO, have to be licensed by the owner according to Fair Reasonable and Non-Discriminatory (FRAND) conditions. However, it remains rather vague how FRAND is defined in practice. Finally, even if FRAND leads to reasonable licensing fees in the case of the single patent, the accumulation of licensing fees for IPR by different owners may generate licensing costs. Consequently, those interested in implementing the standard would incur higher costs.

4.2.5 The way to the MP3 standard

The MP3 standard is a successful example of the integration of IPR into a standard.. Since 1981 the University of Erlangen has conducted research within the Digital Audio Broadcast (DAB) project, which was part of the EUREKA research programme. The first patent applications were filed in 1987 and in the same year audio encoding research started at the Fraunhofer Institute for Integrated Circuits IIS. In 1992, the MPEG-1 Layer3 released as MP3 was published by the international standard standardisation committee MPEG (Motion Pictures Expert Group) founded in 1989. ´The members of MPEG with the official name ISO/IEC JTC1 SC29 WG11 included Sony, Phillips and EMI. A patent pool with all the relevant patents of the various patent owners was established in 1995. Then the massive distribution of MP3 files via Internet started, especially via the peer to peer file sharing networks such as Napster, Kazaa, eDonkey and others. Since 2000 MP3 has been a “de-facto” standard in the Internet. MP3 is a standard format and eponym for MP3 player and precursor of the AAC standard implemented in Apple’s iPods and iTunes software. Figure 5 illustrates the numerous products and services around MP3.

Figure 5: Innovations around MP 3 – products and services (Source: Fraunhofer IIS)



To illustrate the success of MP3, one can just mention that more than 100 million MP3-players have been sold world-wide and that MP3 has generated more than €100 million in license revenues for the Fraunhofer Society.

4.2.6 Business implications

The benefits and costs of integrating IPR into standards and the success story of MP3 technology have underlined the crucial implication of this interrelationship for businesses. First, IPR strategies have an increasing influence on standardisation, which in turn requires better coordination between IPR and standardisation at policy level, but also between related strategies at company level. For example, the strategic use of IPR in standardisation by Fraunhofer IIS generated licensing revenues, which are now used to fund research leading to similar success cases. Secondly, the possible conflicts between IPR and standards require a collaborative use of IPR in standardisation, e. g. by assuring transparency regarding own IPR in standardisation processes. Finally, improved IPR strategies, by making use of the options provided by standardisation, can help to optimise the licensing of IPR, even including royalty free agreements. This will allow the integration of the increasing numbers of IPR and IPR owners into standards.

In summary, the relationship between IPR and standardisation has numerous dimensions with positive and negative implications for both the economy as a whole and for companies. Businesses should try to exploit the opportunities and reduce the threats of this relationship.

4.3 Public Procurement and Standardisation

4.3.1 Background

Based on the insights on technology push and demand pull as drivers for successful innovations, coordination between the two forces is necessary. Furthermore the innovation system approach emphasises the relevance of integrating the demand side in successful innovation processes. As a result, we have recently observed an increased focus on demand driven innovation and policy in this area has gained further importance. The instruments of demand policy are direct public funding of demand for innovative products, subsidising private demand, public procurement, regulation and standardisation. So far we have see little focus on standardisation and no systematic use or coordination of the various instruments at all.

4.3.2 Impacts of innovation for public procurement

Besides the use of public procurement to push innovation, there are several positive impacts of innovation for public procurement. First, innovations can improve the quality of public services and public infrastructures, which may lead to a high customer, i.e. citizen, satisfaction. In addition, such improvements in public services represent an advantage in the intensified competition between regions. Second, innovations may lower the costs over the whole life cycle of a technology, e.g. by lower energy, maintenance and repair costs. However, innovations also have negative impacts for public procurers. First, the purchasing price might be higher due to new features or improved product characteristics. Secondly, innovative technologies, products and services bear higher risks for the user, but also e.g. for the environment, and can increase maintenance costs due to less experience. Finally, specific innovations can be made only by a small number of suppliers or even a single company.

Standards may help to foster the positive impacts and reduce the negative impacts. This topic will be discussed in the next section (Blind 2008a).

4.3.3 Innovation promoting functions of standards in public procurement

Standards can help to support the innovation promoting function of standards in public procurement by the following mechanisms. First, the implementation of standards in innovative products can reduce production costs and therefore the price to be paid by public procurers and the life cycle costs, e.g. by lower expenditures for repair and maintenance. Secondly, standards can secure the interoperability of the purchased

innovation with the existing infrastructure, which also includes the transition from old to new technologies, e.g. by lower costs for gateways or converters, Thirdly, standards push the competition and therefore the innovative pressure among competitors for public tenders. Fourthly, the use of standards reduces the risk of lock-in to a specific supplier. Fifth, there is a direct innovation effect for companies through the implementation of newly released standards referenced in tenders. Sixth, standards reduce the risks related to costs, health, the environment and safety for the public procurer and consequently create a leeway for the procurement of products and services with innovative characteristics. Finally, the use of standards in public procurement facilitates positive spill-over on innovation promoting procurement processes in the private sector. In summary, using standards in public procurement results in a long list of positive innovation promoting impacts.

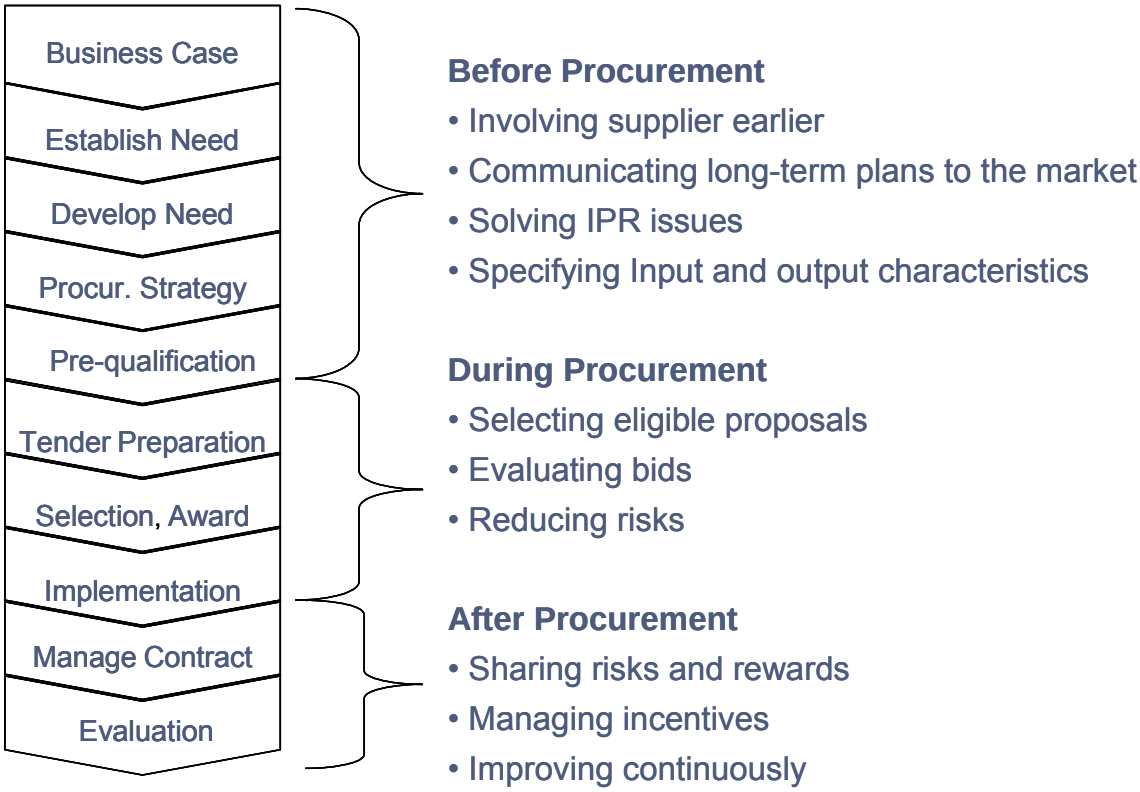
4.3.4 Role of standards in the public procurement process

Since the public procurement process is rather comprehensive, standards come into play at various stages. Before procurement, the supplier might be in discussion about the general options related to the upcoming procurement process, which should also include an analysis of the standards that might be appropriate. Consequently, the communication of long-term plans to the market should also include the standards that could be referenced. The strategic referencing of standards can also be used to solve IPR issues ex ante. Eventually standards are crucial for the specification of both the input, e.g. requiring specific qualification standards, and of the output, e.g. by asking for specific quality standards.

During the core procurement process, the selection of eligible proposals can be based on compliance to the required basic standards. The specific evaluation of the bids can be facilitated by considering standards, possibly with different performance levels. Eventually, possible deviations from the agreed performance of the delivered products or services can more easily be identified by benchmarking them to the referenced standards and possible conflicts can also be settled in court more easily with the help of standards.

After the completion of the procurement process, standards can reduce the transaction costs caused by liability cases by again identifying deviations from the agreed performance using standards as references. The same is true for rewarding outperforming contractors based on references to ex ante agreed standards. In case of long term contracts, the quality of the delivered products and services has to develop with the progress in technology, which can more easily be monitored by taking into account newly released standards.

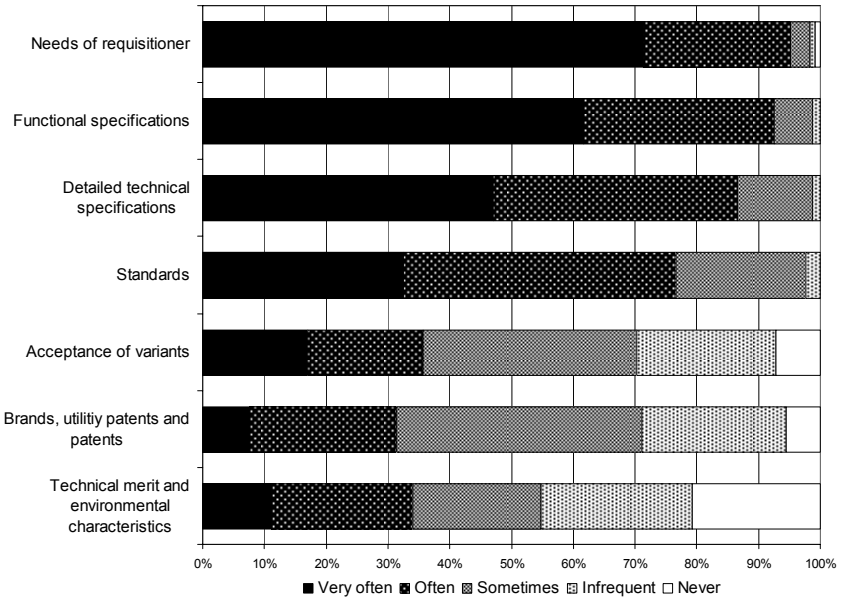
Figure 6: Role of standards in public procurement (Source: based on Office of Government Commerce 2004)



4.2.5 Role of standards in the procurement process in reality

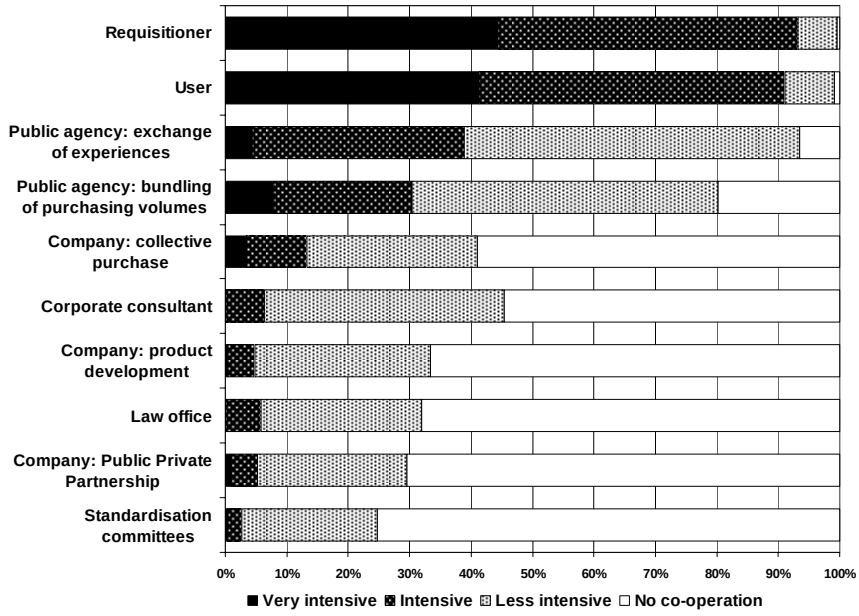
Although we have seen how standards can help to improve public procurement and support the public procurer in the decision processes and risk management, it is interesting to see what is actually happening in practice. A survey among more than 2000 public procurers in Germany, with a response of more than 200, reveals that more than 70% of include standards in the specification of their tenders (Figure 7). An analysis of documents of more than 500 tenders within the European project STEPPIN (www.steppin.eu) funded under the 6th Framework Programmes revealed that 40% indeed reference specific standards, especially the management standards series of ISO 9000 and 14000.

Figure 7: Likelihood of aspects included in the specifications of tenders (Source: Lorenz et al. 2009)



The actual practice of public procurers using standards confirms their multidimensional purposes. Both the theoretical considerations and the empirical evidence would suggest that public procurers are not only interested in referencing and using standards in the tendering processes, but also take the opportunity to contribute to the production of standards and to influence the specifications of the standards they are going to use. However, the procurers were also asked about the intensity of their cooperation with stakeholders and institutions. Figure 8 impressively underlines that public procurers do not establish contact with standardisation committees during the tendering process. This is a clear indication that they just make use of existing standards, but do not follow or participate in ongoing standardisation processes, although they may be influenced by them and even profit from them. The considerable discrepancy between using standards and the lack of contact with standardisation committees clearly shows a lack of awareness among public procurers of the benefits of being involved in standardisation processes, although they are convinced about the usefulness of standards for procurement processes.

Figure 8: Intensity of co-operation with different institutions during the tendering procedure (Source: Lorenz et al. 2009)



4.3.6 Business implications

The actual degree of usage by public procurers indicates that the theoretical considerations about the benefits of standards for the public procurement process have been acknowledged by the majority of public procurers, but interviews have shown that they are not completely aware of the benefits of standards, especially regarding their innovation promoting impacts. In addition, the focus of public procurers on popular management standards shows that they are not fully informed about the whole world of standards. Furthermore, they tend to use very technology specific standards in tenders, which is not very innovation friendly. Finally, public procurers are not involved in standard setting.

The general challenge is to convince public procurers about the benefits of making use of standards, which can be realised from the very beginning of the whole procurement process not only after its completion. In addition, the public procurer has to be proactively informed about the world of standards, because they can benefit not only from requiring management standards, but also from a large set of technical standards referenced in the technical specifications of tenders. In this context, it is necessary to increase awareness about the differences between innovation promoting and hindering standards. Finally, public procurers urgently need to be convinced that their input as major actors on the demand side and as possible users of standards is required in standard setting processes.

5. Summary of the Catalytic Functions of Standards

The three different areas and the examples have illustrated several catalytic functions of standards for innovation. First, the standardisation process reduces the time to market of inventions, research results and innovative technologies. Second, standards themselves promote the diffusion of innovative products, which is most important for the economic impact of innovation. A third more indirect, but important function of standards is that they level the playing field and therefore promote competition and consequently innovation. Fourth, compatibility standards are the basis for innovation in network industries e.g. for communication networks (e.g. GSM), which are increasingly penetrating our economies. In network industries, standards also facilitate the substitution of old technologies by new ones, e.g. by forward and backward compatibility, and also to allow the coexistence of old and new technologies. New platform standards are often the basis for innovation in downstream markets (e.g. GSM as platform for numerous mobile services), but also in upstream markets. Besides these network related functions, a generic characteristic of standards is that they reflect user needs and therefore promote the purchase, i.e. the diffusion, of new products by early adopters. Finally, standards set the minimum requirements for environmental, health and safety aspects and consequently promote trust especially in innovative products.

Despite all these catalytic functions of standards for innovation, there are also shortcomings and problems. First, standards are the outcome of a consensus process of all interested parties and consequently represent the smallest denominator, which is often not a strong incentive for innovation activities, compared to more challenging technological specifications possibly set by governmental top-down regulations. Second, standards which are technology-specific and over-prescriptive instead of technology-neutral and focused on functionalities and performance characteristics do not create leeway and competitive incentives for alternative innovative solutions. Third, standards can also create lock-ins in existing technologies, especially if they do not specify interfaces or allow compatibility with follow-up technologies, because this hinders consecutive innovations in an industry. Especially proprietary standards of single or groups of dominant players may prevent competing technologies to market access and therefore thwart innovation.

6. Recommendations

In order to promote the catalytic functions of standards for innovation and to avoid or at least to restrict the negative side effects, the following recommendations should be taken into account by standardisation bodies and involved stakeholders.

First, the wider the diffusion of the contents of standards, the greater their innovation promoting function. Standardisation processes should be open and transparent in order to include all potential competitors (also in downstream markets), but also science and research and the demand side, including public procurers. Thirdly, standardisation processes should be started in time in new fields of science, research and emerging markets in order to exploit the innovation promoting functions of standards from the very beginning and to avoid unnecessary fragmentations in the development of science and technologies. Fourth, standards with challenging and innovation-promoting requirements should also be allowed without discriminating potential competitors.. Technology-neutral performance standards should be preferred to technology-specific and over-prescriptive design standards. Sixth, during the specifications of standards, a balance has to be found between including as little proprietary content as necessary, but covering all relevant protected technologies. In this context, standardisation bodies should create incentives for owners of IPR to join standardisation processes, but should not allow competition prohibiting strategies. Finally and most important, standardisation management has to be established as a crucial element within innovation and strategic management in companies promoted by adequate education and supported by convincing research.

7. Future Research

In order to come up with convincing and attractive research to promote standardisation as a crucial element of innovation and strategic management, the attention should focus on the business implications of the catalytic functions of standardisation for innovation complementary to the already well developed and successful policy and public view.

A first step is linking data on the innovation activities of companies with information about their involvement in standardisation activities in order to investigate the role of standardisation among other innovation strategies and activities. A special dimension of linking standardisation and innovation activities is matching the former with companies' patenting activities. Besides these generic research challenges, there are other interesting and relevant areas for research into standardisation as a catalyst for innovation. Little research has been conducted into how converging technologies can benefit from standardisation as an integrative platform. The role of standards in service and non-technical innovations needs to be investigated. The question whether innovation, including open innovation, can be fostered by existing and adequate future management standards needs to be examined. In addition, the following complementary aspects of the promoting role of standardisation as catalyst for innovation have to be investigated. We observe a further differentiation of the standardisation landscape, e.g. standardisation consortia being closer to research and standardisation bodies offering new products, such as workshop agreements. These reactions reflect changes in technology and innovation processes, but also have implications for standardisation as a catalyst for innovation, which deserves further research. Besides these industry driven developments, standards are also playing a more important role in the regulatory framework, as successfully illustrated by the New Approach in the European Union, However, regulation can also act as a policy instrument for innovation (Blind 2010), which is both theoretically and empirically not well researched and still completely ignored in combination with standards. The overall objective of future research on standardisation as a catalyst for innovation is the complete integration of standardisation in innovation management as a whole, e.g. starting with technology foresight, on to IPR management, open innovation and finally innovation marketing.

Words of thanks

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I would once again like to thank Henk de Vries for his support when I started here last year by helping me to become fully integrated in the growing teaching activities in standardisation and in the common conduct of research projects. We hope that we will soon be supported by a future PhD candidate whose PhD thesis will focus on innovation and standardisation from a management perspective. Together with NEN and the Central Bureau of Statistics, we have set up databases, which should lead to promising, even path- breaking research on the topic of today's lecture.

Despite the limited time I spend here at RSM, I would like to thank the whole department for its support and I am looking forward to promoting the cooperation with the innovation group, which should lead to promising research activities. I would like to explicitly thank Carmen, who has supported me in all administrative issues from the very beginning and has also arranged this event today.

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