

1

Why Standards?

1.1 General Introduction

The history of standards goes back a long way. As early as 1750 BC, the Codex Hammurabi stated: 'The master of the building will receive a death penalty if he has constructed a house which breaks down and kills the people inside' (§229). The Third Book of Moses (19: 35–36) says: 'You shall not use incorrect length, weight and volume in front of the justice. Right weight, right balance and right volumes shall be used before Jahveh, your God, who has guided you out of Egypt to meet all rules and follow the rights.' This was written around 1000 BC.

In China, in 2200 BC, the Emperor Qin Shihuangdi produced common technical standards for the wheels of transport waggon, the width of the city gates, the dimensions of the streets, for measures of length and weight and for water pipes, weapons and armour.

Standards leave room for creativity when the government of a country sets up rules for traffic or for the format of film material, or when standards define test procedures for *Bacillus cereus* on worldwide basis.

Standards leave more room for creativity where each village sets up rules for traffic or if each camera manufacturer uses his own format for the film material or if each ice-cream manufacturer defines his own test procedure for *Bacillus cereus*.

Standards leave even more room for creativity when each car driver sets up his own rules for traffic, or if each photographer uses his own film material, or each ice-cream seller tests his ice cream by watching if people feel bad after eating it, or if each computer manufacturer uses his own hardware.

Standards are everywhere but we usually do not recognize them.

Credit cards are an example of standardization. Each bank could have developed its own credit-card design. Round, square, thick, thin, one or two chips and so on. Would they have

gained worldwide acceptance? Which would be best for withdrawing money from machines? Even the purse has adapted to the size of the credit card.

Paper sizes (such as B4 in the United States or DIN A4 in Europe) are another example of standardization. Paper sizes are used by printers, for envelopes, publications and so on.

Nobody is obliged to use standards – the only requirement is that products are safe. Manufacturers who do not use standards may find that their products are hard to sell and that it is difficult for them to gain acceptance. Not making the use of standards mandatory opens the door for research and new developments. If all manufacturers always had to use the same manufacturing process and use the same principles, the development of new products would be hindered.

If a new credit-card design appears that is better and safer, users will accept it and a new ‘standard’ credit card would develop and penetrate the market. All other services using credit cards would adapt to this new standard. This is only possible if the market is flexible and standards are not mandatory.

Standards are a way to create order and give a basis for cooperation. They offer state-of-the-art solutions for continuously repeated tasks.

Standardization is a regularly planned process of writing standards according to rules. It is not carried out for the benefit of any single interested party.

Waldemar Hellmich, the first chairman of the standardization organization for general mechanical engineering, Normenausschuss der deutschen Industrie, stated in 1917: ‘Writing standards is crucial work. Those involved often fight with nontechnical arguments for economic reasons.’

1.2 War on Standards

A ‘war on standards’ can happen when someone has an interest in avoiding standards in certain technical fields. There are various reasons why they happen. In most cases they ended up with more disadvantages than advantages for the industry and also for society. Today’s leading standardization organizations follow the recommendations of the WTO, which include rules to avoid such wars on standards.

Here are some examples. The width of railroad tracks varies for different reasons – for instance competition, military reasons or strategic reasons to protect markets. In the United States the railroad track width is different in the north and south. Spain and Russia are different from the rest of Europe.

Sometimes incompatibility may exist by chance or because nobody really recognized that it would be a problem at the beginning. Once it is there, it stays for a long time. In Europe this happened with the power supply, which is different in different European countries. The so-called ‘Europe plug’ came much too late. Now Europe is trying to avoid making the same mistake with charging plugs for electric vehicles.

Network markets are usually dominated by one strong player. Standardization interests need to be coordinated long before technical solutions have been marketed. The goal is to produce technical solutions with compatible designs so that users are able to choose from different manufacturers.

Technologies that do not comply with standards will not develop a strong market position. They will be locked into market niches. They will either have to adapt to the mainstream or they will stop business after a while.

In more recent history a war on standards involved the digital control of factories. The so-called ‘Profi Bus discussion’ in the 1970s concerned a standardized bus system to control machinery in factories. Two large groups of companies fought about the definition of the design of the bus system – about how many data lines and control lines there should be and their function.

It was not possible to agree a standard bus design but technical development continues. Millions of dollars have been invested in parallel developments of two different bus systems. There was no winner. The manufacturers had large additional development and design costs and the users could not gain from the technical development, increased functionality and reduction in price that standardization might have brought. The lessons from this antistandardization fight was that none of the main players will win.

In the 1990s, when digital communication had to be standardized, the global industrial community came together to design a common standard protocol. Counterparts on both sides of the Atlantic worked smoothly together in International Electrotechnical Commission (IEC) working groups.

1.3 Main Players

1.3.1 Europe

The framework for standardization in Europe is given by the World Trade Organization (WTO) and its rules for trade without technical barriers. In the European Union, the International Organization for Standardization (ISO) produces general standards, the IEC electrical standards, and the International Telecommunication Union (ITU) telecommunication standards. Europe follows exactly the same structure, with the Comité Européen de Normalisation (CEN) for general standards, the European Committee for Electrotechnical Standardization (CENELEC) for electrical standards and ETSI (European Telecommunications Standards Institute) for telecommunication standards – see Table 1.1.

This structure makes the European Union a very homogeneous region with regard to standards. The main goal of the member states was to create free market access for all member countries. The 28 member countries following EN standards make it the largest single market place in the world with more than 500 million people from Norway to Sicily and from Portugal to the Baltic countries.

Before harmonization, in the electrical field in different countries of the European Union, a total of close to 30 000 standards were used. Today the number is down to about 6000, including standards for new technologies that did not exist before.

The basis for this harmonization was organized by new European institutions – CEN, CENELEC and ETSI – with the technical support of experts financed by the industry.

Table 1.1 European standardization organizations.

	Europe	International
General	CEN	ISO
Electrical	CENELEC	IEC
Telecommunication	ETSI	ITU

No government was involved directly and this remains the case today. These so-called ‘self-regulating’ bodies are purely focused on technical questions and not on political issues. The European standardization organizations are, in principle, financially independent from politics and industry because their main finances come from membership fees of national standardization organizations, which generate their main income by selling standards.

In real life nothing is independent of political issues or social trends but CEN, CENELEC and ETSI can determine their own direction. European nations sometimes set up rules that are in conflict with EN standards. In such cases, so-called deviations are used for particular countries. Deviations from EN standards are possible but have to be harmonized as soon as possible.

For example, pressure-vessel applications have to follow national regulations or laws because politicians want to protect their people from exploding vessels. That is clear and understandable. On the other hand, different test methods and calculation rules require expensive development processes and testing. If each country has its own set of rules, the result in the end in each European country is the same: pressure vessels are safe – but the way in which this has been achieved is different in each country.

Gas-insulated substations contain devices to switch high-voltage power lines; the enclosures are pressure vessels and have to follow national rules. Before European harmonization the rules were different in almost any country. If a manufacturer placed an offer he had to calculate the additional cost for testing and certification. As all manufacturers must do so there is no competition and additional costs go directly to the customer and then to the electricity consumer. Before harmonization in Europe took place there were more than 20 different requirements for such pressure vessel tests and certification.

Today only one requirement for pressure vessels by a related EN standard is in place and only one deviation is left in the EN standards for high-voltage switchgear assemblies, which is for Italy. All other national legislatures have changed and adapted their regulations or laws for pressure vessels to the EN standards. For sure Italy will follow soon to adapt their national regulations. The advantage is clear. Today the manufacturer needs to follow only one procedure for testing and certification of pressure vessels for high voltage switchgear assemblies and he can serve all the EU member countries, only Italy requires special design rules.

Today the same EN standards are widely accepted outside Europe – in America, Africa, Asia, and Australia.

The European Union is often seen as overregulating daily life. Examples of this are requirements concerning the size of bananas, the radius of cucumbers, or the size of steps on ladders. This might be true and such requirements might be unnecessary but in the technical field of electrical equipment, services and systems, standardization in Europe has provided large benefits for users. In many cases European standardization is relevant globally because of active European participation in global standardization organizations like the IEC, ISO and ITU.

Standardization in Europe is often driven by industry. This does not only involve large industrial players; in many cases small and medium-size companies bring their knowledge and look for a global market. Small and medium-size companies use international standardization to make their products available on a global basis without needing sales and technical offices in any country.

International standardization promotes innovation and new technical solutions in a global market, gives new opportunities and helps to spread products in the world market.

1.3.2 America

Standardization in America differs from Europe on one key point: there are many standardization organizations providing standards at a local or regional level or in technical branch. In the electrical field the main organizations are the IEEE and the IEC; in some cases EN standards are also applied. Many sector-related organizations offer their standards in the market.

The Pan-American Standards Commission (COPANT) is a civil, nonprofit association. It is financed by its membership fees and by grants from the Organization of American States (OAS). The key objectives are the promotion of the development of technical standardization in its member countries to evaluate existing standards and to resist attempts to develop national standards if international or regional standards meet COPANT's national requirements.

The Forum of IEC National Committees of the Americas (FINCA) is a coordination body founded 2007 in Ottawa, Canada. The member countries coordinate their standardization interests every year at an IEC General Meeting. The members are Canada, the United States, Mexico, Colombia, Brazil, Argentina and Chile. The activities of American nations in the IEC and ISO are shown in Tables 1.2 and 1.3.

The dominant IEC member countries are the United States and Canada, which have a high level of participation in IEC technical committees (TCs) and hold many leading positions on the IEC as chairmen and secretaries. Mexico and Brazil are building up active participation in the IEC, while Argentina, Columbia, Cuba and Chile are just starting their activities with the IEC.

The long list of ISO members in America shows the wide spread of this international organization and its deep links with even the very small nations. Many more member states are active with the ISO than the IEC.

The Council of Harmonization of Electrical Standardization of the Nations of America (CANENA) is a regional standardization organization in North America's NAFTA region. It was founded in 1992 to foster the harmonization of electrotechnical standards, conformity assessment test requirements and electrical codes. It does not publish its own standards but coordinates participation in standard-writing organizations.

There is a similar organization in the Mercosur countries of South America. American Mercosur Nations (AMN) coordinate standardization activities with the goal of harmonization. It does not publish standards.

Table 1.2 American members in IEC technical committees (TC). The numbers show how many experts have been nominated to the organizations.

Nation	Organization	P member of TC	O member of TC
Argentina	CEA	4	11
Brazil	COBEI	31	51
Canada	SCC	93	26
Mexico	CEM	46	57
USA	ANSI	154	–
Colombia (associated)	ICONTEC	4	–
Cuba (associated)	ICONTEC	4	–
Chile (in preparation)			–

Notes: P – member has full voting rights; O – Member can comment.

Table 1.3 American members on ISO technical committees.

Nation	Organization	Nation	Organization
Argentina	IRAM	Jamaica	BSJ
Barbados	BNSI	Mexico	DGN
Bolivia	IBNORCA	Nicaragua	SON
Brazil	ABNT	Panama	COPANIT
Canada	SCC	Paraguay	INTN
Chile	INN	Peru	INDECOPT
Colombia	ICONTEC	Saint Lucia	SCBS
Costa Rica	INTECO	Saint Vincent and the Grenadines	SVGBS
Cuba	NC	Suriname	SSB
Ecuador	INEN	Togo	CSN
El Salvador	CONACYT	Trinidad and Tobago	TTBS
Guatemala	COGUANOR	United States	ANSI
Guyana	GNBS	Uruguay	UNIT
Honduras	COHCIT		

Table 1.4 provides an overview of American organizations involved in standardization at a national level.

In South America there is some competition between standardization organizations. On one hand, organizations from the NAFTA area in North America, like the American National Standards Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), Underwriter Laboratories (UL) or the National Electric Manufacturer Association (NEMA), are promoting their standards; on the other hand, the international standardization organization, IEC, based in Europe, offers its own standards.

In Brazil, Argentina, Colombia and other nations, this results in requirements that specify several standards, so devices and products are overdesigned and more expensive. This situation also leads to higher costs for design, development and manufacturing because of smaller numbers following each standard. At the end this leads to higher costs for users and customers.

Such conflicting standardization can also be seen in South Africa, Australia and parts of Asia. In recent years a new player in the field of standardization has arrived on the scene: China and its SAC standards.

1.3.2.1 United States of America

1.3.2.1.1 General

The electrical network in the United States is one of the largest in the world and so is the standardization structure and organization. Since early industrialization, the United States has been continuously developing the electric system and technical standardization has developed with it.

Spread over many industrial sectors, business is a big driver for standardization. Once a new business opportunity is identified the related standardization organizations develop new standards in competition and government organizations support standardization with laws, regulations and, in some cases, with grants to finance expert groups.

Table 1.4 An overview of American organizations involved in standardization at a national level.

Country	Organization	Abbreviation
Argentina	Instituto Argentino de Normalización y Certificación	IRAM
Barbados	Barbados National Standards Institution	BNSI
Bolivia	Instituto Boliviano de Normalización y Calidad	IBNORCA
Brazil	Associação Brasileira de Normas Técnicas	ABNT
Canada	Standards Council of Canada	SCC
Chile	Instituto Nacional de Normalización	INN
Colombia	Instituto Colombiano de Normas Técnicas y Certificación	ICONTEC
Costa Rica	Instituto de Normas Técnicas de Costa Rica	INTECO
Cuba	Oficina Nacional de Normalización	NC
Ecuador	Instituto Ecuatoriano de Normalización	INEN
El Salvador	Consejo Nacional de Ciencia y Tecnología	CONACYT
Grenada	Grenada Bureau of Standards	GDBS
Guatemala	Comisión Guatemalteca de Normas	COGUANOR
Guyana	Guyana National Bureau of Standards	GNBS
Honduras	Consejo Hondureño de Ciencia y Tecnología	COHCIT
Jamaica	Bureau of Standards Jamaica	BSJ
México	Dirección General de Normas/Secretaría de Economía	DGN
Nicaragua	Ministerio de Fomento, Industria y Comercio y Dirección de Tecnología, Normalización y Metrología	MIFIC
Panamá	Comisión Panameña de Normas Industriales y Técnicas	COPANIT
Paraguay	Instituto Nacional de Tecnología y Normalización	INTN
Perú	Instituto Nacional de defensa de La Competencia y de La Protección de La Propiedad Intelectual	INDECOPI
República Dominicana	Dirección General de Normas y Sistemas de Calidad	DIGENOR
Santa Lucia	Saint Lucia Bureau of Standards	SLBS
Trinidad y Tobago	Trinidad and Tobago Bureau of Standards	TTBS
United States	Estados Unidos de América American National Standards Institute	ANSI
Uruguay	Instituto Uruguayo de Normas Técnicas	UNIT
Venezuela	Fondo Para la Normalización y la Certificación de la Calidad Fdn: Fondo de desarrollo Para la Normalización, Calidad, Certificación y Metrología	FONDONORMA/FDN

Smart Grid is an example of how the standardization process works in a new technical field in the United States. It will bring new intelligent sensors, meters and digital control devices into use and will create solutions for a complex electric power system. Electric power generation in the Smart Grid world will use a mixture of generation resources – gas, coal nuclear, wind, solar, geothermic, biomass and water. In addition, different storage technologies for electricity will be developed with hydropower storage plants, chemical processes to generate

hydrogen from wind or solar energy and electric batteries. Combined with intelligent electric loads for industrial processes, home electric management systems, electromobility and decentralized generation with photovoltaic panels on the roof, the need for digital real-time control offers many new business models for saving, selling or trading electricity. All these activities will drive new business in the electricity market and need standardization.

Standard-developing organizations combine their industrial activities in different subject-related organizations under competitive conditions. The National Electric Manufacturer Association (NEMA) has created a Smart Grid Advisory Panel to formulate requirements on technical standards for Smart Grid.

The US IEC National Committee, with the support of NEMA, formulated the Gridwise Architecture Council (GWAC) to present this to IEC TC 8, to initiate the Smart Grid Strategic Advisory Group in the IEC to study the role of the IEC in international standardization efforts for Smart Grid. The US National Committee was selected to lead this effort for the United States.

In the IEEE Standards Coordination Committee, SCC 21 conferences have been hosted by IEEE on the issue of Smart Grid and to develop documents like Energy 2030 or IEEE P2030 to gain a lead in the technical interpretation of the influences on, and needs of standardization for, Smart Grid.

The IEEE played a central role in contacting the National Renewable Energy Lab (NREL) and the Department of Energy (DoE). From this, the IEEE Standards Association Board started several standardization projects in different technical areas on Smart Grid.

This short example should show how standardization organizations become involved as soon as industry has identified future business. Without future business no standardization work will be started because the experts in the standardization working groups are from industry and are getting paid by industry. Finishing a standard typically requires a period of 3–4 years with two or more experts' meetings in the United States or internationally.

How is this environment structured in the United States?

1.3.2.1.2 Legal Framework

The responsibility for standardization on the government side is linked to the Department of Commerce (DoC). The National Institute of Standards and Technology (NIST) was established based on the National Technology Transfer and Advancement Act of 1996. The NIST signed a Memorandum of Understanding (MoU) with the American National Standards Institute (ANSI) to put in place rules about how standards have to be written. It received the right to control the standard-writing process for any accredited standard-developing organization in the United States (see Figure 1.1).

The US regulator uses voluntary standards to offset the need for additional regulations or to enhance existing regulations. On the other hand, if regulations are necessary, US regulators are required by law to use voluntary standards whenever possible. There are more than 6500 laws and regulations in place that refer to standards.

1.3.2.1.3 Comparison between the United States and the European Union

The legal framework in the United States is different from the situation in Europe, where European Directives only provide the framework for standards. Standards in Europe (EN) are the technical specifications for the directives.

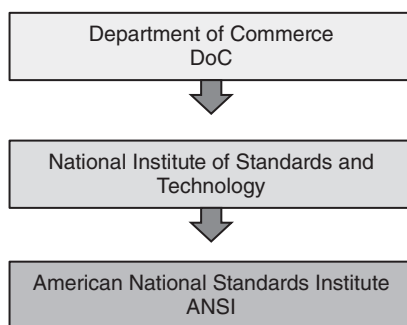


Figure 1.1 Legal framework of standardization in the United States.

In the United States, standardization is seen as national, whereas Europe operates on a multinational basis. Each European standard must be changed into a national standard and must remain in accordance with national laws and regulations.

In the United States, standards are primarily seen as strengthening the economy and improving quality of life. In Europe the primary goal of EN standards is to harmonize national conditions and to reduce trade barriers in the European Union.

In the United States consensus standards come from industry or governmental agencies. In Europe there are only two consensus standard organizations: CENELEC for electricity and CEN for anything else. The United States has more than 270 standardization organizations accredited by ANSI – agency standards, for example FCC or FDA, and standards from NIST.

In Europe only three standardization organizations release European standards: CEN, CENELEC and ETSI. In addition, each of the 28 member countries has its own standardization organization, which has to follow EN standards when they are available and can write its own standards if no other EU country is interested – see Chapter 4.

In the United States the application of standards is voluntary in general and only required in the regulated domain of public entities. In Europe, the EN standards are only applied voluntarily. In cases when European Directives (regulations) apply, standards may be mandatory. In such cases the manufacturer or trader displays the EU conformity sign to indicate compliance with these standards and regulations.

In the United States, national and international standards coexist and might conflict. Market participants are free to choose the standards that best fit their needs. It is not the case that ‘one size fits all’. In Europe, CEN and CENELEC have formal agreements with ISO and IEC (the Vienna and Dresden Agreements) to reach the maximum level of convergence – see Table 1.5.

The agreement with the World Trade Organization (WTO) in the United States is signed by ANSI, which is linked to the government. In Europe the WTO agreements are signed by CEN, CENELEC and ETSI, which are private organizations with a nonprofit orientation and no direct government control.

1.3.2.1.4 Understanding the US Standardization System

There are several misunderstandings about the standardization system in the United States. The European view of the United States is often influenced excessively by the systems used in Europe and does not see that the different approach in the United States also works very efficiently.

Table 1.5 A comparison of US and EU standardization.

United States	European Union
National	International
Strengthen economy and improve quality of life	Remove national trade barriers
• Industry consensus • Governmental agency consensus • 270 SDOs accredited by ANSI • Agencies (FCC, FDA, NIST)	Only CEN and CENELEC consensus
Voluntary application when unregulated	• CEN, CENELEC, ETSI • National Institutes
National and international standards coexist	Voluntary application with presumed conformity
	Formal agreements
	ISO-CEN and IEC-CENELEC
WTO signed by ANSI	WTO signed by CEN, CENELEC, ETSI

One statement that is often heard is that the United States is not committed to ISO or IEC. This is not true. The US National Committee, ANSI, is one of the biggest contributors to ISO and IEC. This is the case for leading roles like chairman and secretaries and also at the level of experts in the working groups. In some technical fields, like digital communication or computers, the United States sometimes has a dominant role.

What the United States does not do is to adopt any ISO or IEC standard routinely in a national standard as is done in Europe with the EN standards – with a requirement that it be adopted by national standardization organizations of the members of the EU. On the other hand this does not mean that ISO or IEC standards are not used in the United States. The use of IEC and ISO standards is up to the standard user. Users of standards are free to choose those standards that best fit their needs. Only in cases where there are regulations or legal requirements in the United States might it be necessary to follow specific standards, such as the National Safety Code. So standard users in the United States are much freer to use standards they like most.

Another statement often heard is that the United States is not committed to the withdrawal of conflicting standards. The use of ISO and IEC standards is not mandatory in the United States. There is no centralized organization, like CENELEC in Europe, to withdraw standards of other organizations. The decision to use an ISO or IEC standard is made by the standard user and depends on his requirements.

A further statement that is heard is that the United States does not use ISO or IEC standards. This is not true. The United States is using ISO and IEC standards but the United States believes that standards from other long-established organizations that develop and publish standards have a role that complements that of the ISO and IEC in certain technical fields. Again it is up to the user of standards to decide which standard his specification will follow. This could also be a mix – one requirement from one standard and another requirement from another standard.

Some believe that the United States, with ANSI, promotes standards that originate in the United States ahead of ISO and IEC standards. This is not correct: ANSI promotes the use of market-relevant international standards whoever publishes them and wherever they are published. They may originate from the ISO or the IEC or another standardization organization. What is more important is the standard user's experiences with standards and his specific knowledge of the technical details of standards. If some company has had good experiences

with specifications that follow, for example, an IEEE standard, it is very likely that the next specification will follow the related IEEE standard too. In such cases it will be not be easy to convince the user to use any other standard, such as IEC or ISO standards.

The statement that the standardization system in the United States is fragmented, with many uncoordinated standardization organizations, is not really true. At the first glance the United States has more than 270 accredited standard-writing organizations, which is certainly a big number. But looking more deeply, many organizations are working in different technical areas or operate in different regions or have different organizational structures (private, public, state, county, city). The standardization system of the United States is more decentralized but it is not fragmented. Real duplication of work and standards is prevented by the well coordinated voluntary expert system, with experts sent and paid by companies. They will not pay if a standard that they need has been published somewhere – they just will use it.

It is true that the United States has differing state requirements on technical standards. This is the case because the US constitution grants this freedom to any state in the federal union. Different state requirements lead to different effects in technical sectors and ends up with different strategies. One significant example today is that Texas focuses on the installation of renewable wind energy generation whereas Arizona focuses on solar photovoltaic generation. Different strategies are leading to different state tax and sponsoring models, which lead to different results in the end. This is often not understood in Europe, which sees the United States as one nation. In many aspects state rules differ widely from state to state – as in European nations.

1.3.2.1.5 Standardization Entities

In the United States a large number of entities are engaged in the standardization market. Driven by market interests and future business possibilities, industries and experts are entering the standardization scene. In most cases the experts are contributing to one of the 270 accredited standardization organizations or they start with a new consortium – whichever best fits their needs. Government has responsibilities for controlling the standardization market to maintain high-quality standardization organizations.

The roles of the main players in the United States are discussed below.

Government

The Department of Commerce (DoC) is responsible for national and international standardization. Technical work on standardization in the United States is delegated to NIST and to ANSI.

The government also provides financial support to ANSI to fulfil its duties and to set up specific technical investigations to promote and prepare standardization.

Outside the United States, embassies support standardization. United States' embassies operate so-called standards attachés to represent the United States in standard activities in countries where they are based. This shows how important standardization is regarded by the US government.

In bilateral agreements with other nations the United States supports the World Trade Organization (WTO) in removing trade barriers. In such agreements, trade rules between the nations are linked to the use of standards following the rules of the WTO.

The US government also gives direct financial support to the outreach programs of standard-developing organizations in important regions. With such financial support, technical experts

are sponsored, for example, to participate in technical standardization meetings worldwide. This financial support shows the importance of international trade for US industry.

Examples

These examples are taken from the Department of Commerce's Market Development Cooperator Program – web site: <http://trade.gov/mdcp/> (accessed 2 March 2016).

- Steel Founder's Society of America. Led by this trade association, a Market Development Cooperator Program award of \$172 000 will support experts' participation in ISOTC 17 for steel products with the intention of influencing European and Chinese standards.
- Consortium for Standards and Conformity Assessment (CSCA). A cooperative effort of standards organizations American Society of Mechanical Engineers (ASME) and the ASTM: American Society for Testing and Materials (ASTM), the American Petroleum Institute (API) and CSCA America. The \$ 400 000 MDCP award and technical assistance will help CSCA establish a presence in Beijing. The goal of CSCA Beijing is to form relationships with peer agencies, monitor standards development and promote acceptance of consortium members' standards and conformity assessment systems.

These two examples show how financial support is organized in a very transparent way by making it public on the Internet, together with the goals linked to the money spent.

National Institute of Standards and Technology (NIST)

The National Institute of Standards and Technology (NIST) was founded in 1991 as a nonregulatory federal entity within the US Department of Commerce for Technology Administration. The mission of NIST is to develop and promote measurements, standards and technology and to enhance productivity, facilitate trade and improve quality of life. It does not produce and publish standards or regulations. There is no formal relationship or mandate between NIST and ANSI. More about NIST can be found under <http://www.nist.gov/> (accessed 2 March 2016).

The American National Standards Institute (ANSI)

The American National Standards Institute (ANSI) plays a central role in the standardization system of the United States. It controls US participation in ISO and IEC as one of its major roles. An industry, as a member of ANSI, nominates technical experts to be sent to standardization organizations. For IEC, ANSI forms the United States National Committee (IEC US NC) as the formal link to IEC. Experts are nominated and standards are voted on and commented on. The US NC of the IEC sends delegates to represent the United States at technical meetings.

Technical experts are nominated by ANSI to the organization levels of ISO at working level and at leaders' level in technical committees.

The American National Standards Institute represents the United States in the International Accreditation Forum, a worldwide organization for coordinating conformity assessment accreditation bodies in the field of management systems, products, services, personnel and other similar programs of conformity assessment (www.iaf.nu, accessed 7 February 2016).

It also sends delegates to COPANT, the pan-American organization for standards coordination, and to PASC, the Pacific Area Standards Congress, which coordinates standardization

Box 1.1 ANSI-accredited US standard-developing organizations.

3-A	ASC X9	ASA	ACCA	AMCA	ARI	ATIS	AA	AAMA	AAMVA
ABMA	ABYC	ABMA	ACC	ACI	ADA	AFPA	AGA	AGMA	AH&LA
AIHA	AIAA	AISC	AITC	AISI	ALI	ANS	ANLA	API	ASNT
ASQ	ASAE	ASB	ASCE	ASHRAE	ASME	ASSE	AWWA	AWS	AWEA
ATA	ACMI	ASIS	AIIM	AMT	NPES	AAMI	ACDE	AHAM	ARMA
ASTM	AIM	AGRSS	ALI	BHMA	BICSI	BOMA	BIFMA	CCPA	CSAA
CAPA	CLSI	CFPMI	CAP	CPA	CAGI	CGA	CAM-I	CEA	CSPA
CEMA	CTGI	CSA	DISA	DASMA	EIMA	EASA	EIA	ESTA	EIA
EOS/ESC	FCI	FM	GTEEMC	GICC	GEIA	BEI	HPVA	HIBCC	HL7
HPS	HFES	HI	IESNA	ITSDF	IEEE	IEST	IIE	INMM	12AMA
IAF	IAAMC	IAPMO	ICPA	ICC	ITI	NETA	I3A	IIAR	ISEA
ISO	ASANTA	IWCA	IPC	ISA	JCSEE	KCMA	LIA	MSS	MHI
MBC	NACE	NAHBRC	NAAMM	NBBPVI	NBFAA	NCMA	NCSL	NCPDP	NECA
NEMA	NFPA	NGA	NGCMA	NISO	NIMS	NIST/ ITL	NPPC	NSC	NSAA
NADCA	NERC	NAESB	NALFA	NASPO	NSF	NIRMA	OLA	OPCC	OEOSC
OPEI	PMMI	PSA	PCA	PWMA	PMI	RPTIA	RSTC	RVIA	RESNA
RIA	RMA	SIA	SSFI	SIA	SMA	SPRI	SBS	SAE	SCTE
SMPTE	SVIA	SAAMI	SES	SDI	SJI	SSCI	TIA	TCATA	CI
TMS	SPI	TCA	TOY-TIA	TAPS	TCIA	TPI	USDA	USPRO	UL
UAMA	UAMA	UCC	VITA	WQA	WDMA	ECMA	WMMA		

in the Pacific Rim countries. In the United States today there are more than 270 standard-developing organizations accredited by ANSI. Box 1.1 shows a sample of 188.

The American National Standards Institute has an annual certification process in place to control the standardization work of accredited standards organizations.

To express the role of ANSI in a more striking form: ANSI is preparing the rules by which standard-developers operate, driven by experts from companies, government, agencies and other standard users.

In some regulated market environments, ANSI and industry cooperate closely with regulatory bodies like the Federal Communication Commission (FCC) for standards involving, for example, radio frequencies, or with the Federal Food and Drug Administration, for standards in the health sector.

International Electrotechnical Commission participation is the responsibility of the US National Committee Council (US NC Council). The members of the US NC Council are nominated by the board of directors of ANSI. The US NC Council nominates experts to working groups or maintenance teams in the IEC or it delegates representatives of the United States for the Technical Committee meetings. The US NC Technical Management Committee also administers the IEC secretariats and chair positions held by the United States in the IEC.

The US NC IEC Council coordinates the involvement of the United States in the IEC and other electrotechnical bodies associated with the IEC. It also coordinates US NC activities with appropriate standards boards to promote consistency between those international and national activities that fall within the scope of the IEC.

1.3.2.1.6 American Society of Mechanical Engineers

The American Society of Mechanical Engineers (ASME) is a globally recognized standardization organization used in more than 100 countries. There are 24 ASME Codes and Standards Programs, with standards translated into six different languages.

The ASME standards mainly cover boilers and pressure vessel requirements. ASME also prepares rules for the accreditation process. Such boilers are widely used in power plants to heat up the water to steam and use it in steam turbines to generate electricity – an important technical field. Others are used in chemical plants, refineries, pharmacy, pipelines and many other applications with pressure in an enclosure. These ASME codes and standards are widely used in North, Central and South America, in Asia and Africa but not so much in Europe where the so-called Euro Code is used.

Other top-ranking technical areas for the application of ASME are piping for gas, water and liquids; elevators; escalators; nuclear codes and the performance of test codes.

1.3.2.1.7 American Society for Testing and Materials

The American Society for Testing and Materials (ASTM) was founded in 1898 in the United States. It has developed and published more than 14 000 standards based on an international, voluntary consensus process. More than 30 000 experts from over 125 countries are participating in the standardization work and 138 technical committees focus on areas such as materials, products, systems and services, and develop standards for technical fields, as shown in Box 1.2.

The international impact of ASTM may be seen from the fact that 40% of its standards are sold outside the United States. There are memorandums of understanding with national standard bodies in over 40 nations for the use of ASTM standards.

ASTM is the number one standard-developing organization in the United States on the government regulatory list. This means that more than 3000 standards out of a total of 6500 standards are referenced by the US Codes of Federal Regulations.

1.3.2.1.8 Underwriters Laboratories

Underwriters Laboratories (UL) is a third-party certifier. In recent decades UL developed into a more global organization, with 25 offices around the world and with an increased amount of work done outside the United States.

The mutual recognition agreement (MRA) with Canada is the basis for accepting test reports and certification. This has the advantage that only one witnessing test is required to allow joint submission to both the UL for the United States and the CSA for Canada. The Component Recognition Program provides acceptance by one organization of certification by the other organization.

Box 1.2 Technical fields of ASTM.

Metals	Paints	Plastics
Textiles	Petroleum	Construction
Aviation	Energy	Medial services and devices
Consumer products	Environment	Computerized systems
Electronics	Homeland security	

1.3.2.1.9 Impact on the World Market

The strategic goal of US standardization organizations to become active on the world market with their own standards beside ISO and IEC will lead to a market split. The market will be divided, with ISO/IEC versions and US-based standards and different requirements. This is a disadvantage for the user or consumer because the scale of the market shrinks; the manufacturer needs to provide different technical solutions at higher development and design costs.

The main areas of conflict today are in Brazil and China, where both standardization worlds exist side by side and in conflict. Global harmonization and coordination is necessary to reduce high costs and to save the limited time of experts involved in writing standards. It is not possible for manufacturers and users to work in parallel in different standardization organizations on the same subject.

It will be to the benefit of all who are involved with international organizations to promote only harmonized standards coordinated by technical fields. The convergence of standards is important; overlap is expensive and hinders technical development. A fight on standardization content of standards must be avoided for the sake of all participants. Cooperation is needed.

The technical field of standardization is growing so it is necessary to share work between all standard-writing organizations.

1.3.2.2 Mercosur

Mercosur is a union of nations in South America, except the Andean nations. Mercosur nations are Argentina, Brazil, Paraguay, Uruguay and, as invited members, Bolivia and Chile. The Mercosur nations are organized in the standard-developing organization, Mercosur Association of Standardization (AMN). The members are shown in Table 1.6.

The organization of AMN is shown in Figure 1.2.

The members of AMN are delegated by the national committees of the member countries. They are delegates of the Directive Council and the Executive Secretariat. The standardization areas are split into technical committees (CSM) where CSM 01 is responsible for electricity and CSM 03 for electronics and telecommunication. The electricity sector is further split into four subcommittees (SCM), where SCM1 is responsible for electricity, SCM2 for cables and conductors, SCM3 for consumer goods and SCM4 for lighting.

The development of standards in AMN occurs in the following steps. At the draft stage, the document is sent to the members for consideration and comments. After final draft document is reached, an approval process by consensus is started. The document will be sent to national members of the technical committee (CSM or SCM) for balloting and comments. When the national standardization bodies have approved the document it will be published and registered as a Mercosur standard.

There are more than 30 technical committees for different sectors of standardization as shown in Table 1.7.

One principle of standardization in AMN for Mercosur is the prioritization of international standards coming from IEC, ISO or ITU. If no standard is found there, the priority is next given to the regional standards of COPANT for all South America. Only if no standard can be found at the international level and the regional level of South America will AMN publish a new document for the Mercosur nations.

Table 1.6 Members of Mercosur Association of Standardization (AMN).

Nation	Organization	Founded	Type
Argentina	IRAM Instituto Argentina de Normalización www.iram.org.ar (accessed 11 February 2016) Private organization	1935	Full member
Brazil	ABNT Associação Brasileira de Normas Técnicas www.abnt.org.br (accessed 11 February 2016) Private organization	1940	Full member
Paraguay	INTN Instituto Nacional de Tecnología y Normalización Paraguay www.intn.gov.py (accessed 11 February 2016) Governmental organization	1963	Full member
Uruguay	UNIT Instituto Uruguayo de Normas Técnicas www.unit.org.uy (accessed 11 February 2016) Private organization	1939	Full member
Bolivia	IBNORCA Instituto Boliviano de Normalización y Calidad www.boliviacomercio.org.bo/ibnorca (accessed 11 February 2016) Private organization	1963	Invited member
Chile	INN Instituto Nacional de Normalización www.inn.cl (accessed 11 February 2016) Governmental organization	1962	Invited member

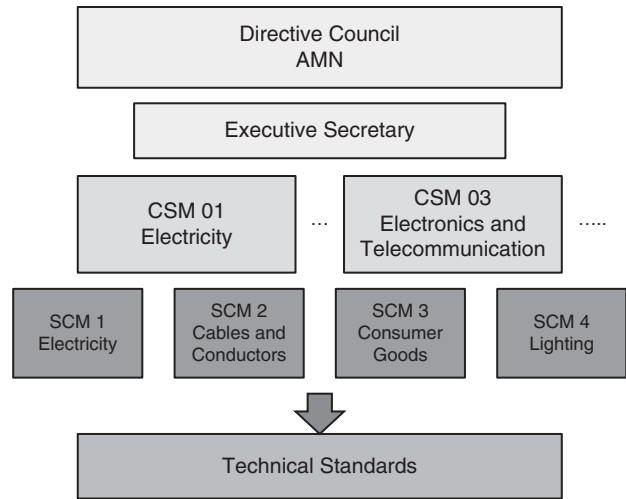


Figure 1.2 The organizational structure of AMN.

Table 1.7 Sectors of CSM technical committees.

CSM No.	Sector	Secretariat
CSM 01	Electricity	ABNT, Brazil
CSM 02	Metallurgy	IRAM, Argentina
CSM 03	Electronics and telecommunication	ABNT, Brazil
CSM 04	Toys	IRAM, Argentina
CSM 05	Cement and concrete	ABNT, Brazil
CSM 06	Mechanical machines and equipment	ABNT, Brazil
CSM 07	Automotive	IRAM, Argentina
CSM 09	Plastics for civil construction	ABNT, Brazil
CSM 12	Paper and cellulose	ABNT, Brazil
CSM 13	Quality	IRAM, Argentina
CSM 16	Environmental management	ABNT, Brazil
CSM 17	Accessibility	UNIT, Uruguay
CSM 18	Graphic technology	ABNT, Brazil
CSM 20	Clinical analysis and <i>in vitro</i> diagnosis	ABNT, Brazil
CSM 21	Sheet glass	ABNT, Brazil
CSM 22	Conformity assessment	IRAM, Argentina
CSM 23	Tourism	ABNT, Brazil
CSM 24	Nondestructive testing	IRAM, Argentina
CSM 25	Packaging	INTN, Paraguay
CSM 26	Food safety	IRAM, Argentina
CSM 27	Software quality	UNIT, Uruguay
CSM 28	Information safety	ABNT, Brazil
CSM 90:01	Lighters	IRAM, Argentina
CSM 90:02	Gas cylinders	IRAM, Argentina
CSM 90:03	Vehicles using gaseous fuels	IRAM, Argentina
CSM 90:04	Textiles	ABNT, Brazil

The European standards of CEN and CENELEC will also be checked before ANM starts its own standardization work. To coordinate these activities AMN has reached agreements with ISO, IEC, COPANT, CEN and CENELEC.

The goal of this coordination activity of AMN is to reduce deviations in different standards as much as possible for the Mercosur market. This is to the benefit of users and consumers, to avoid additional costs arising from uncoordinated standard requirements. Differing standard requirements are trade barriers between the Mercosur countries and the rest of the world. National deviations in standard requirements should be avoided.

Cooperation between Brazil, Argentina and Chile on the one hand and CEN and CENELEC on the other hand in recent years, based on a cooperation protocol signed in 2004, and stronger engagement in IEC and ISO standards, could improve standardization harmonization in Mercosur nations.

Publications

Publications in Mercosur nations are released by AMN and are identified as Norma Mercosur (NM) with a number. They are published by the national standardization bodies. There are three types of NM publications: two are based on international standards (ISO and IEC) and the other is made by AMN.

International Standards without Deviations

In the case of a Mercosur publication based on an international standard, the identification is as in the following example:

NM-ISO 15189:2008
Laboratorios de análisis clínicos.
Requisitos particulares para la calidad y la competencia.
Requisitos especiais de qualidade e competencia.
Sustituyendo a la norma IRAM-ISO 15189:2005

International Standard with Deviation

In the case of a Mercosur publication based on an international standard the identification is as in the following example:

NM 60884-1:2001 (IEC 60884-1:1994, MOD)
Plugues e Tomadas – Uso Doméstico e Análogo, ABNT NBR

American Mercosur Nations (AMN) Standard for Mercosur

In cases where there is no international based standardization publication the identification is as in the following example:

NM 243:2000
E+L Series – Nora Lighting

1.3.2.2.1 Argentina

The standardization organization in Argentina is embedded in the Mercosur regional structure and international standardization. Figure 1.3 shows the structure.

The standardization process in Argentina is led by IRAM for the nomination of experts to the Mercosur standards organization (AMN) and to the ISO. The National Standardization Committee of Argentina (CEA) is the link to the IEC. It participates in technical work by nominating experts or sending comments and voting on IEC documents. The National

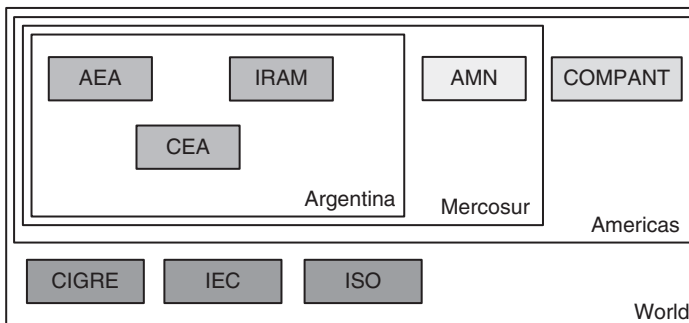


Figure 1.3 Structure of standardization in Argentina.

Table 1.8 Accredited product certifiers.

Organization	Area of activity
IRAM	Electric, electronic toys, personal protection, auto parts, bicycles,
Instituto Argentino de Normalizacion y Certificacion	lightners, latex painting, refrigerator, energy labelling, coolers, lamps, fruit, vegetables, flowers, coffee, tea
Bureau Veritas Argentina S.A.	Electric products, lightners, energy efficiency, refrigerators, coolers, efficiency of lamps
TÜV Rheinland Argentina S.A.	Electric products, steel, toys, energy efficiency, labelling for refrigerators, lamps, air conditioners, wind turbines
IQCSA	Electric products, toys, lightners, energy efficiency, labelling for lamps and EPP
UL de Argentina S.R.L.	Electric products for personal protection
IRAM-ITS-IMQ S.A.	Electric products
Instituto del Gas Argentina S.A.	Electric products
Net Connection International S.R.L.	Electric products
CAYLAS Consultores	Electric products
Assesiados S.R.L.	
SGS Argentina S.A.	Fruit and vegetables

Electrotechnical Association of Argentina (AEA) participates in the international work of the International Council on Large Electric Systems (CIGRE).

Accreditation in Argentina

There are several local and international organizations active in Argentina for Product Accreditation and Certification. Table 1.8 gives some examples.

Standardization System in Argentina

The national standardization organization of Argentina, which represents the country in the IEC, is Comité Electrotécnico Argentina (CEA). The AEA is responsible for standardization of electrotechnical installations including the certification of electrical installation personnel and companies. The standardization of products, services, systems and processes in Argentina is the responsibility of IRAM.

The different industrial sectors are organized in associations covering the technical matters in their related field. Some examples include CACAAU, CAEM, CAMARCO, and CALAMA. Test laboratories in Argentina are LENOR, INIT or UT and the active certifiers are listed in Table 1.8.

Argentinean Electrotechnical Committee (CEA)

The CEA was founded in 2001 as the official representative of Argentina in the IEC. It consists of IRAM, the national standardization and certification organization, and the AEA. The primary work of IRAM is in the area of product standardization and that of the AEA is in the area of electrical installation standardization. The CEA has established internal committees, mirroring the technical committees of IEC as shown in Table 1.9.

Table 1.9 Mirror committees of the IEC in Argentina.

Committee	Title
TC 14	Power transformers
SC 23E	Circuit breakers and similar equipment for household use
TC 42	High-voltage testing techniques
TC 45	Nuclear instrumentation
TC 57	Power system management and associated information exchange
TC 61	Safety of household and similar electrical appliances
TC 64	Electrical installation and protection against electric shock
TC 78	Live working
TC 81	Lightning protection
TC 99	System engineering and erection of electrical power installations in systems with nominal voltages above 1 kV AC and 1.5 kV DC, particularly concerning safety aspects
TC 122	Low-voltage switchgear and control gear

National Standardization and Certification (IRAM)

The Instituto Argentina de Normalización (IRAM) was founded in 1935. It is a private organization, which was recognized by the government in 1994 as an institute for standards in Argentina (National Decree 1474/94). As the national standardization organization, IRAM produces standards by itself or in conjunction with other organizations.

International standards from ISO and IEC are adopted by IRAM for Argentina whenever possible. Instituto Argentina de Normalización also subscribed to the ‘Code of Good Practice’ for the development of standards, defined in Technical Barriers to Trade Agreements of the World Trade Organization (WTO) (https://www.wto.org/english/docs_e/legal_e/17-tbt_e.htm, accessed 2 March 2016).

Instituto Argentina de Normalización is the first body accredited by Argentina’s Accreditation Organization (OAA) for the certification of persons working with nondestructive tests (IRAM-ISO/IEC 17024, IRAM-ISO 9712). The Institute is a member of the IEC CB Scheme and IQ Net.

Instituto Argentina de Normalización has developed several international agreements on cooperation in standardization and certification. International agreements have been made with Brazil, United States, Venezuela, Spain, France, Ukraine and Malaysia. Agreements have been made with certification bodies: AENOR in Spain, ANCE in Mexico, ASTA in the United Kingdom, CEBEC in Belgium, CSA in Canada, ITS in the United States, JET in Japan, KEMA in the Netherlands, KTC in Korea, LCIE in France and TÜV in Germany, to mention some.

1.3.2.2.2 Chile

International and national standardization in Chile is relative young. Founded in 1973, the Chilean National Standardization Institute (INN) started as a private entity. It represents Chile in ISO today and is preparing its membership in IEC. The INN is part of the national quality system and has activities in standardization, accreditation, metrology and education.

On the government side, standardization in Chile is linked to the Ministry of the Economy and the Ministry of Energy. These Ministries have formed the National Commission of Energy

(CNE), the Commission for the National Energy Efficiency Program (PPEE) and National Governmental Supervisory Body (SEC) to support the government in Chile on questions of standardization and certification.

The National Standards Institute (INN) is the government-recognized organization for standardization and certification. It has established technical committees with members for customers, private entities, universities and laboratories to work on standards. Through the Ministry of Economy the work of INN may also be published as a regulation (www.inn.cl, accessed 7 February 2016).

The Association of Electrotechnical International Industry (EPEI) (Asociación Gremial de Empresas Internacionales de Productos Eléctricos) is the National Committee representing the country on the IEC. The EPEI members are Osram, Siemens, ABB, Schneider, Legrand, BTICINO, and Philips.

1.3.2.3 Andean States

The Andean states are Venezuela, Colombia, Ecuador and Peru. In standardization activities Colombia has the lead. The participation of Andean states in standardization on an international level is relatively low and in most cases international standards are applied.

1.3.2.3.1 Venezuela

The standardization organization in Venezuela was Fondo Norma which was replaced by the National Standardization Body (FDN). The FDN carries out activities in fields such as safety and occupational health and quality management. In the electrical field, standards are released in four technical areas as shown in Table 1.10.

The FDN of Venezuela has only a few standardization activities of its own. Most standards are used from international organizations like IEC and ISO and standards from the United States – for example, the IEEE.

1.3.2.3.2 Colombia

Standardization in Colombia is organized by the Instituto Colombiano de Normas Técnicas (ICONTEC). This is the government-recognized national standardization body representing Colombia in ISO, COPANT, PASC, IQNET, on the management board of ASTM and as an observation member of IEC. Under the Ministry of Commerce ICONTEC carries out two responsibilities: national standardization and organization of accreditation.

National accreditation uses the Deutschen Akkreditierungs-Rat (DAR) for the Colombian quality management system. Accreditation agreements exist with Chile (WN) and Peru (INDECOP).

Table 1.10 Technical activities in the electrotechnical field.

Committee	Title
SC 02	Electronics
SC 07	Electric installation
SC 08	Protection equipment
SC 09	Machines and parts

International agreements for cooperation in standardization have been made with Sweden, Spain, Argentina, Mexico, Norway, Brazil, the United States, Uruguay, Venezuela, Ecuador and Germany.

1.3.2.3.3 Peru

National standardization in Peru is carried out by the National Normalization Institute (INDECOPI). Peru follows international standards such as ISO and IEC and standards from ANSI, IEEE and NEMA in the United States are widely applied.

There are some national standardization activities for electric motors, illumination, cables, low-voltage switchgear and power transformers. The healthcare sector is regulated by the Health Ministry (Ministerio de Salud).

The National Institute of Defense of Competition and Protection of Intellectual Property (INDECOPI) is the national standardization body of Peru, which has a suborganization – the Peruvian Office of Normalization (OPN). The OPN operates some technical committees for normalization. There are three categories of standards and guidelines used in Peru:

- Category A: international technical standards, for example ISO, IEC, ITU. These standards are applied directly in Peru.
- Category B: international technical standards in the final phase of approval, for example draft international standards. These are used as draft standards in Peru.
- Category C: regional technical standards, such as CEN, CENELEC, ETSI, COPANT, ANDINA. These standards are used directly in Peru.

1.3.3 Asia and Oceania

1.3.3.1 General

Standardization in Asia and Oceania is very different in activities and organizational structure. One of the first Asian nations to use standardization is Japan, which introduced it in conjunction with its industrial development. Today China is growing in national and international standardization activities, with an increasing number of Chinese experts attending international standardization organizations. India is an upcoming internationally active nation in standardization. With its links to Britain arising from the years of colonialism, economic growth and its innovative technology sector will drive India more into standardization.

In Australia the standardization structure is at the same level as in Europe or North America. Compared to the size of the country, its presence in international standardization activities is high. Other Asian and Oceanian countries are more followers of international standardization with few activities of their own.

1.3.3.2 China

The structure of the Chinese legal system is the basis for standardization activities in China. The principles are shown in Table 1.11.

The National Parliament of China is the highest legal authority and its laws have an impact on standardization. With regulations released by the State Council, more administrative

Table 1.11 Chinese legal structure.

Legislative	Documents	Type
National Parliament of China	Laws	Law
State Council	Administration	Regulations
Peoples' Congress or Standing Committees of the Provinces, Regions, or Municipalities	Local regulations	Regulations
Ministries and Commissions	Department rules	Rules
Standardization Administration of China	Mandatory standards	GB or DL standards

regulations are influencing the technical standardization process. In principle this is the same in Europe and in North America but the Chinese government is stricter in formulating requirements into laws.

The Peoples' Congress, which meets in the Great Hall of the People, and its standing committees have a strong impact on local regulations applied in Chinese provinces, autonomous regions, and municipalities directly under the central government. These regulations have a regional impact on standardization.

The State Audit Administration and other local organizations and authorities set up rules that impact standardization. These rules are set up at ministry level or by commissions of the State Bank of China.

Standardization and conformity assessment in China are based on several laws and regulations. Standardization laws were released in 1988 and 2007 and regulations were implemented in 1990. These laws and regulations are the basis for more specific regulations in the industry sector, at the national level and at local level.

On the conformity assessment side, a product quality law from 1993, revised and extended in 2010, and the Import and Export Commodity Inspection Law from 1999, revised in 2002, form the basis for more specific and detailed regulations regarding product quality certification from 1991 and the Implementation Regulation from 1992. The China Compulsory Certification (CCC) regulations have been published since 2001 for different areas of application.

Several laws and regulations have been formulated for environmental protection, as shown in Box 1.3

Legislation in China involves a permanent process producing new laws and amendments to existing laws for compulsory product certification (CCC). The liability of manufacturers for their products is based on preventive principles. The product liability laws require strict product liability for the producer; in the case of a fault there is fault-based tort liability. In a contractual relationship, there is 'contractual liability'.

The following requirements are connected to strict liability:

1. There must be a product. (Buildings and agricultural structures are not products.)
2. There must be a failure of the product.
3. There must be damage to a person or property.
4. There must be causality between fault and damage.
5. There should have been no relief to the author for the damage.

Box 1.3 Laws and regulations on environmental protection.

- Laws**
- Energy Conversion Law
 - Renewable Energy Law
 - Energy Law
 - Electricity Law
 - Product Quality Law
 - Clean Production and Promotion Law
- Regulations**
- Bylaw on Accreditation and Certification
 - Regulation of Energy Efficiency Labelling Administration
 - Decision on Energy Conversation by the National Council
 - Implementation Rule on Energy Label of Refrigerator
 - Implementation Rule on Energy Label of Air Conditioner
 - Implementation Rule on Energy Label of Washing Machine
 - Implementation Rule on Energy Label of Unitary Air Conditioner
 - Implementation Rule on Energy Label of Motor
 - Implementation Rule on Energy Label of Gas Water Heater

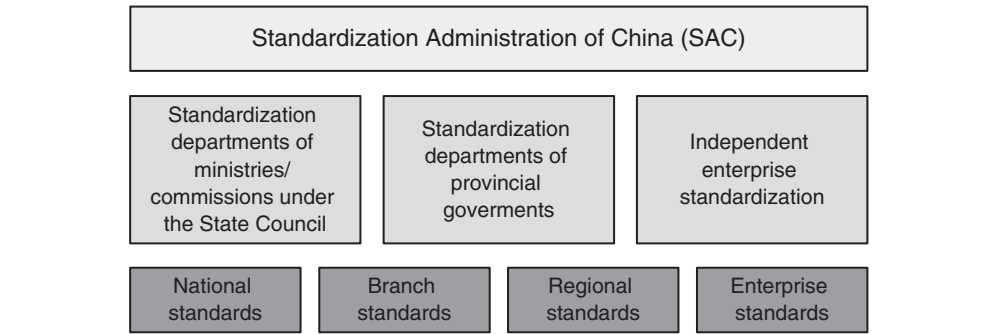


Figure 1.4 Responsibility for standardization.

Responsibility for Standardization

Overall responsibility for standardization in China rests with the Administration Authority of China (SAC), as shown in Figure 1.4.

The Standardization Departments of Ministries or Commissions release national and branch standards. Regional standards are published by standardization departments of provincial governments. Independent enterprises’ standardization organizations release enterprise standards.

In China today there are more than 320 standard institutes and 290 national standards technical committees publishing standards. In addition to this, the China National Institute for Standardization

<i>GB = Guo Biao (Chinese national standard)</i>	
GB	Mandatory national standard (~3000)
GB/T	Voluntary national standard (~18 000)
GB/Z	National standardization guiding technical documents
GBJ	Construction and design national standard
GBW	Sanitary national standard
GBZ	National occupational health and safety (OHS) standard
GJB	National military standard (~3800)
GSB	National certified reference materials
JJG	National compulsory metrology standard for calibration and official verification
JJF	National metrology standard for calibration

Figure 1.5 Types of national standards.

(CNIS), the China Association for Standardization (CAS), the China Standards Information Centre (CSIC) and China Standards Press (CSP) are also active in the standardization process.

In the field of branch standardization in China there are 26 research institutes and specialized ministerial and commission standardization institutes; 339 technical committees publish documents and 12 specialized ministerial standards associations are active.

There are 158 provincial standard-publishing research institutes with an unknown number of regional technical committees. In parallel with these, 85 provincial associations are active in standardization. The number of enterprises active in standardization and publishing enterprise standards is not known. There are many enterprise standards from technical research institutes, technical committees and business enterprise associations.

China-wide, there are about 38 000 members of standardization technical committees; 100 000 members of research institutes and universities work together with more than 20 000 members of the standardization management standing organizations. They work on more than 3000 mandatory and 18 000 voluntary standards at the National Standards Level *Guo Biao* (GB) – see Figure 1.5, which shows the different types of national standards (GB).

Mandatory Standards

Mandatory standards are fixed in Article 7 of the Standardization Law of the Peoples Republic of China. National standards and trade standards are classified into compulsory standards and voluntary standards. Those for safeguarding human health and ensuring the safety of people and property and those for compulsory execution as prescribed by the laws and administrative rules and regulations are compulsory standards; the others are voluntary standards.

Local standards formulated by the standardization administration departments of provinces, autonomous regions and municipalities, directly under the central government, for the safety and sanitary requirements of industrial products are compulsory standards within their respective administrative areas.

Origin of National Standards (GB)

There are more than 25 000 national GB standards in China. About 50% have been adapted from international standards, mostly from ISO and IEC. The rest of the adapted GB standards come from other organizations such as DIN/VDE or IEEE.

Product Quality Law

The Product Quality Law of the Peoples Republic of China states in Article 27:

Marks on the products or on the packages thereof shall be authentic and meet the following requirements:

1. with certificate showing that the product has passed quality inspection;
2. with name of the product, name and address of the producer, all marked in Chinese;
3. with corresponding indications in Chinese regarding the specifications and grade of the product, and the name and quantity of main ingredients, where such particulars are to be indicated according to the special nature and the instructions for use of the product; with corresponding indications on the package of information necessary for consumers to know in advance, or providing consumers in advance with documents indicating these information;
4. with production date, safe-use period or date of expiry at easily spotted areas if the product is to be used within a time limit;
5. with warning marks or statements in Chinese for products that, if improperly used, may cause damage to themselves, or may endanger the safety of human life or property.

China Compulsory Certification (CCC) is organized into different fields of application as shown in Box 1.4.

These accredited certification bodies use more than 20 different marks for certification indications as shown in Box 1.5.

Box 1.4 China Compulsory Certification (CCC) – Accredited Certification Bodies.	
CCC	Basic mark
CCC	Product safety
CCC	Fire protection products
CCC	Product safety and EMC
CCC	EMC
CCC	WLAN products

Box 1.5 Certification marks used by China Quality Certification Centre.

Safety Product Certification
 General Product Certification
 Safety and EMC Product Certification
 EMC Product Certification
 Performance Product Certification
 ISO 14000 EMS Certification
 Energy Save...Product Certification
 Textile Safety Product Certification
 Bolts Certification
 Environmental Label Product Certification
 Hazard Analysis and Critical Control Product
 IECEE CB Scheme
 IQNET
 Organic Product Certification

1.3.4 Africa

Standardization activities in Africa follow the international standards of IEC, ISO or ITU and regional standards from North America (e.g. IEEE or ASME) or from Europe (the EN standards). In recent years standards from China have appeared in Africa. In Africa, only the Republic of South Africa is active in international standardization work related to industrial development there.

In northern Africa, Egypt plays a role in standardization with participation in international standardization.

National standardization in African nations follows the international standards in most cases. Driven by international consulting companies and the World Trade Organization, with financing from the World Bank, international standards of the IEC, SO and ITU are used primarily.

1.4 The Public View of Standardization

The general public view of standardization is rather negative. As soon as someone states: 'I'm active in standardization!' people will think someone who is rather dull and grey. It gets a little better when one states: 'I'm active in international standardization!'. At least – thinks the general public – he can travel to some exotic places like China, Japan, India and America. But in both cases the general public thinks that his professional career is coming to an end in his company's hierarchy.

One little piece of the pattern that forms such pictures in the mind of the general public mind relates to standardization activities. For example, the front page of a standard – which is also standardized and needs to be standardized for easy recognition by users – sometimes gives the impression that standardization experts sit around all day with a ruler, measuring millimetres and centimetres on the title page of a standard as Figure 1.6, from a German standard, shows.

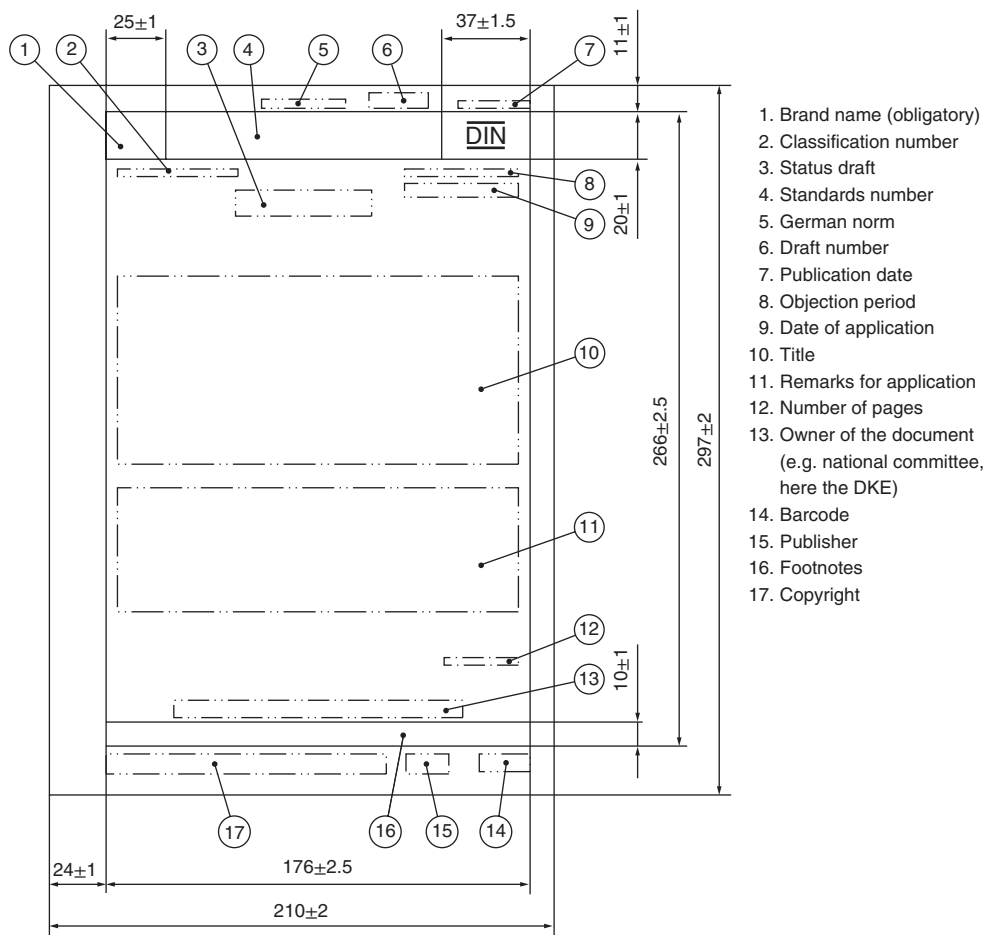


Figure 1.6 Standardized standard title page.

The information given on the title page is well structured and there is a need to simplify the world of technical information by using structures.

The general public also pictures an expert at one of the standardization institutes as a white-collar worker, with a very strict appearance. Such work is seen as bureaucratic and not really interesting or exciting. This picture is still too often the public view of standardization.

Standards are also seen as somehow trivial – for example, European requirements about the size of apples or the radius of bananas or cucumbers. Such examples can be found all around the world.

What the general public does not know is the complexity of industrial standards, the high grade of innovative technology related to the latest versions of the standards, or the new technical fields made accessible to the market. This is made possible by experts in the related technical field around the world. The people engaged in standardization work are the best in their technical fields.

The general public's knowledge of standardization is not very specific – people do not know how it works – but many would agree on the statement that standards benefit them. For most people standards are seen as a basis for economic success. Products and services are easier to provide with standards than without. Particularly in Asia, standardization is seen by the public as a way to deliver to a global market.

In Japan, standardization is more important to the public than it is in the Western world. This high level of interest even led Japanese TV makers to produce a documentary on standardization that was broadcast at 8 p.m., prime time. It showed that Japanese industry is producing products for the world market and related how there was a need for the country to be active in international standardization, to put forward its specific interests and technical views. The show illustrated how Japanese engineers are travelling around the world to participate in experts' meetings, providing information that would influence the content of standards.

On the other hand, the topic of standardization is often missing from engineering education in universities. This should be improved given the importance of standards in industry.

1.5 Right Timing

1.5.1 General

In standardization, if experts meet too early in the product innovation process they might find that not enough technical information is available on the product to specify requirements and to define test routines. On the other hand, if the experts are too late in starting work on standardization, various technical solutions might already be established in some market places and a unique standard solution might not be possible any more. The correct timing of standardization is related to the innovation process, market access and the regulatory processes as explained in the following.

1.5.2 Innovation Process

The innovation process is the driving force of technology companies. Here, new ideas are born that will bring new products onto the market, or improve existing products, or reduce prices. In some cases the innovation process brings all three in one.

In the beginning there is an idea about how to solve a problem, how to increase functionality, or how to avoid cost. These ideas are usually protected by patent rights. Innovative companies are proud of the number of patents that they receive every year and patents are among the goals of management. The belief is that only by producing enough patents each year can technology companies match their competitors in the market. But patents by themselves are not sufficient to be successful in the market. Standards are needed for this.

Many patents are needed to create one successful product in the market and it is not clear which of the patents will make it to a successful market product. To link these processes it is necessary to have a systematic view of the ideas and patents together with the design and development process. Within the product design and development process technical milestones are set to plan market access. These technical milestones provide orientation and a starting point for the standardization process. With standardization times of about 2 to 3 years, orientation in the design and development process comes with product prototypes and pilot

installations. By this time enough technical information is available to explain technical requirements for the product and devise procedures to test these requirements. The standard writing process then can take place in parallel with the product marketing initiatives and the first drafts of the standard can be used for product specification of applications.

In international standardization, consensus standards are the goal and more than one manufacturer is needed to find this technical consensus. In most standardization processes rules are given on how many countries, industry sectors or users need to send experts to the new working groups to produce a standard. In the IEC, a minimum of four or five experts from different countries are required to start work, depending on the number of member countries in the related technical field. These rules are applied in any consensus-orientated standardization and give a balanced set of standard-writing expert groups.

So, besides the right timing, it is also necessary to find other manufacturers to be willing to participate in the standardization work. Having more than one manufacturer also increases the transparency of the standard's technical content. This allows any user to have a choice of different technical solutions and encourages price competition. The standard provides the basis for long-term success in the market.

Monopolistic markets, with one product and one manufacturer, do not need standards. Such situations happen in markets like smart phones and computers. Innovative industries provide different technical solutions and offer a wide range of products based on the same standard. The role of standardization is to set common rules for product requirements and test procedures. For this reason standards are not static and adapt with the innovation of new products. Depending on the industry sector, the mean time for the revision of standards is in the range of 3 to 6 years. For basic and horizontal standards the revision time may be as long as 12 years. Basic standards cover subjects that are very stable and do not change much. A horizontal standard is defined by the IEC as a standard that gives values and requirements for safety to a wide range of product standards – for example the levels of test voltages or the permitted electric and magnetic field strength to which humans may be exposed.

Innovation is the driving force for the future success of technical companies and consensus standards prepare and open the market for business.

1.5.3 Market Access

There are different ways to access the market with products. In a regulated market products come to market only if laws and regulations are fulfilled. In an open market, competition between manufacturers of technical products offers a wide range of products for customers' needs. In most cases market access involves a mixture of regulatory requirements and competitive products. What is the role here of standards in market access?

Standards are made to assist users to find the right products for their requirements and to enable them to trust that this product will have the required technical features.

An example from my own technical field, high-voltage switchgear, explains this. The electric power supply needs substations with switches to switch electricity on and off. In the high-voltage transmission network, such switches need to switch 420 000 V in Europe or 550 000 V in America and Asia and up to 1 100 000 V in China. They need to be able to interrupt rated currents of 3000 A, 4000 A and sometimes 5000 A. In the event of a short circuit in the network, they are required to interrupt 50 000 A, 60 000 A or even 80 000 A. Worldwide

there are some 20–30 manufacturers who produce high-voltage circuit breakers. Users of such applications are usually not in a position to prove the statements of manufacturers that their product is able to fulfil the criteria.

Standards now define the requirements and set rules for design and construction. In specific tests, which are usually carried out by independent test laboratories, standardized test processes are applied to prove functionality.

A positive test result is then documented in a test report and this test report is then used with the offering of a circuit breaker by the manufacturer. This gives the user confidence that the product offered will function as required.

The standard is opening the market for products that follow the specified requirements. Without such a technical standard it would be very difficult for a manufacturer to convince the user about the functionality of his product. To carry out an approval test with each user in each project would be very expensive and this would be the situation without standards.

1.5.4 Regulatory Processes

In many countries a regulatory process sets additional requirements for products in cases where safety is involved. This could be electric shock, explosions, fire and other dangerous product effects to humans. Regulations and laws must be followed in every case; the application of standards is for the user to decide.

When international standards are written they usually follow any relevant requirements in so far as such requirements are known and acceptable to the expert group. On the other hand, regulatory bodies follow the recommendations of the standardization experts with their regulations and laws. Therefore, in most cases standards are in line with regulations. It is clear that there are technical areas where there is a difference in the requirements of regulations and standards. This conflict will stay because laws and regulations are produced by governments and their associated organizations, which make their decisions independently from the standardization organizations and their experts.

But standards are always oriented towards the regulatory requirements which are usually focused on human safety, environmental protection and health. Regulations, when made in a proper way, leave the technical specification to the standards and give only the framework for standardization.

1.6 Benefits of Standards

What are the benefits of standardization? This is an often-asked question in companies when it is necessary to justify why so many experts need to go to standardization working groups at distant locations for such a long time and so often. International standardization is often viewed in terms of long-distance travelling to such pleasant places as New York, Berlin, Paris, London, Tokyo, Delhi, Beijing, Rio de Janeiro...the list can be extended to many more.

In my company, in the field of energy transmission and distribution, more than 350 experts are active in standardization. As coordinator, responsible for the participation of our experts in the right standardization working groups, I often have to answer questions like: ‘Is it necessary that these experts are participating in standards?’ ‘What is the benefit for our company?’ ‘What could be stopped without having a negative impact on our business?’

These questions are not easy to answer because the direct impact of standards can hardly be seen. Their impact is usually felt over some months or even years but the costs of travelling and working time have to be paid right now.

The interesting thing with standardization work is that even when all experts do a good job, when everything is running smoothly, when newly designed and developed devices can be sold on the market with reference to international, regional or national standards and when the business runs well – the experts in standardization are still asked what they are doing, besides travelling and whether it is necessary to send so many experts to so many standardization meetings. Again the benefits of standardization are questioned.

Unfortunately, experts in standardization working groups are immediately asked about their standardization work if equipment or a device that has just been developed does not fulfil some of the requirements and high additional development cost are necessary to bring the device or equipment to a technical level to fulfil the standard's requirements. Standardization experts can become very famous if something goes wrong but if everything goes well only the travelling is recognized.

A general understanding of the importance of standardization is seen in almost any company. Most are just following technical requirements as written in standards – they are passive users and do not participate actively. Companies that will become leaders in their technical field cannot act as passive user of standards; they need to be active creators of standards so that their leading technology is reflected in the standards. For them the main benefit is to have a standard in place at the time when the new designed and developed device or equipment is ready for the market. Market entry in parallel with new or revised standards creates a business advantage over other market players who cannot fulfil the new standards' requirements. This is the reason why standards are constantly adapted to technical developments. In this way, standardization work is more a strategic tool for successful business planning, understood as an important link between innovation and product design and acceptance of new product in the market when based on standards. Technical leaders always work that way. Beside this strategic view of standardization, the general benefit of standards can be described, as reported in an investigation by the Deutsches Institut für Normung (DIN) in 2010 [2].

In principle, there are two areas of benefit: business benefits and social benefits. Business benefits cover the strategic benefits explained above – advantages in a competitive market (national, regional or international), reduction of product costs, reduction of costs of relationships with subsuppliers, an increase in safety and reduced costs for product liability, a link from research to market and an opportunity to make technical developments known to the public.

The benefit of standardization for society is seen in the political sphere, national economics, international trade and macroeconomic advantages for companies active in national or international business.

The business benefits were investigated in Germany, Austria and Switzerland [2]. For this, more than 4000 companies, organizations and institutions were interviewed and the results were presented. At the strategic standardization level it was found that the marketing effect is seen by standardization experts but is often not recognized by the companies' management. This result is that standardization activities are recognized as expenses ('they are travelling all the time!').

Seventy-five per cent of those questioned indicated that the experts are engaged in international (ISO, IEC, ITU) and regional (CEN, CENELEC, ETSI) standardization to influence standards work.

Standardization activities need to be planned on a long-range scale to create benefit for the companies. Most short term engagements are not effective and cannot create benefits. The main advantage seen by the companies is that they can offer products at the time of the publication of the standard whereas competitors not active in standardization need to redesign their product and come to market with a delay and a higher development cost. This effect is even stronger if the regulator uses standards for defining regulations, which is quite often the case.

Direct advantages of companies in the technical field over their competitors are not often seen with consensus standards as they are usually also participating in the standards process. So active participation in standardization is more to avoid a competitive disadvantage that would arise if a product is not in line with a standard. Standards set by companies (IBM, Apple, Microsoft) can create a strong advantage in competition against other companies in the market. They can also give rise to disadvantages in creating a market as customers do not like monopolistic situations and it is difficult to reach such a market position. In many cases such company standards do not last for a long time.

The main advantage of standardization seen by companies is the time and knowledge advantage. Those who participate in standards are informed at an early stage about the changing technical requirements in a standard and they learn the reasons why technical changes are made from their competitors participating in the standardization work.

The influence of a business's own experts participating active in standardization is seen as high. Those who write the standard's text first have the highest impact on the final text. In Germany we say: 'Wer schreibt, der bleibt' ('who writes the text, stays with the text').

Global business requires global standards. Even small and medium-size companies are using international markets for their products to sell or to buy subparts for their own use on the global market. The Internet offers global sourcing for anybody. The standards offer the required quality level and reliable products. Small companies do not need to travel to Australia, the United States or China to test a product. They only need to use globally accepted standards to sell and buy products. That is why the main focus on standardization is at the international level with a global reach. The costs of adapting products to regional or national standards are usually high. Redesign, testing and certification can easily cost several hundred thousand euro or more, which must be earned back in the regional market.

In a harmonized standardization field many additional costs can be saved and cross-border trade is much easier. Standards open up many trade opportunities around the world with easier contracts and fewer trade barriers.

To compare cost for experts active in standardization with costs arising from failing to fulfil standard requirements and necessary redesign is not easy because companies do not like to speak about that, or publish numbers.

When a company misses a standard requirement and is unable to bring a product to market successfully, this will not be communicated to the outside world. Experts will sit down and will change their product so that it is in line with the standard or they will stop selling the product.

The problem with sending experts to standardization work is that these experts are also needed in the company for the development of the new devices. This is a standards expert's dilemma all the time.

Cost reductions in companies through the use of consensus standards are usually not appreciated. Standards are often just seen as requirements to be fulfilled. The cost-cutting effects are also not communicated with competitors because they give businesses advantages in competitive markets.

In the subsupplier market, there is much less dependence on one supplier in standardized technical fields than in fields without standards. There are more suppliers and there is more competition. The standards require quality and reliability, which has to be delivered by the subsupplier and this is an advantage in the market. The supplier can share a much larger market and he does not really need to know the final use of the delivered product. The market power of the standardization of products is much stronger for the supplier market than for the user market.

Standardization supports cooperation between companies as technical requirements are defined and quality controlled by testing, giving reliable products.

From a research and development point of view standardization does not affect the innovation process because it comes later in the process chain. Standardization of research work does not really make sense because there is not yet a product or service for the market. Standardization starts with the market process of developing products and services ready to be used in the market.

Participation in the standardization process during product development reduces the risk of stranded investments because the content of standards can be influenced by discussions with the other experts in the standardization working group. A company's own misdevelopments can be detected early and can be corrected or stopped.

Typical reaction times for new developments and adaptation of standards are in the range of 2–5 years. Two years' revision in consensus standards is the shortest possible time when following the commenting and voting rules. In most cases 3–4 years are needed.

In terms of insurance, standards are mainly seen as safety. In companies using standards, injuries and accidents are much lower than in companies not following standards. Safety-related requirements are covered by standards for all types of products and help to reduce the liability for nonfunctioning products.

The economic benefit of standards is not only linked to the innovations made in society – it also needs a competitive market with efficient produced and reliable products. The economic benefit is created by the efficient diffusion of innovation and standardization.

Investigations in Germany have shown that in very innovative technical areas (in terms of number of patents per year) a high number of standards are also produced. The dynamic development of innovations creates new standards and the faster the innovations occur the quicker new standards are developed. The standardization process reflects very much the type of business behind it. Very dynamic companies with a high level of innovation are often not very open to participating in consensus standardization because they fear to loose knowledge to competitors.

In a long-term comparison of the number of patents and standards from 1960 to 1996 it can be seen that standards influence technical innovation and market development just as patents do.

Exports to the global market are easier with international standards. Standards do not only affect exports; they influence imports in the same way. So there is a winning situation on both sides for the user. Exports based on standards increase; imports based on standards increase.

Standards are very modern and up-to-date. The following subsections give some examples of today's standardization activities with benefits for companies and society [3].

ISO/IEC 15962 Radio Frequency Identification (RFID)

With this standard, automated identification and localization of things or livestock can be made. It is easy to find objects in a factory or storage, or to control the feeding of animals, or to identify flowers from growth to your table at home. Radio frequency identification technology allows IT support for the logistics of any object – the flower from the Netherlands or South Africa, or the seat of an automobile from the subsuppliers to car assembly.

IEC 62478 Smart Textiles

This standard defines safety requirements for smart textiles related to the person wearing such clothes. Textiles with specific functions are possible in work or in private activities. Control of body temperature, electromagnetic fields, changing colours, energy generation and heat protection are only a few possibilities for new business.

EN 60601 Telemedicine

Telemedicine can be used by a doctor far away can collect data about your health or give information about medicine. It can be used to support elderly people in controlling their own lives or to assist with complicated surgery by consulting a doctor far away. This standard gives requirements and quality-control measures for telemedicine.

DIN VDE 0100-705 Big Data

Collection, management and evaluation of large amounts of data is becoming much easier with data storage possibilities available today. Big data include weather data, data regarding livestock management including the control of each cow and anything it will eat and data from sensors on human bodies collecting data about any move. This standard defines data handling and privacy of data.

IEC 61850 Smart Energy

The Internet of energy needs to be managed over a wide area with millions of devices generating, transmitting and distributing electrical energy with guaranteed network stability and efficiency each millisecond. This standard is an information backbone for the future renewable electric power supply.

EN 61508 Smart Workflow

This standard is the basis for equipment such as a robot in an assembly line of a car manufacturer, which poses a risk of causing harm to workers.

EN 61950 E-Mobility

The e-mobility of cars, bikes and bicycles with an electric battery storage and notes. Charging station and vehicle safety. The basic aspects are defined including standardized plugs and charging processes.

IEC 62883 Ambient Assisted Living (AAL)

Using modern technology to help older people to manage their daily lives in their own homes. Electric motors to control window shades, automated vacuum cleaners, service robots, stair mover, alarm in case of emergency, motion detection and many more technical aids are defined in this standard.

ISO/IEC 24571-1 Smart Collaboration

This standard defines requirements for e-learning software, e-books, online studies with examinations and virtual lectures.