Understanding ICT Standardization: Principles and Practice

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The latest version of these slides is available from: www.etsi.org/standardization-education

Contents

Contents (Slide Zoom)

General information

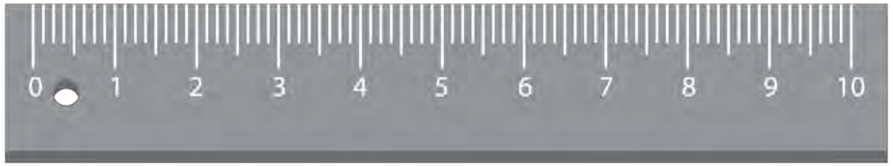
Accompanying textbook:

- Understanding ICT Standardization: Principles and Practice (Published 2021)
  - Includes supporting material, e.g. quizzes to prove knowledge
  - More detailed information about the topics
  - Available at: www.etsi.org/standardization-education

1 Introduction

1 Introduction

- Standards support everyday life much more than people think
- Society recognized importance of standardized measurements thousands of years ago: e.g. weight, distance or length
- Development of a common reference system agreed upon people and institutions



1 Introduction

- Rapid technological progress → need for standardization grows
- Especially in the area of Information and Communications Technologies (ICT)
- Standardization and standards boost progress and create basis upon which technology can evolve

2 Introduction to Standards

- The learning objectives of this section are:
  - To identify what the purpose of standards is and how standards impact people's everyday life
  - To learn what a standardization process is
  - To distinguish between SDO and de facto standard
  - To understand benefits and risks of standards
  - To acquire a basic knowledge of the international, regional and national standardization landscape
  - To have an overview the international, regional and national standardization landscape
  - To understand the basic concepts of the SDOs' processes and the characteristics of the main deliverables

2.1 Basics of standardization

What standards are (in a wide sense) and why they're needed

The most general definition for a «standard» may be

«**a widely agreed way of doing something**» .....

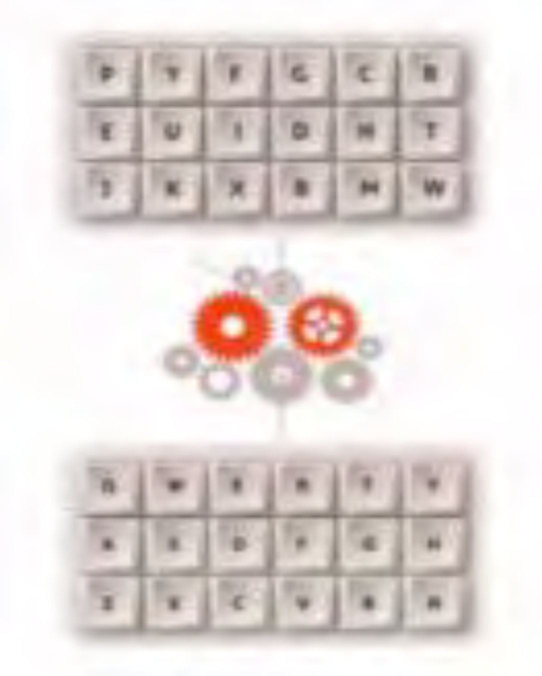
.... where, depending on the specific area of application, "**doing something**" may be replaced by, e.g., "**designing a product**", "**building a process**", "**implementing a procedure**" or "**delivering a service**".

«Standard» (i.e. agreed and common) ways of doing things bring lot of benefits; our technological world without «standards» simply **would not work (or, at least, it would be harder to make it work)**

2.1 Basics of standardization

What standards are (in a wide sense) and why they're needed

For instance, what if



each computer had its own type of keyboard

each smartphone and PC had its own specific set of connectors and charger (though some have by choice ... more on this in next slides)

each device had its own protocol for interoperation

2.1 Basics of standardization
Two main different types of “standards”

Different types of standards according to the development process (standardization)

De facto standards, or standards in actuality, are adopted widely by an industry and its customers. These standards arise when a critical mass simply likes them well enough to collectively use them.

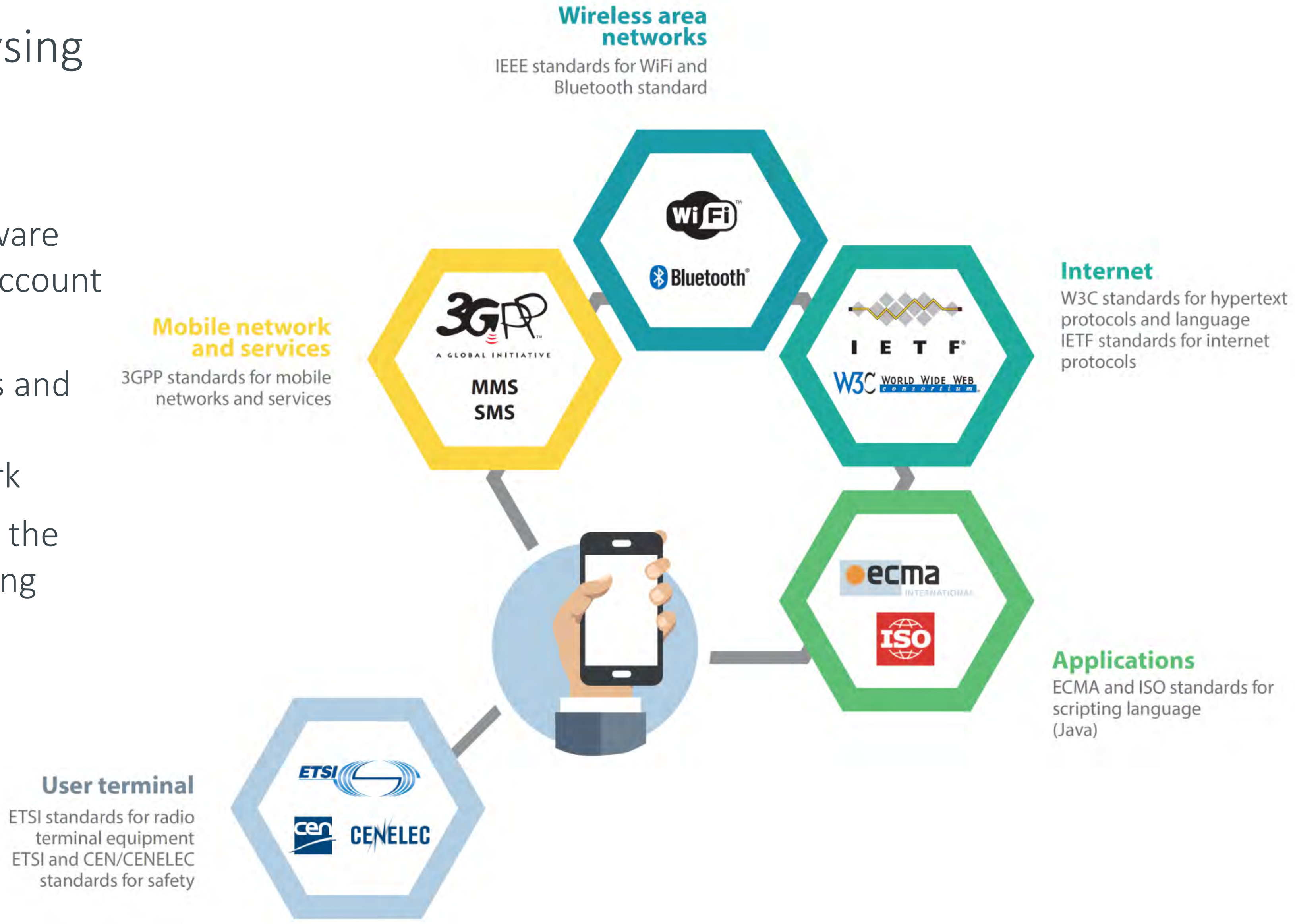
SDO standards are produced by devoted organizations, called Standards Development Organizations (SDOs). SDOs are organizations whose purpose is to develop standards and that put in place formal well-defined procedures to guarantee a fair development process.

De facto standards can become formal standards if they are approved by a SDO. Examples: HTML PDF

2.1 Basics of standardization
Standards in everyday life

Using a Smartphone for browsing (some of possibly involved standards):

- User equipment regarding hardware characteristics, also taking into account safety issues
- Connectivity among user devices and wireless network as well as the functionality of the same network
- Functionality of the Internet and the protocols to support web browsing



2.1 Basics of standardization
Standards in everyday life

Using a Personal Computer
(some of possibly involved standards)

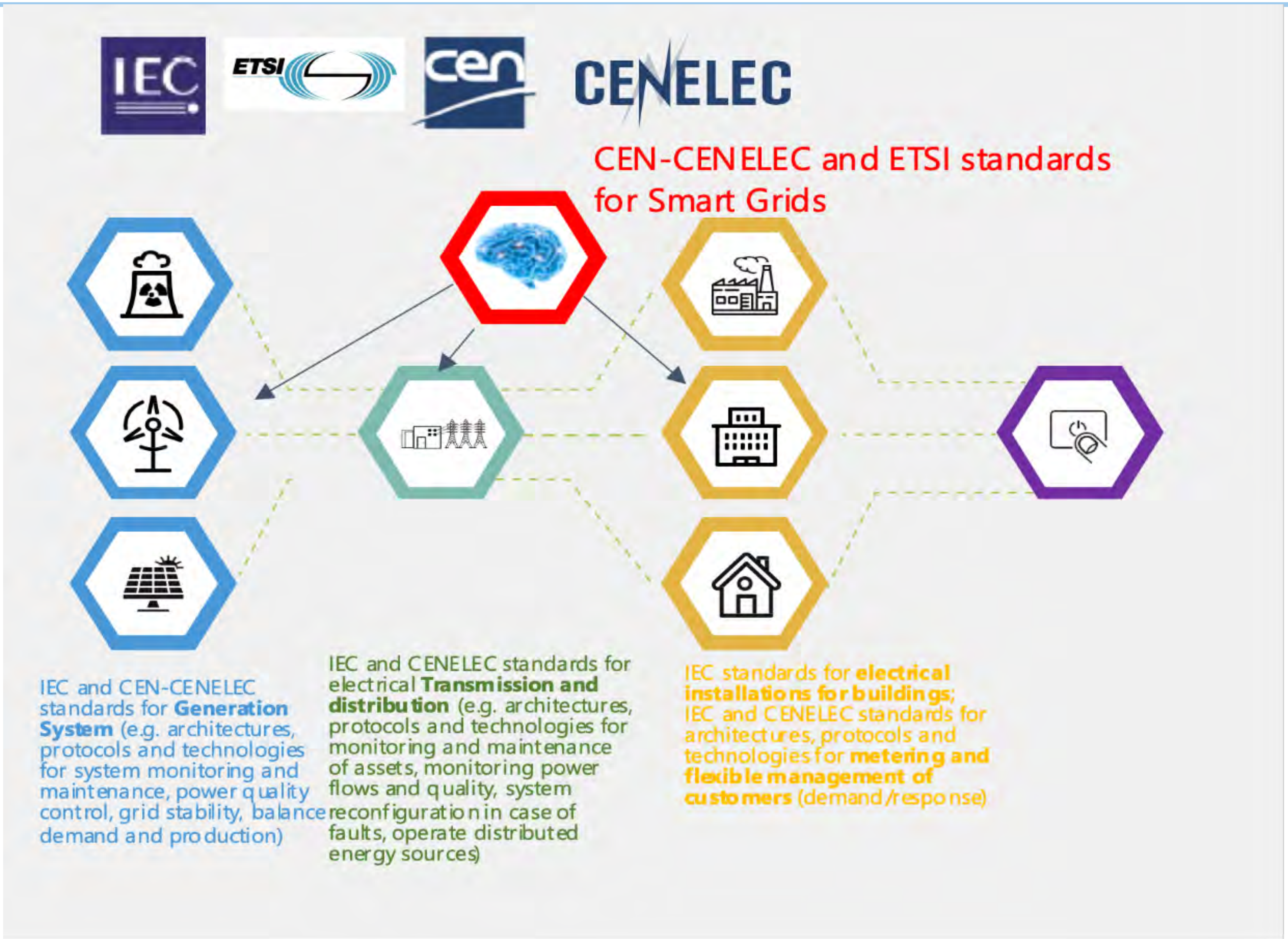
A 2010 paper (Biddle & al., 2010) identifies 251 technical interoperability standards implemented in a laptop computer, but total number estimated to be over 500

Out of the 251 identified standards, "202 (80%) were developed by SDOs and 49 (20%) by individual companies"

2.1 Basics of standardization

Standards in everyday life

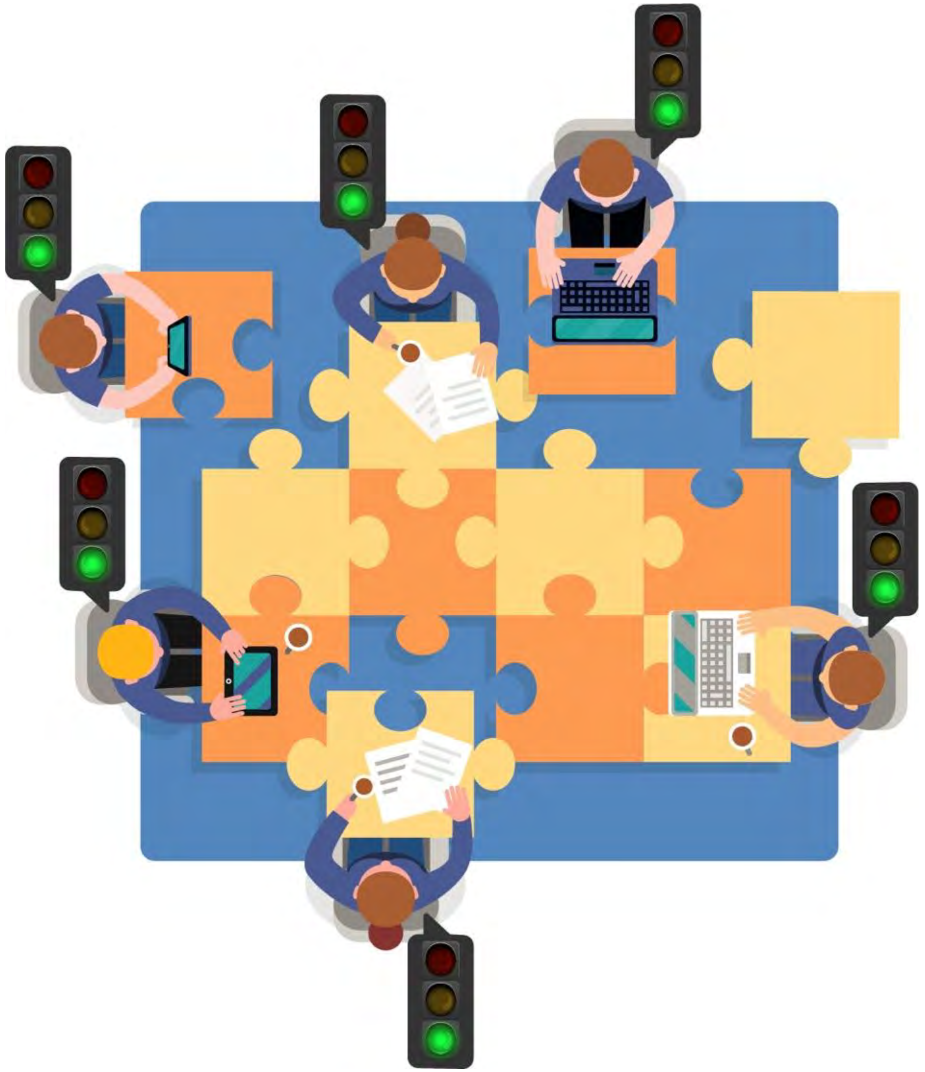
Switching on lights
(some of the standards involved)



2.1 Basics of standardization

Formal standardization, SDO standards, and regulation

- **Formal standardization** is a well-defined process, open to any individual or organization, and its results are produced in consensus with all interested parties.
- Formal standardization is inspired by international directives on standardization, the most important being the principles produced by the Technical Barriers to Trade (TBT) Committee of the Word Trade Organization (WTO).
- Formal standardization is the process adopted by SDOs to produce standards. Hence, we refer to these standards as **SDO standards**
- SDOs put in place formal standardization procedures to guarantee a **fair standard development process**, which is aimed at **building consensus among involved stakeholders** (e.g., manufacturers, providers, consumers, and regulators) and guaranteeing the **quality** of the final deliverables.



2.1 Basics of standardization

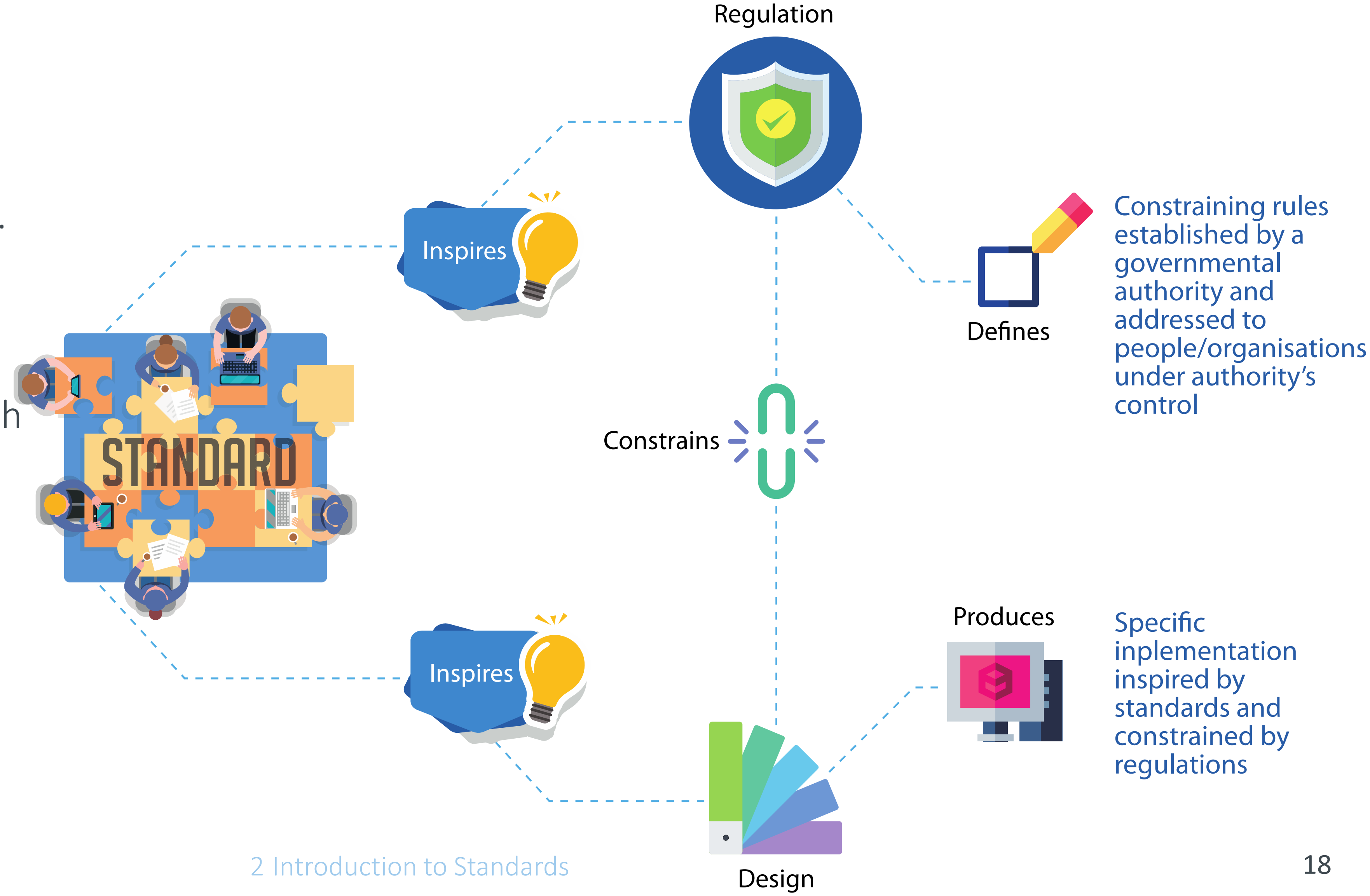
Formal standardization, SDO standards, and regulation

From here on, we will focus on “SDO standards”; so, in the following and unless otherwise explicitly stated when referring to “standards” we will mean “SDO standards”

2.1 Basics of standardization

Formal standardization, SDO standards, and regulation

- Standards are NOT regulations.
- Standards are NOT a set of thorough design rules.
- Standards are voluntary NOT compulsory
- Yet, they may inspire both



2.1 Basics of standardization
Formal standardization, SDO standards, and regulation

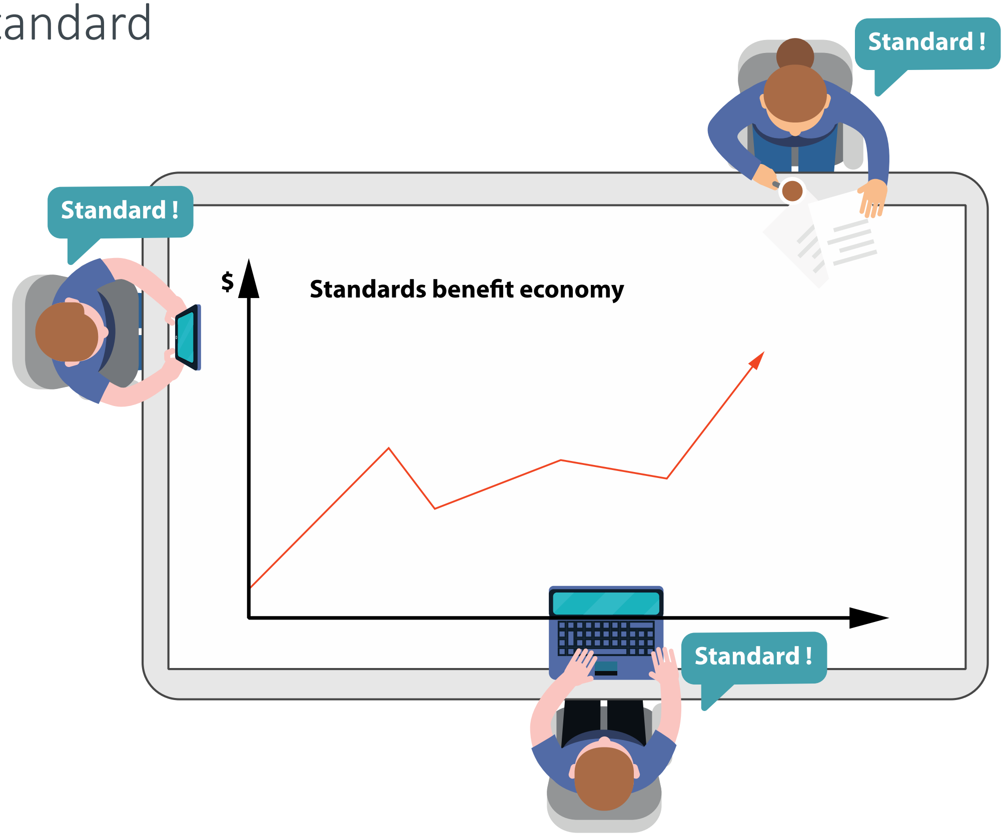
- Standards are NOT regulations
  - While conformity with standards is voluntary, regulations are compulsory; i.e.
    - An item (product, service, process, etc.) that doesn't fit regulations is not allowed in the territory/market where those regulations apply;
    - On the contrary, non-compliance to standards doesn't limit 'by law' the diffusion of an item (e.g., remember the case of some smartphones' proprietary connectors)
  - Standards are often (fully or partially) captured into regulations, as this simplifies and accelerates regulatory work thanks to the directions of established best practices defined in standards
- Standards are NOT a set of thorough design rules
  - Standards are aimed at defining a minimum set of requirements for an item (product, service, process, etc.) in order to make it meet certain well-defined objectives (e.g., to guarantee a certain degree of interoperability or to define a minimum level of performance)
  - Many 'standard-compliant' implementations of the item are possible

2.2 Benefits and risks of standardization
Examples of benefits from Standards

As a consensus-built set of rules for doing something, a Standard

Benefits the economy by

- Incentivizing investments, as standards ensure the stability of the technology in a reasonable time frame
- Enabling economy of scale
- Facilitating trade thanks to common approaches among Countries
- Encouraging larger and fairer competition
- Consolidation of new technologies and identifying evolution paths that are able to preserve past investments
- Increasing collaboration opportunities among the companies, especially for small and innovative enterprises



Examples of benefits from Standards

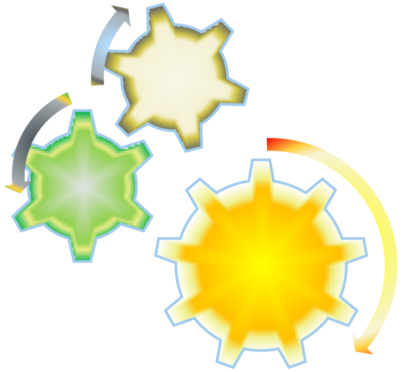
Benefits the environment by

- Supporting environmental sustainability
- Enhancing the safety of products
- Informing consumers in a clear unambiguous way, promoting company and product image at the same time

2.2 Benefits and risks of standardization

Examples of benefits from Standards

As a consensus-built set of rules for doing something, a Standard benefits innovation, by



reducing development time, costs and risks, by steering designers' activity, which facilitates the uptake of innovation in the marketplace

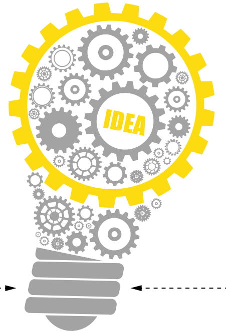
- Improving quality
- Decreasing time to market
- Promoting the interoperability of products, services and processes
- Attract customers

2.2 Benefits and risks of standardization

Examples of benefits from Standards

Benefits of standards for industries (<u>especially for newly established ones and SMEs</u>)

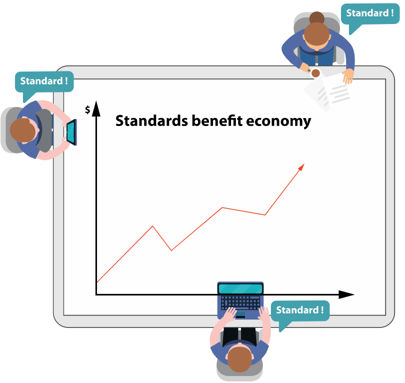
+ Innovation



STANDARD

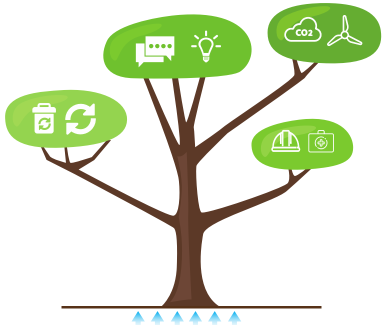
Ease new developments
(- risk, - investment,
+ opportunities)

+ Trade and competition



Enlarge potential market

+ Safety and sustainability



STANDARD

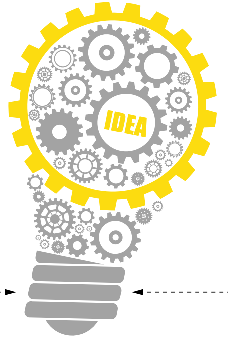
Fairer competition and less
risks of non-compliance
(widespread and shared
basic requirements)

2.2 Benefits and risks of standardization

Examples of benefits from Standards

Benefits of standards for communities and individuals

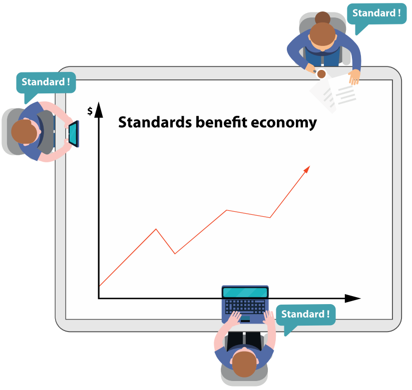
+ Innovation



STANDARD

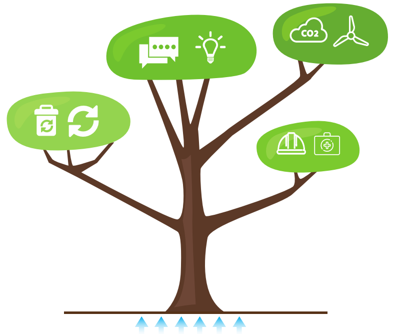
Satisfaction of tangible and intangible needs

+ Trade and competition



Best value for money

+ Safety and sustainability



STANDARD

Safer environment

2.2 Benefits and risks of standardization

Possible risks of Standards

- Standards may jeopardize innovation, as:
  - When established, standards may limit or delay the introduction of innovative (disruptive) solutions in the market
  - Introducing innovation into standards may take a long time
- Measures SDOs put in place to minimize risks:
  - Effectively managing the standardization processes by being open and responsive to the market innovation trends and to research impulses from the experts involved in the standardization activities
  - Establish open expert groups to explore innovation

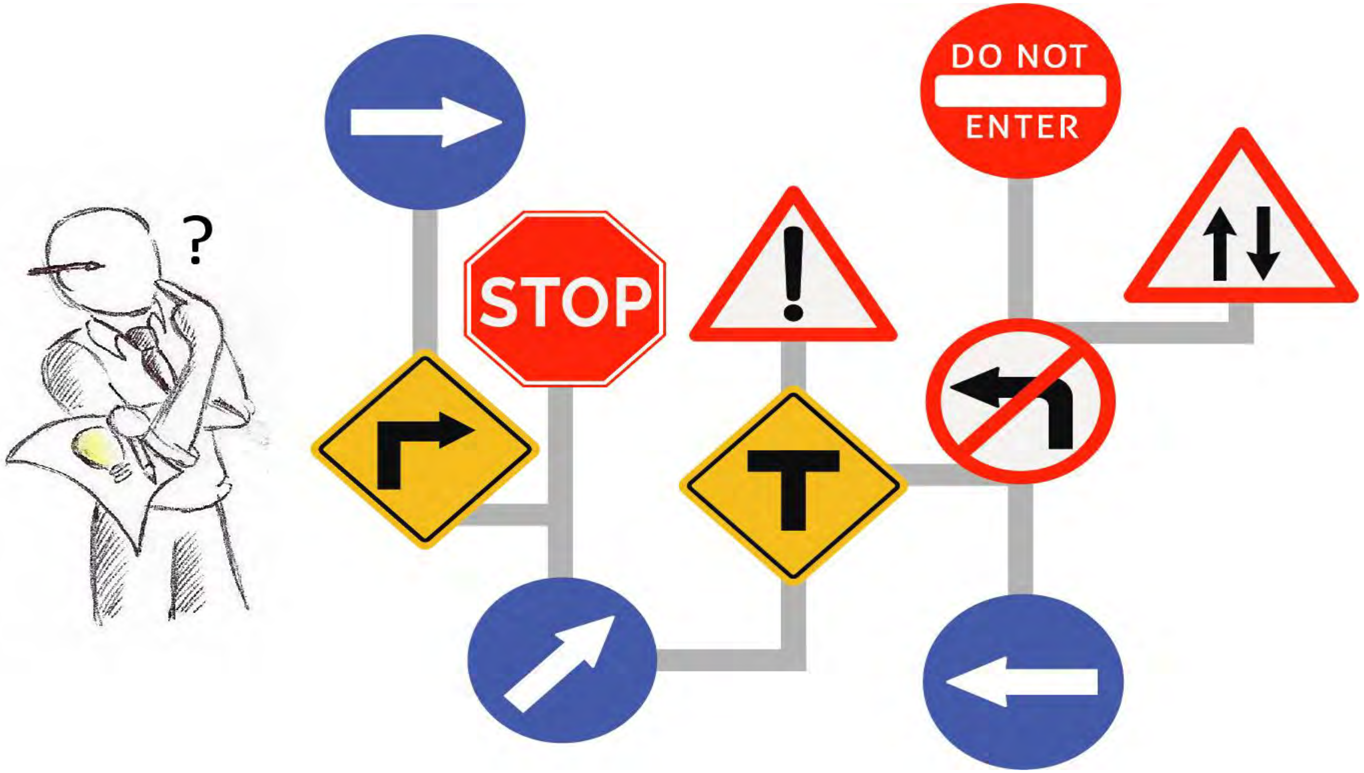
2.2 Benefits and risks of standardization
Possible risks of Standards

- Standards may jeopardize fair competition among industries and Countries, as:
  - SDOs may be politicized, or unduly influenced by special interests

- Measures SDOs put in place to minimize risks:
  - Enlarge contributor base
  - Right balance between effectiveness and fairness

2.2 Benefits and risks of standardization
Possible risks of Standards

- Varied standardization landscape may carry to inconsistencies, as:
  - Standards produced by different SDOs may be in competition or partially overlap; consequent production of inconsistent or, at least, redundant requirements may strongly jeopardize standardization benefits
  - Risk of unfairness as some SDO may be misused for local or specific interests



- Measures to put in place to minimize risks
  - Users and contributors to standards must select the most appropriate SDO
  - SDOs need to promote liaisons and collaboration among themselves

2.3 ICT Standardization Landscape
Classification of SDOs

- Standardization landscape includes multiple SDOs that may differ in
  - Geographical coverage
  - Technical scope of activities (as per each SDO's statute)
  - Level of recognition from regulatory or political organizations

- SDOs often establish liaisons or set up common working groups to generically coordinate their activities or to join efforts on specific items

2.3 Standardization Landscape

Classification of SDOs

- International SDOs
  - These have members worldwide, which sometimes also include national or regional standard bodies, and their deliverables have worldwide coverage.

- Regional SDOs
  - These have members (industries, academia and national SDOs) from countries that usually share, or are interested in promoting common practices and regulations.

2.3 Standardization Landscape

Classification of SDOs – International SDOs (examples)

ITU

- Since 1947 it's a specialized agency of UN, with study group made up by state members, sector members, associates from industry, international and regional standard organizations, and academia.
- ITU sectors: ITU-T (electronic design and test specifications), ITU-R (global radio spectrum, satellite orbits), ITU-D (promotion of fair and affordable access to telecommunications)

ISO

- Independent, international non-governmental organization founded in 1946
- Members from 160 country divided into hundreds of technical committees and subcommittees
- ISO standards covers ICT, healthcare, energy and automotive.

IETF

- Governing body of the Internet as part of the Internet society (ISOC)
- It is controlled by the Internet Architecture Board (IAB), which is both a committee of the IETF and an advisory body of the Internet Society

2.3 Standardization Landscape
Classification of SDOs – Regional SDOs (examples)

ETSI

- ETSI is a European Standards Organization (ESO), recognized regional standards body dealing with telecommunications, broadcasting and other electronic communications networks and services.
- ETSI supports European regulations and legislation through the creation of Harmonised European Standards. Only standards developed by the three ESOs (CEN, CENELEC and ETSI) are recognized as European Standards.

ARSO

- Main goals: harmonize national and/or sub-regional standards as African Standards, to initiate and coordinate the development of African Standards (ARS) with reference to products that are of particular interest to Africa, such as agriculture and food, civil engineering, chemistry, and chemical engineering, and to encourage and facilitate the adoption of international standards by member bodies.

PASC

- main objectives: to strengthen ISO and IEC international standardization programmes, to improve the ability of Pacific Rim SDOs to participate in these programmes effectively, to improve the quality and capacity of standardization and to promote standardization

2.3 Standardization Landscape
Classification of SDOs - Geographical coverage

- National Standard Development Organizations (NSDO)
  - National SDOs (NSDOs or NSB) operate at the single country level and issue country-specific standards; they often collaborate with International and Regional SDOs.
  - Some relevant NSDOs outside Europe are:

2.3 Standardization Landscape

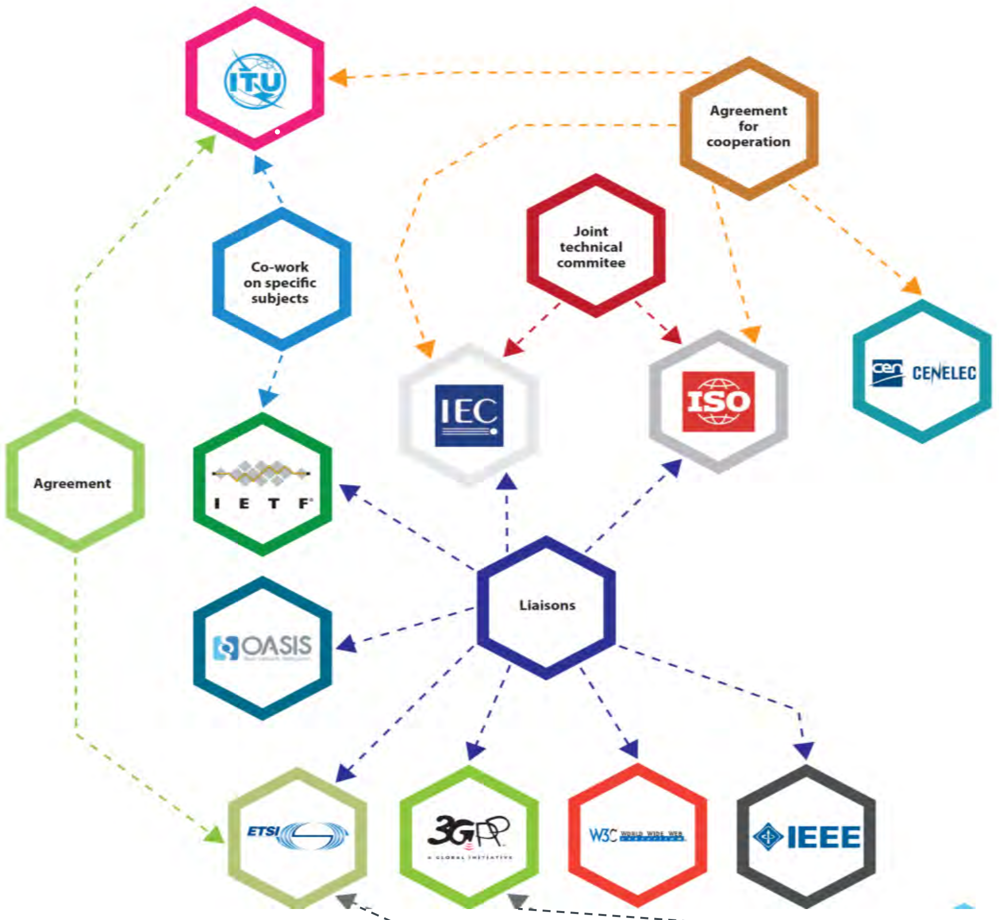
Classification of SDOs - Examples of scope of activities

- A non exhaustive overview of the ICT ecosystem, where International, Regional and National SDOs, Professional Organizations and Industrial Consortia operate

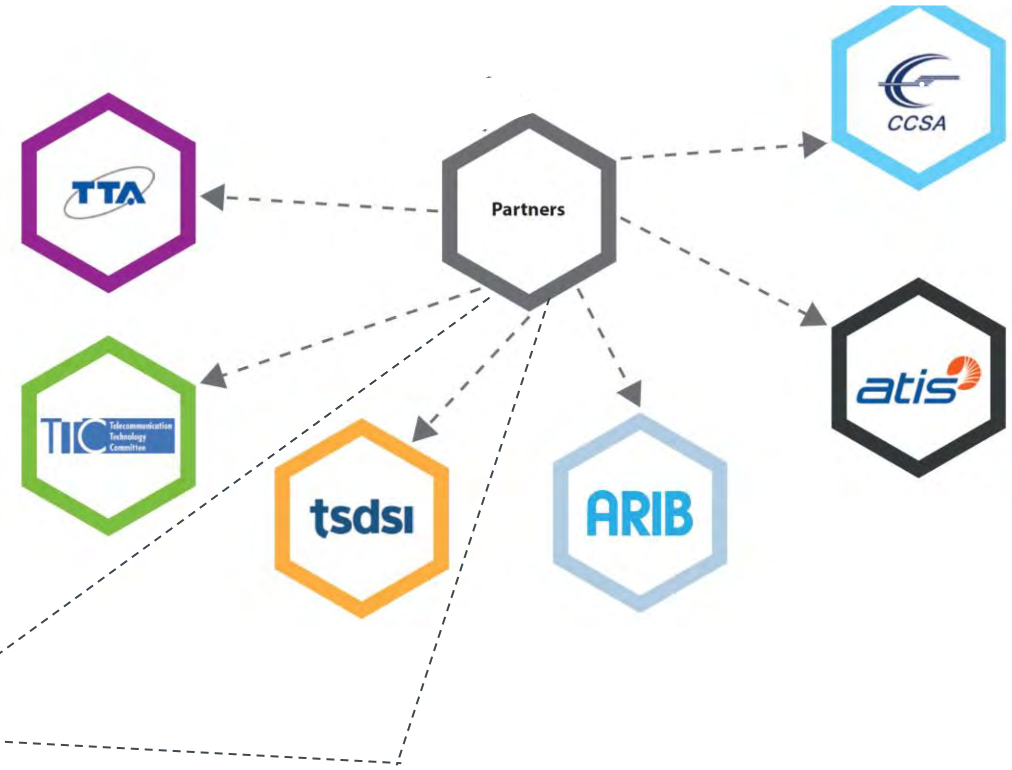
Organization	Typical technical scope of activity
ITU	Interoperable telecom specifications incl. architecture, services, protocols, addressing / numbering plans
ISO	ICT architecture (OSI model) services, protocols incl. application protocols
IEC	Electrotechnical standards, incl. connectors, electrical safety and tests
ETSI	Standards for ICT-enabled systems, applications and services
CEN	Household appliances, Intelligent Transportation and Mobility, Smart Grids and Smart Metering, Cybersecurity, Blockchains
CENELEC	Electrotechnical standards, incl. connectors, electrical safety and tests, ECM
IEEE	All LAN specifications: IEEE 802.xx, including cabled LANs, Token Ring and Bus, Wireless LANs WLAN, e.g. WiFi)
IETF	All internet related specifications including protocols, generic applications, addressing rules (IP, url)

2.3 Standardization Landscape

Classification of SDOs – Examples of liaisons among SDOs



- A non exhaustive overview of the ICT ecosystem, where International, Regional and National SDOs, Professional Organizations and Industrial Consortia collaborate through liaisons and Standard Initiatives



2.3 Standardization Landscape
Classification of SDOs

- **Recognized SDOs**
  - These are officially recognized by regulation systems or political bodies
  - ITU, UN specialized agency for information and communication
  - UE regulation 1025/2012 rules the standardization at an European level and lists a set of reference SDOs with either an international (ISO, IEC, and ITU) or European scope (CEN, CENELEC, and ETSI)
- **Not Recognized Organizations**
  - These are not recognized by any political bodies
  - IEEE is a primary SDO with a large number of active technical standards, ranging from wireless communications and digital health to cloud computing, power and energy, 3D video, electrical vehicle standards, and the Internet of Things. It was created by the Institute of Electrical and Electronics Engineers (IEEE), the American association of Electrical and Electronics Engineer and it brings together and organizes members from all over the world

2.3 Standardization Landscape

Classification of SDOs

- SDOs can create groups/projects, possibly also involving industries, for cooperating in the definition of specific standards
  - 3GPP
    - It consists of SDOs operating in the telecommunication field in countries and regions across the globe
    - Shared environment in which to produce the reports and specifications that define mobile radio technologies (radio access, core transport network, service capabilities and hooks for non-radio access to the core network, and for interworking with Wi-Fi networks)
  - OneM2M
    - Purpose is to develop technical specifications, which address the need for a reference Machine-to-Machine Service Layer that can be embedded within various hardware and software.
    - One of the main goal is to involve organizations from M2M-related business domains, such as telematics and intelligent transportation, healthcare, utilities, industrial automation, smart homes, etc.

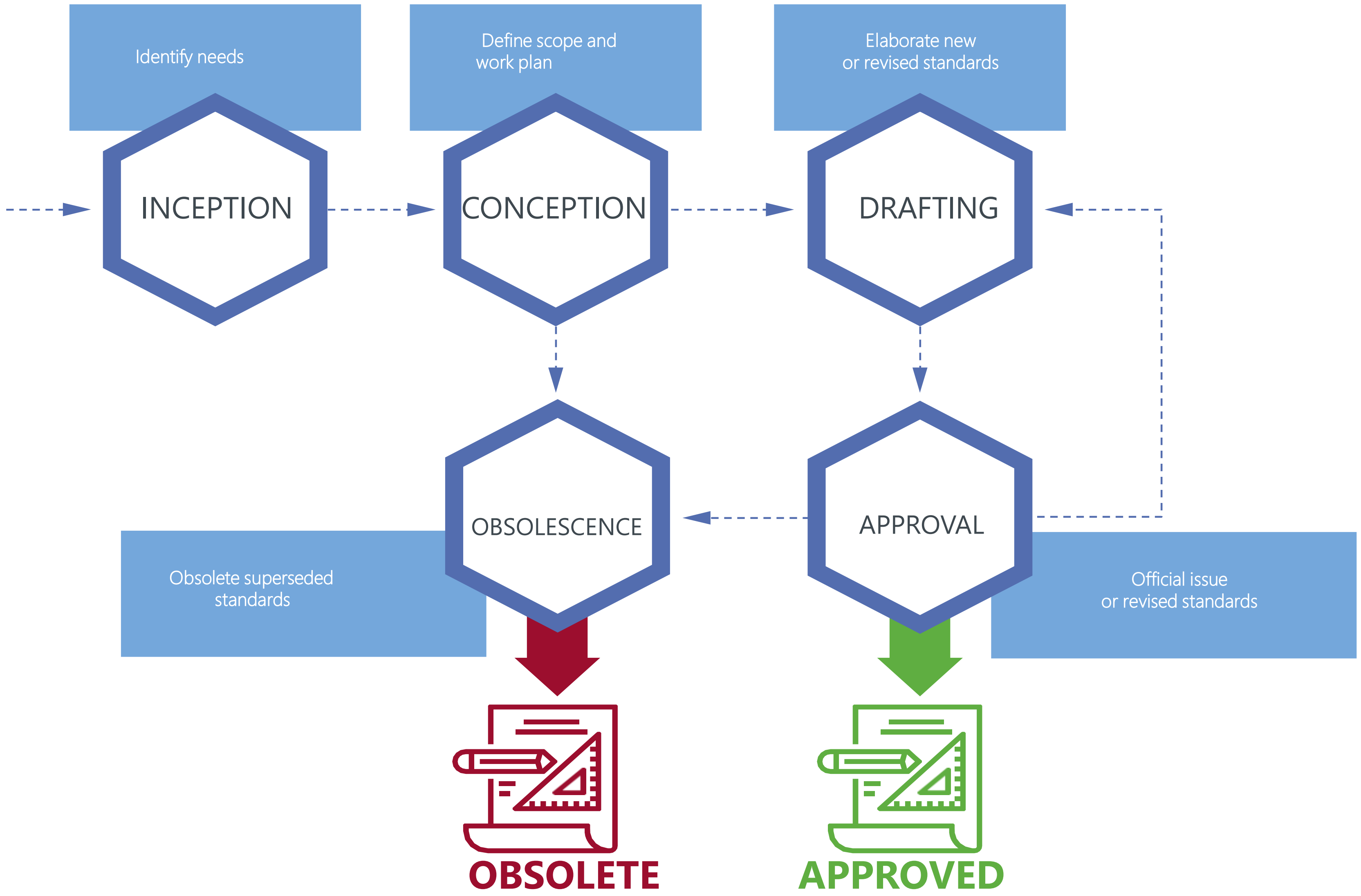
2.3 Standardization Landscape

Classification of SDOs - Affiliation

- In addition to SDOs, there are other organizations that do not strictly or entirely use the formal standardization procedures but aim at defining standard in a specific area
  - Example Industrial Fora/ Consortia: they are composed of groups of companies that temporarily join their efforts on specific subjects to realize, accelerate, complement, or promote the development of standards on them

2.4 The standardization process at a glance

Standard-development process



2.4 The standardization process at a glance

Main characteristics of a standard

- Standards are addressed to expert technical audiences in order to define some characteristics for a set of a specific item (which may be a product, material, procedure, service or process)

- Standards are not intended to fully specify an item, or to provide a throughout scientific-technical elaboration on a subject, but they're aimed to define the minimum requirements in order to meet certain well defined objectives (e.g., to guarantee a certain degree of interoperability or a minimum level of performance)

2.4 The standardization process at a glance

Main characteristics of a standard

- It shall be clear and unambiguous
  - It shall help readers to clearly understand what is essential to ensure compliance
  - It shall include and clearly separate parts that are
    - Normative, i.e. which describe mandatory standard requirements, i.e. the individual characteristics that the item being standardized must implement if it is to fully comply with the standard
    - Informative, i.e. which help with conceptual understanding
- It shall be written in plain language
  - Simple and short sentences
- Its requirements must be consistent, not redundant and testable
- It shall have well-defined objectives that meet real needs
  - It has NOT to be fruitlessly over-prescriptive

2.5 Using standards

How to find a standard

The procedures described here in order to identify standards related to a specific product/service are a simple example of how a beginner may proceed (depending on seniority, knowledge or specific goals the steps can change)

- Select relevant SDOs
  - by technical scope (which corresponds to the typology that the product/service is targeted for)
  - by geographical scope (which corresponds to the geographical market that the product/service is targeted for)

Note: Evolution of standards needs to be monitored to be informed about SDOs' scope and possible liaisons

- Identify selected SDOs' relevant specification documents and their relevance
  - SDOs may produce different kinds of documents such as technology roadmaps, product/service requirements, product/service technical specifications, regulations produced on behalf of regulatory bodies and product/service test specifications

2.5 Using standards
Select relevant SDOs

First step: to identify relevant SDOs according to geographical scope and technical domain

Example

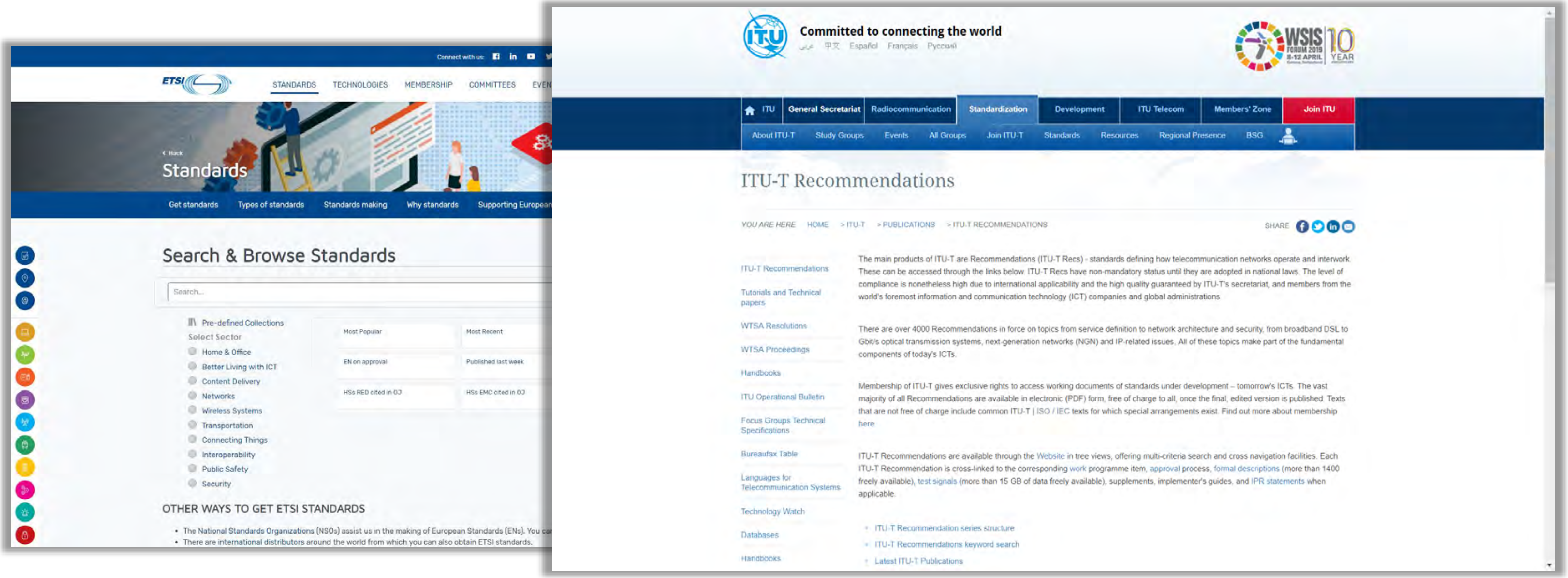
Organization	Headquarters	Geographical scope	Domain of activity	Affiliate organizations / members
ITU	Geneva (CH)	International	Telecom	National SDO / Industries
ISO	Geneva (CH)	International	ICT	National SDO
IEC	Geneva (CH)	International	Electrotechnical	National SDO
ETSI	Sophia Ant (FR)	Regional (Europe)	Telecom	National SDO / Industries / Research Institutes / Government bodies
CEN	Brussels (BE)	Regional (Europe)	ICT	National SDO
CENELEC	Brussels (BE)	Regional (Europe)	Electrotechnical	National SDO
IEEE	New York (US)	International	ICT Electrotechnical	Professionals
IETF	Fremont (US)	International	ICT	Professionals

2.5 Using standards

Identifying and accessing SDO documents

All SDOs make their documents available on line

Access may be restricted to authorized users



2.5 Using standards
Identifying and accessing SDO documents

- Clearly identify standard document's scope and objectives

Assigned standard document code may include information about document scope and applicability

Examples

ITU	ETSI	IETF
Publications from ITU Telecommunication standard sector (ITU-T) are coded with format X.nnn, where X describes document domain, such as, e.g.: A - Organization of the work B - Means of expression: definitions, symbols, classification C - General telecommunication statistics D - General tariff principles E - Overall network operation, telephone service, service operation and human factors F - Non-telephone telecommunication services G - Transmission systems and media, digital systems and networks …… etcetera ..	ETSI produces a range of publications, each with its own particular purpose, which is encoded in the first two letters of document's code; e.g.: EN – the document is intended to meet needs specific to Europe and requires transposition into national standards, or the document is required under a mandate from the European Commission (EC)/European Free Trade Association (EFTA). ES and TS and GS – the document contains technical requirements (the difference between ESs and TSs lies in different approval rules) EG – identifies guidance to ETSI in general on the handling of specific technical standardization activities TR and GR –the document contains explanatory material … etcetera ..	The IETF's official documents are named RFCs. "RFC" stands for Request for Comments, and this name expresses IETF's approach to standardization: "the Internet is a constantly changing technical system, and any document that we write today may need to be updated tomorrow". IETF doesn't code documents' scope and objectives in RFC identifier, which is simply a progressive number.

Reference
- ETSI,Web Page «Different Types of ETSI Standards», http://www.etsi.org/standards/different-types-of-etsi-standards; accessed in 2017
- ITU, Web page «ITU-T Recom. series structure», http://www.itu.int/en/ITU-T/publications/Pages/structure.aspx; accessed in 2017
- IETF, Web page «Info for Newcomers», https://www.ietf.org/newcomers.html#officialdocs; accessed in 2017

2.5 Using standards

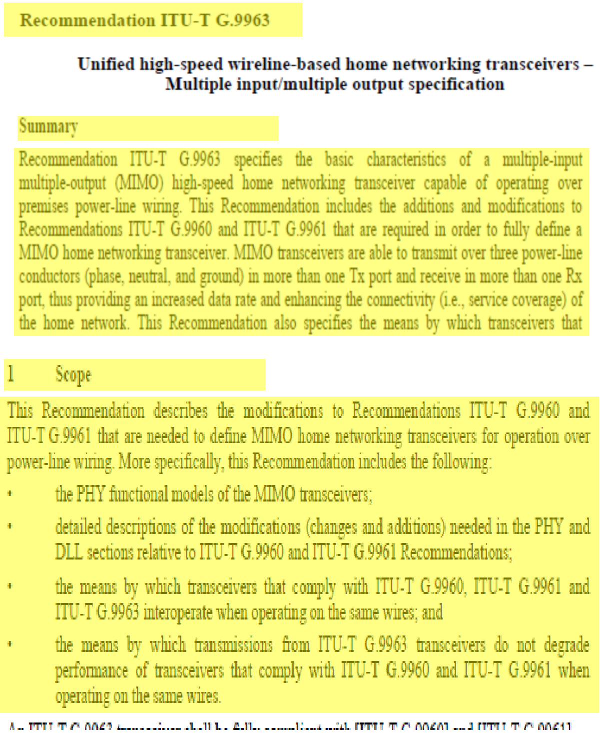
Understanding structure and formalism of the standards

- Clearly identify standard document's objectives and area of application

Standard documents explicitly claim scope and applicability, usually in introductory sections of the document

Examples

ITU



Recommendation ITU-T G.9963

Unified high-speed wireline-based home networking transceivers – Multiple input/multiple output specification

Summary

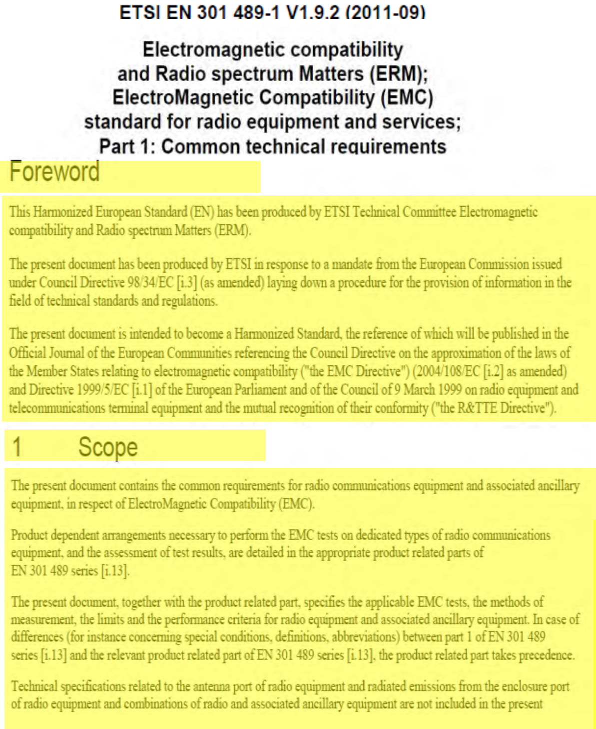
Recommendation ITU-T G.9963 specifies the basic characteristics of a multiple-input multiple-output (MIMO) high-speed home networking transceiver capable of operating over premises power-line wiring. This Recommendation includes the additions and modifications to Recommendations ITU-T G.9960 and ITU-T G.9961 that are required in order to fully define a MIMO home networking transceiver. MIMO transceivers are able to transmit over three power-line conductors (phase, neutral, and ground) in more than one Tx port and receive in more than one Rx port, thus providing an increased data rate and enhancing the connectivity (i.e., service coverage) of the home network. This Recommendation also specifies the means by which transceivers that

1 Scope

This Recommendation describes the modifications to Recommendations ITU-T G.9960 and ITU-T G.9961 that are needed to define MIMO home networking transceivers for operation over power-line wiring. More specifically, this Recommendation includes the following:

- the PHY functional models of the MIMO transceivers;
- detailed descriptions of the modifications (changes and additions) needed in the PHY and DLL sections relative to ITU-T G.9960 and ITU-T G.9961 Recommendations;
- the means by which transceivers that comply with ITU-T G.9960, ITU-T G.9961 and ITU-T G.9963 interoperate when operating on the same wires; and
- the means by which transmissions from ITU-T G.9963 transceivers do not degrade performance of transceivers that comply with ITU-T G.9960 and ITU-T G.9961 when operating on the same wires.

ETSI



ETSI EN 301 489-1 V1.9.2 (2011-09)

Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements

Foreword

This Harmonized European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 98/34/EC [i.3] (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

The present document is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility ("the EMC Directive") (2004/108/EC [i.2] as amended) and Directive 1999/5/EC [i.1] of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity ("the R&TTE Directive").

1 Scope

The present document contains the common requirements for radio communications equipment and associated ancillary equipment, in respect of ElectroMagnetic Compatibility (EMC).

Product dependent arrangements necessary to perform the EMC tests on dedicated types of radio communications equipment, and the assessment of test results, are detailed in the appropriate product related parts of EN 301 489 series [i.13].

The present document, together with the product related part, specifies the applicable EMC tests, the methods of measurement, the limits and the performance criteria for radio equipment and associated ancillary equipment. In case of differences (for instance concerning special conditions, definitions, abbreviations) between part 1 of EN 301 489 series [i.13] and the relevant product related part of EN 301 489 series [i.13], the product related part takes precedence.

Technical specifications related to the antenna port of radio equipment and radiated emissions from the enclosure port of radio equipment and combinations of radio and associated ancillary equipment are not included in the present

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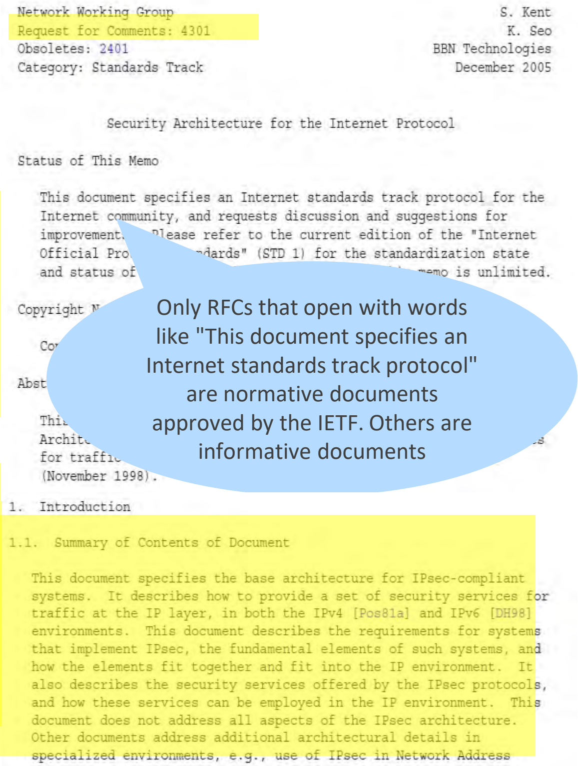

Network Working Group S. Kent
Request for Comments: 4301 K. Seo
Obsoletes: 2401 BBN Technologies
Category: Standards Track December 2005

Security Architecture for the Internet Protocol

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvement... Please refer to the current edition of the "Internet Official Pro... ...dards" (STD 1) for the standardization state and status of ... memo is unlimited.

Copyright N...

Co...

Abst...

Thi... Archit... for traffi... (November 1998).

1. Introduction

1.1. Summary of Contents of Document

This document specifies the base architecture for IPsec-compliant systems. It describes how to provide a set of security services for traffic at the IP layer, in both the IPv4 [Pos81a] and IPv6 [DH98] environments. This document describes the requirements for systems that implement IPsec, the fundamental elements of such systems, and how the elements fit together and fit into the IP environment. It also describes the security services offered by the IPsec protocols, and how these services can be employed in the IP environment. This document does not address all aspects of the IPsec architecture. Other documents address additional architectural details in specialized environments, e.g., use of IPsec in Network Address

Only RFCs that open with words like "This document specifies an Internet standards track protocol" are normative documents approved by the IETF. Others are informative documents

2.5 Using standards

Understanding structure and formalism of the standards

- Identify the list of other reference documentation.

Standard documents may have a very narrow scope as they can define only specific parts of a complex item; to get the actual relevance of the standard, it has to be correlated with provided other standard references (usually, they're explicitly quoted in the document itself)

ITU

Recommendation ITU-T G.9963

Unified high-speed wireline-based home networking transceivers – Multiple input/multiple output specification

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the

[ITU-T G.9960] Recommendation ITU-T G.9960 (2011), *Unified high-speed wire-line based home networking transceivers – System architecture and physical layer specification.*

[ITU-T G.9961] Recommendation ITU-T G.9961 (2010), *Unified high-speed wire-line based home networking transceivers – Data link layer specification.*

[ITU-T G.9964] Recommendation ITU-T G.9964 (2011), *Unified high-speed wireline-based home networking transceivers – Power spectral density specification.*

ETSI

ETSI EN 301 489-1 V1.9.2 (2011-09)

Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] CENELEC EN 55022 (2006) and A1 (2007): "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement".

[2] CENELEC EN 61000-4-2 (2009): "Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test".

[3] CENELEC EN 61000-4-3 (2006), A1 (2008) and A2 (2010): "Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test".

IETF

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Network Working Group                                        S. Thomson
Request for Comments: 4862                                        Cisco
Obsoletes: 2462                                               T. Narten
Category: Standards Track                                           IBM
                                                              T. Jinmei
                                                                Toshiba
                                                         September 2007

IPv6 Statel...

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   improvements.  Please refer ... "Internet
   Official Protocol Standards" (STD 1) for the standardization state

8.1.  Normative References

   [RFC2464]     Crawford, M., "Transmission of IPv6 Packets over
                 Ethernet Networks", RFC 2464, December 1998.

   [RFC2119]     Bradner, S., "Key words for use in RFCs to Indicate
                 Requirement Levels", BCP 14, RFC 2119, March 1997.

   [RFC4291]     Hinden, R. and S. Deering, "IP Version 6 Addressing
                 Architecture", RFC 4291, February 2006.

   [RFC4861]     Narten, T., Nordmark, E., Simpson, W., and H. Soliman,
                 "Neighbor Discovery for IP version 6 (IPv6)", RFC 4861,
                 September 2007.

8.2.  Informative References

   [RFC3315]     Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C.,
                 and M. Carney, "Dynamic Host Configuration Protocol for
                 IPv6 (DHCPv6)", RFC 3315, July 2003.

   [RFC3484]     Draves, R., "Default Address Selection for Internet
                 Protocol version 6 (IPv6)", RFC 3484, February 2003.
```

Explicit list of obsoleted RFCs

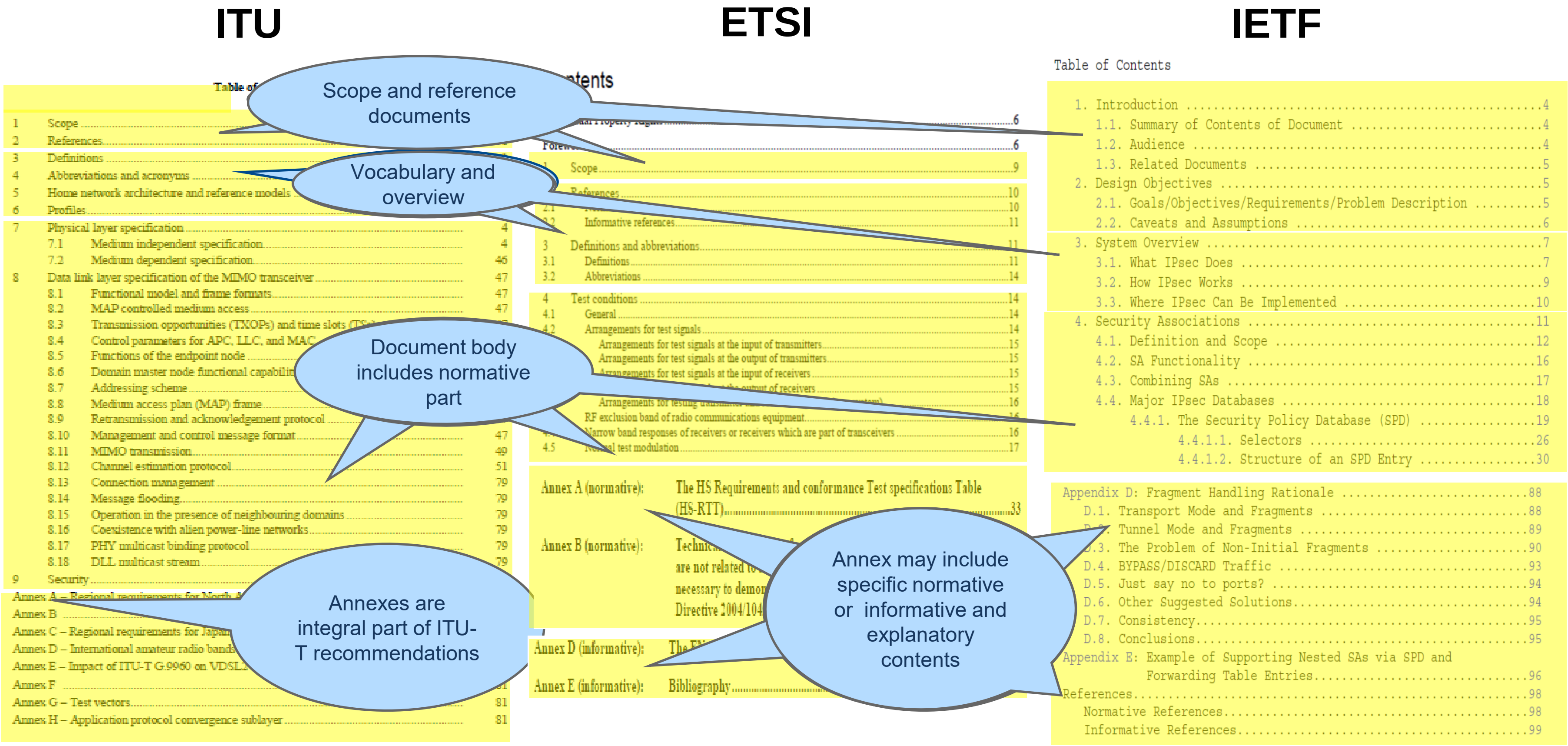
- Note

To fully get the context of a standard document and build a comprehensive picture of the production of standards on a specific area, it may be useful referring to specific informational documents provided by SDOs and to additional documentation (such as, technical white papers, scientific journals and books)

2.5 Using standards
Understanding structure and formalism of the standards

- Discriminate document sections and between normative and informative parts

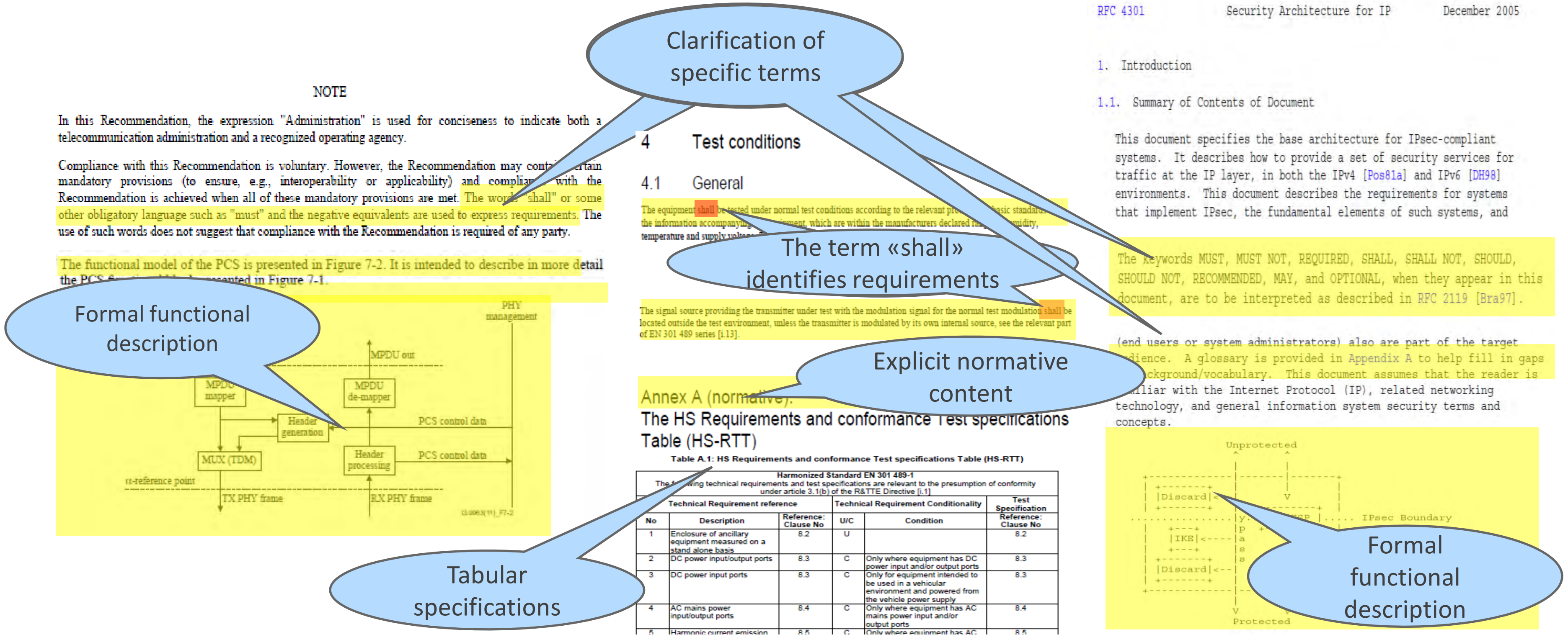
Examples



2.5 Using standards
Understanding structure and formalism of the standards

- Capture standard specific 'language' and 'formalisms' to express requirements and clearly discriminate between normative and informative statements

Examples ITU ETSI IETF



List of abbreviations: Chapter 2

- 3GPP: 3rd Generation Partnership Project
- AAP: Alternative Approval Process
- AD: Area Director
- ANSI: American National Standards Institute
- ARSO: African Organization for Standardization
- BGP: Border Gateway Protocol
- CEN: Comité européen de normalization - European Committee for Standardization
- CENELEC: Comité européen de normalization en électrotechnique - European Committee for Electrotechnical Standardization
- CERN: Centre Européen pour la Recherche Nucléaire - European Organization for Nuclear Research
- DVD: Digital Versatile Disk
- ECMA: European Computer Manufacturers' Association
- ETSI: European Telecommunications Standards Institute
- IEC: International Electrotechnical Commission
- INCITS: InterNational Committee for Information Technology Standards
- ISO: International Organization for Standardization
- ITU: International Telecommunication Union
- JEDEC: Joint Electron Device Engineering Council

List of abbreviations: Chapter 2

- HD DVD: High Definition Digital Versatile Disc
- HTML: HyperText Markup Language
- IEEE: Institute of Electrical and Electronics Engineers
- IETF: Internet Engineering Task Force
- IP: Internet Protocol
- IPsec: IP security
- HDMI: High Definition Multimedia Interface
- ICT: Information and Communication Technology
- LTE: Long Term Evolution
- M2M: Machine to Machine
- NSDO: National Standard Development Organization
- OSPF: Open Shortest Path First
- PASC: Pacific Area Standards Congress
- PDF: Portable Document Format
- SDO: Standard Development Organization
- TAP: Traditional Approval Process
- UMTS: Universal Mobile Telecommunications System
- VESA: Video Electronics Standards Association

List of abbreviations: Chapter 2

- W3C: World Wide Web Consortium
- WG: Working Group
- WI: Work Item
- XML: eXtensible Markup Language

References: Chapter 2

- Biddle & al. (2010). How many standards in a Laptop? (and other empirical questions), http://ssrn.com/abstract=1619440
- CEN-CENELEC (2018). Smart Grids, https://www.cencenelec.eu/standards/Sectors/SustainableEnergy/SmartGrids/Pages/default.aspx. Accessed March 2018.
- ETSI (2013). A Guide to Writing World Class Standards, https://portal.etsi.org/LinkClick.aspx?fileticket=N_gN9ctXowg%3D&tabid=1408&portalid=0. Accessed March 2018.
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- ETSI (2018). Protocol Specification Languages, http://www.etsi.org/technologies-clusters/technologies/protocol-specification. Accessed March 2018.
- Fishman, G. (2012). Decision-Making and Approval Procedures: soft and hard decisions, https://www.itu.int/en/ITU-T/tutorials/Documents/201210/Session-06-Rapporteur%20Tutorial%201208G-Decision_Making.pdf
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- IETF. The Tao of IETF: a Novice's Guide to the Internet Engineering Task Force, https://www6.ietf.org/tao.html. Accessed March 2018.
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- IETF (1998). RFC2418 - IETF Working Group Guidelines and Procedures, https://datatracker.ietf.org/doc/rfc2418/?include_text=1. Accessed March 2018.
- IETF (2001). Guidelines for the Use of Formal Languages in IETF Specifications, https://www.ietf.org/iesg/statement/pseudocode-guidelines.html. Accessed March 2018.

References: Chapter 2

- IETF (2012). RFC 6771 - Considerations for Having a Successful "Bar BOF" Side Meeting, https://tools.ietf.org/html/rfc6771. Accessed March 2018.
- IETF (2013). RFC 2026 - The Internet Standards Process - Revision 3, https://datatracker.ietf.org/doc/rfc2026/?include_text=1. Accessed March 2018.
- IETF (2014). RFC 7322 - RFC Style Guide, https://tools.ietf.org/html/rfc7322. Accessed March 2018.
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- ITU-T. ITU Standards development, https://www.itu.int/en/ITU-T/about/Pages/development.aspx. Accessed March 2018.
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3 The Standards Ecosystem

3 The standards ecosystem

- The learning objectives of this section are:
  - To **understand and apply** the different **criteria** for establishing the classifications of **organizations and documents**, especially in the **ICT** arena.
  - To be able to **describe** the role in **ICT standardization of SDOs, recognised SDOs, and industrial consortia**, as well as their **interplay**.
  - To **identify** the **characteristics** of **formal and de facto standardization**, and to be aware of the processes through which de **facto standards are adopted by SDOs**.
  - To **identify** the main **categories of ICT standards and documents**, including which type of documents may be produced by each organisation, and to get familiar with the **naming conventions**.
  - To **understand** the differences among **National, Regional and International** organizations, the benefits derived of their **coordination**, and to be aware of the main **agreements** and procedures supporting it.
  - To **understand** why **standards** are usually **referenced by legislation**, and the need to issue **standardization requests** when a societal need is identified in a specific area.

3.1 Introduction

- The standardization **landscape is rich and complex**, because of the variety in standard development organizations (SDOs) and the documents they produce…
- The current chapter aims to provide some **basic concepts** to help readers **find their way** around the **standards ecosystem**.

3.2 Standards organizations

Formal standardization and SDOs (1/2)

- **Formal standardization** is based on **well-defined processes**, open to any individual or organization, and its results are produced in consensus with all interested parties.
- **It is inspired** mainly by the six principles of the **Technical Barriers to Trade (TBT)** Committee of the Word Trade Organisation (**WTO**): Transparency, Openness, Impartiality and consensus, Effectiveness and relevance, Coherence, and Development dimension.
- Organizations doing formal standardization are known as **Standard Development Organizations (SDOs)**. They do it in response to specific industry or societal needs.

3.2 Standards organisations

Formal standardization and SDOs (2/2)

- Some SDOs are officially **recognized by regulatory systems** as providers of standards. They are known as **recognized SDOs**.
- Sometimes, the expression **"de jure" standards** is used as an equivalent to **SDO standards**.
  - However, "de jure" fits only in the case of a subset of these standards, i.e., those that are used by legislation.

3.2 Standards organizations

Recognized SDOs in the European Union

- **Regulation (EU) No 1025/2012** of the European Parliament and of the Council:
  - **Designates CEN, CENELEC and ETSI** as the **European Standardization Organizations (ESOs).**
  - The aims set out in the EU treaties are achieved by several types of legal act: regulations, directives, decisions and opinions.
  - Example: Directive (EU) 2016/2102 on the accessibility of the websites and mobile applications of public sector bodies makes references to the CEN/CENELEC/ETSI standard EN 301 549.

3.2 Standards organizations
SDOs that are not officially recognized

- Besides the officially recognized SDOs, there are **well respected and long existing SDOs,**
  - like **W3C, IETF, OASIS, IEEE, OMG.**
- These are **not officially recognized** by the authorities, **but they have well established procedures** to ensure the quality of their standards.

3.2 Standards organizations
SDOs that are not officially recognized. Examples

- W3C's Web Content Accessibility Guidelines (WCAG) standard is explicitly referenced by CEN/CENELEC/ETSI standard EN 301 549 on ICT accessibility requirements.
- IEEE counts on a specific board (the IEEE-SA Standards Board) for coordinating the development and revision of IEEE standards:
  - This includes approving the initiation of standards projects and reviewing them for consensus, due process, openness, and balance.
- IEEE 802 is just an example of an IEEE family of standards with a significant impact in society.
  - 802 standards deal with local area networks and metropolitan area networks.

3.2 Standards organizations

Public and private organizations

- Public organizations have been normally created by treaties. This is the case of ITU, which is an agency of the United Nations

- Other standards organizations are private, such as ISO, OMG, ETSI or ANSI.

3.2 Standards organizations
De facto standards (1/3)

- These **ICT-related items** have in common that they have had a **huge impact** in society…
  - **PDF**: a document format created by Adobe Systems.
  - **HTML**: a language for describing the structure of Web pages. It was originally created by Tim Berners-Lee, and it is currently published and maintained by W3C.
  - **Microsoft Windows**: an operating system that became an industry standard, and so did its specifications (e.g. the Microsoft Web Services Security specification, WS-Security).
- … They are called "**de facto standards**". They are **common practices adopted by the market**, which are not the result of any standardization process.

3.2 Standards organizations
De facto standards (2/3)

- A **de facto standard** is a **custom or convention** that has achieved a **dominant position** by public acceptance or market forces, and that usually has the attractive characteristic of having been **validated by market processes** (Maxwell 2006)
- Abernathy and Utterback (1978) introduced the ‘**dominant design**’ concept.
  - Dominant designs may not be better than other designs; they simply incorporate a set of key features that sometimes emerge due to technological path- dependence and not necessarily strict customer preferences.

3.2 Standards organizations

De facto standards (3/3)

- De facto standards may be adopted as formal standards by recognized SDOs:
  - ISO/IEC 15445:2000 Information technology -- Document description and processing languages -- HyperText Markup Language (HTML).
  - ISO 32000-1:2008 Document management -- Portable document format -- Part 1: PDF.

3.2 Standards organizations

De facto standards vs SDO standards (Blind 2008)

SDO STANDARD	DE FACTO STANDARD
▪ Developed in SDOs	▪ Dominant design through a standard war or natural selection. E.g., a company achieves a dominant position by public acceptance or market forces
▪ Open and consensus oriented with the option of opposition, which may sometimes lead to lengthy decision procedures	▪ Standardization process with restricted access; homogeneous environment may allow fast decisions
▪ Clear and transparent participation and voting rules	▪ Direct participation of company alliances (e.g. consortia) and individual companies

3.2 Standards organizations
Industrial consortia

- **Some standards organizations** were created as **industrial consortia**, e.g.:
  - The Home Gateway Initiative (HGI) developed a smart home architecture that enables applications to connect with devices on any home network interface.
  - The EnOcean Alliance created a wireless standard to develop self-powered wireless monitoring and control systems for sustainable buildings as well as energy harvesting solutions.
- In the ICT context of rapid developments, consortia benefit from a **lighter process** and a **lower level of consensus** of document approval than SDO standards go through.
- Documents developed by a **single company** (e.g. Windows as as Microsoft standard) **do not fall into this category**.

3.2 Standards organizations

Industrial consortia interplay with SDOs: The PAS process (1/3)

- What is the **Publicly Available Specification** (PAS) process?
  - A means to transpose a specification more rapidly into an international standard published by a recognized SDO.
- The document to be published in a **PAS process** is:
  - A publication already developed at a quasi-final stage.
  - Approved by consensus at the consortium level.
- The **PAS process involves:**
  - Benefiting from the **SDO's reputation** as a provider of standards for global use.
  - Subsequent **maintenance and possible evolution** by the SDO that applied the procedure.
  - **Faster availability to the market** and in a lighter way than with the full regular SDO process.

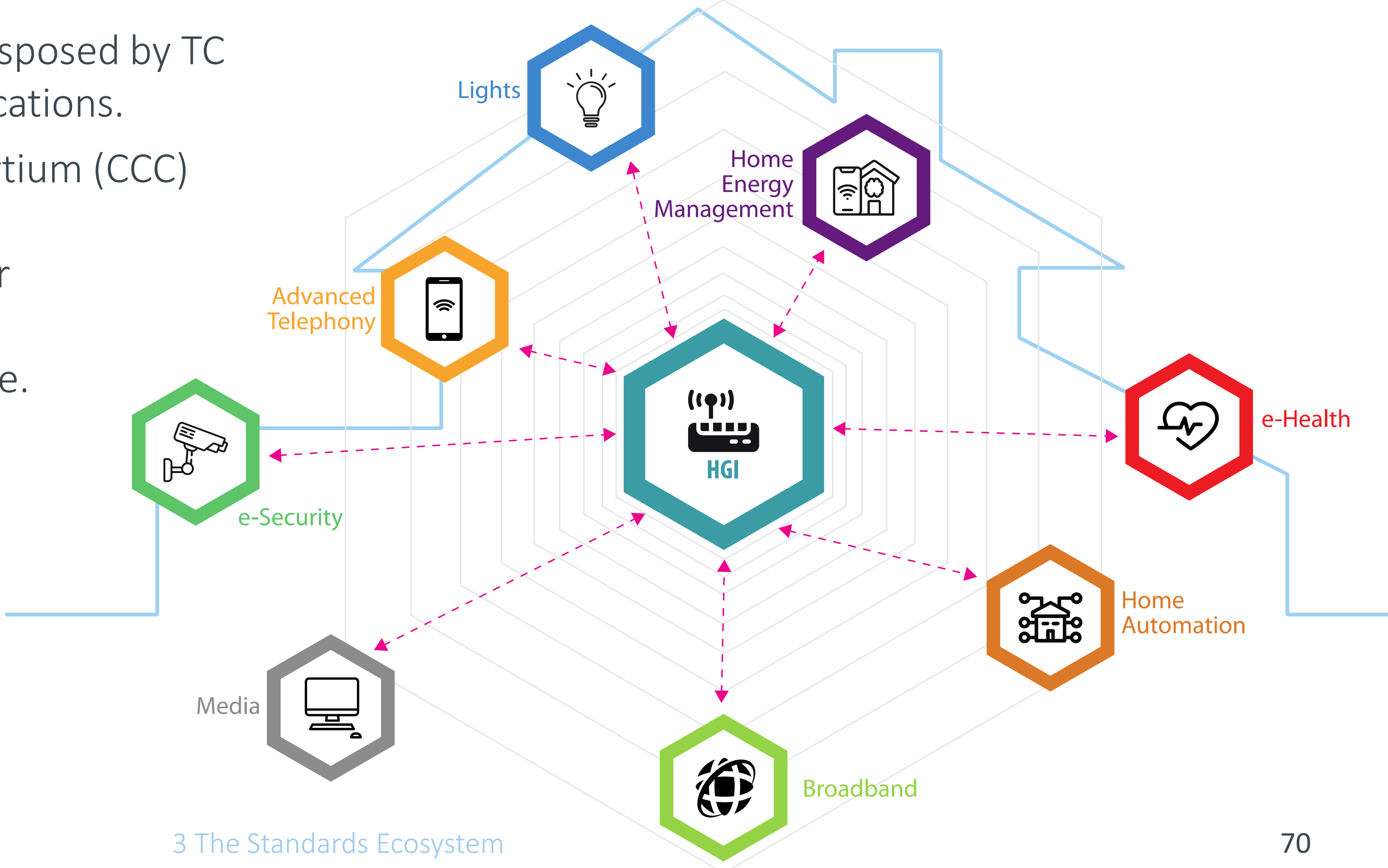
3.2 Standards organizations
Industrial consortia interplay with SDOs: The PAS process (2/3)

- **ISO PAS process**
  - EnOcean Alliance develops specifications for sustainable buildings
  - Wireless Short-Packet (WSP) protocol developed by EnOcean ratified as standard ISO/IEC 14543-3-10.
  - EnOcean Alliance complements this standard with dedicated equipment and generic profiles

3.2 Standards organizations

Industrial consortia interplay with SDOs: The PAS process (3/3)

- **ETSI PAS process:**
  - HGI specifications were transposed by TC SmartM2M into ETSI specifications.
  - The Car Connectivity Consortium (CCC) defined the MirrorLink open standard for smartphone-car connectivity that has been adopted by TC ITS committee.



3.2 Standards organizations

Industrial consortia interplay with SDOs: extension of standards

- SDO standards may be **extended by industry** to create **test suite specifications** and **promote** the involved technology.
  - The Wi-Fi Test Suite was designed by the Wi-Fi Alliance to support the certification of devices with the IEEE 802.11 standard.
  - The Global System for Mobile Communications Association (GSMA) writes guidelines and specifications to help implementers use the ETSI standards developed by 3GPP.

3.3 Types of documents produced by SDOs

- There are **different types of documents** produced by SDOs.
- **Different organizations** may produce different types of **documents.**
- The **definition/purpose** of each type of document may differ across organizations.
- Different types of documents may differ in:
  - Their **scope** and addressed **stakeholders.**
  - The **process** leading to their approval/publication.

3.3 Types of documents produced by SDOs
Normative and informative documents (Hatto, 2013)

- **Informative** documents, **do not contain any requirements** and it is therefore not possible for compliance claims to be certified.
- **Normative** documents **contain requirements** that must be met in order to claim compliance with the standard.
  - **Requirements** in a standard are usually worded with the term "**shall**".
  - **Recommendations** in a standard are usually worded with the term "**should**".
  - In order to avoid confusion or contradiction, **informative elements** (even in normative documents) **cannot contain requirements.**

3.3 Types of documents produced by SDOs

Normative documents (1/2)

- **Standard**:
  - A document containing requirements or recommendations that have reached **wide consensus**.
  - Normally, approval of standards requires to go through the **most comprehensive and rigorous procedures** of organizations publishing them.
  - E.g., ISO/IEC 27001 Information technology — Security techniques — Information security management systems — Requirements.

3.3 Types of documents produced by SDOs
Normative documents (2/2)

- Specification:
  - A document **needed by industry** in the short term concerning a **technical aspect that is still under development**, or where it is believed that there will be a future, but not immediate, **possibility of agreement on a standard.**
  - E.g., ETSI TS 103 645 CYBER; Cyber Security for Consumer Internet of Things.

3.3 Types of documents produced by SDOs
Informative documents

- Technical report:
  - A document with **explanatory material** about a topic.
  - E.g., ETSI TR 103 234 Power Line Telecommunications; Powerline recommendations for very high bitrate services.
- Guide:
  - Documents used by standards organizations for **providing advice on how to handle specific technical standardization activities**.
  - E.g., ISO/IEC Guide 71:2014 - Guide for addressing accessibility in standards, guides standardizers on how to address accessibility when either producing new standards or revising existing ones.
  - E.g., CEN-CENELEC and ISO-IEC Guide 17 – Guides standardizers to take into account SME needs, e.g. making "simple and understandable" standards.

3.3 Types of documents produced by SDOs

- Some **documents are particular** to certain organizations:
  - ETSI Standard (ES).
  - CEN Workshop Agreement (CWA).
  - ISO Workshop Agreement (IWA).
  - ISO Publicly Available Specifications (PAS).

3.3 Classification of ICT standardization documents
(modified from de Vries, 2006 and Hatto, 2013)

- **Terminology** standards:
  - ITU-T E.800 Definitions of terms related to the quality of service.
  - ISO/IEC 17788:2014 Information technology – Cloud computing – Overview and vocabulary.

- **Measurements or test** methods
  - IEEE Std 299-2006 IEEE Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures.
  - ETSI ES 203 228 V1.3.1 (2020) Environmental Engineering (EE); Assessment of mobile network energy efficiency.

3.3 Classification of ICT standardization documents
(modified from de Vries, 2006 and Hatto, 2013)

- **Specifications**:
  - ISO/IEC 10918-1:1994 Information technology—Digital compression and coding of continuous-tone still images: Requirements and guidelines.
  - CLC/TS 50134-9 Alarm systems - Social alarm systems - Part 9: IP Communications Protocol.
- **System architecture**:
  - ISO/IEC/IEEE 42010:2011 Systems and software engineering—Architecture description.
- **Reference models:**
  - ISO/IEC 7498:1994 Preview. Information technology -- Open Systems Interconnection.
  - W3C Recommendation 15 December 2004 - the Architecture of the World Wide Web, Volume One.

3.3 Classification of ICT standardization documents
(modified from de Vries, 2006 and Hatto, 2013)

- **Software and networking**:
  - Computer software, including programming languages (e.g. C++ is published as ISO/IEC 14882).
  - Application Programming Interfaces (API) (e.g. ISO 17267 on API for navigation systems for intelligent transport systems).
  - Communication protocols (e.g. Wifi IEEE standards).
  - File information and formats (e.g. RFC 8259 JSON).

- **Quality assurance**:
  - IEEE 730-2014 –Software Quality Assurance Processes.

3.3 Classification of ICT standardization documents

- The above classification is **not strict!** One document may be allocated to more than one category, for example:
  - Requirements standards may include testing procedures to assess whether the requirements are met.
  - Documents where systems or reference models are described may include the involved vocabulary.
  - Software standards may include requirements.

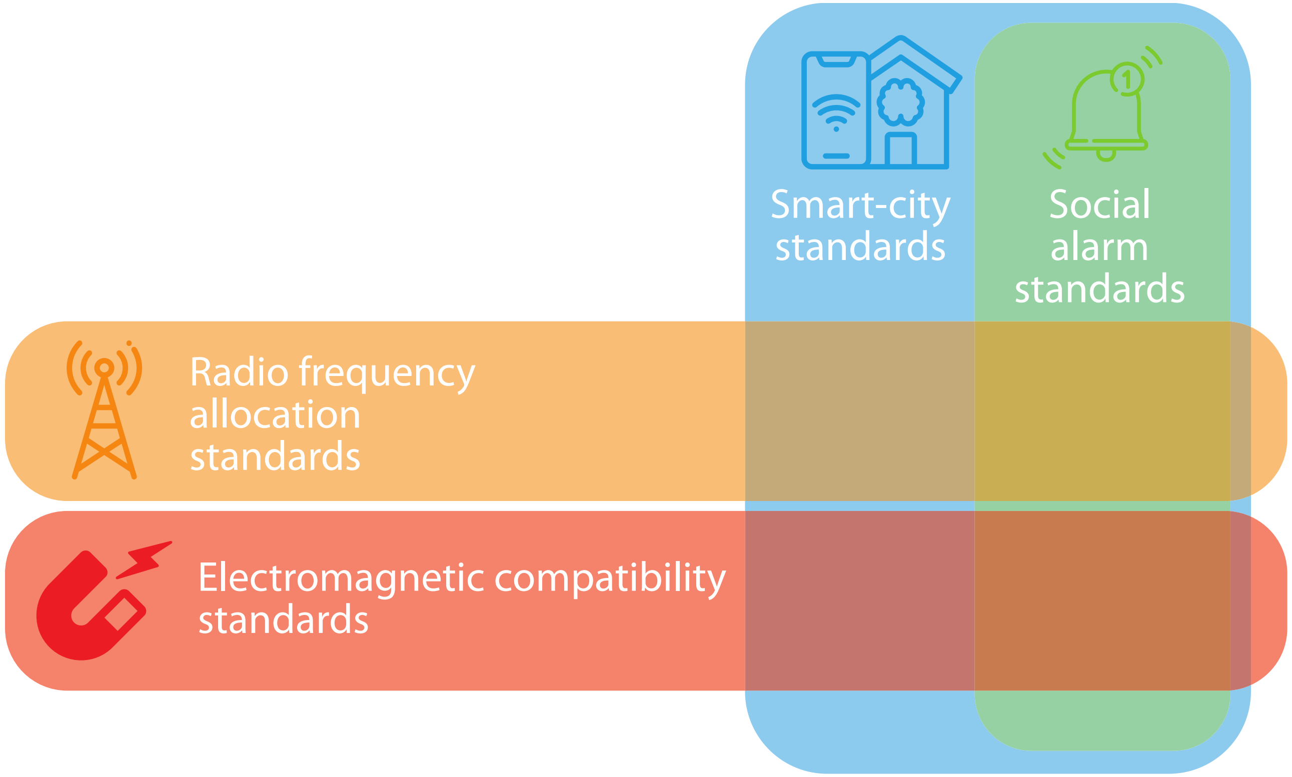
3.3 Classification of ICT standardization documents

Vertical and horizontal standards (de Vries,2006)

- **Horizontal** standards are applicable across multiple industries or entities:
  - E.g., the Electromagnetic compatibility (EMC) standards which are applicable in all electrical/electronic equipment, like the EN 61000 family of EMC standards.
- **Vertical** standards apply to a particular industry or entity
  - E.g. the CENELEC family of standards about social alarm systems (EN 50134) includes direct or indirect references to the EN 61000 standards.
- **Vertical** standards normally **reference horizontal** standards.
  - For instance, standards about mobile phones or social care alarm devices reference EMC standards.

3.3 Classification of ICT standardization documents

Vertical and horizontal standards



3.3 Naming conventions for standardization documents

Information provided by a document’s name (1/2)

- The **SDO** (or SDOs, in case it is a joint publication) that has published it.
- **Other SDOs** that might have **adopted** the standard after it was originally published.
- The **type of document**, e.g., whether it is an International, European or National standard, a specification, technical report, etc.
- Whether the document belongs to a **family** of standards.

3.3 Naming conventions for standardization documents
Information provided by a document's name (2/2)

- Whether it is a **harmonised** standard.
- The **version** number of the standard, indicating whether it is a draft or final version, as well as informing of major, technical or editorial changes.
- The **year** of publication of the document.
- The **title** of the standard.

3.3 Naming conventions for standardization documents
Examples (1/3)

- EN 45502-2-3:2010 Active implantable medical devices - Part 2-3: Particular requirements for cochlear and auditory brainstem implant systems
  - The “EN” prefix indicates that it is a European Standard.
  - The code of the standard “45502-2-3” indicates that it includes the 2nd part and the 3rd sup-part documents of a standard family (“45502”).
  - It was published in 2010.
  - The family name is “Active implantable medical devices”.
  - The title of the standard itself is “Part 2-3: Particular requirements for cochlear and auditory brainstem implant systems”

3.3 Naming conventions for standardization documents
Examples (2/3)

- ETSI TS 102 412 V12.1.0 (2019-06) "Smart Cards; Smart Card Platform Requirements Stage 1" (Release 12)
  - The “ETSI” prefix indicates that this standard has been published by ETSI.
  - The “TS” prefix indicates that it is a Technical Specification.
  - The code of the standard is 102412.
  - This is the version 12.1.0 of the standard (which is confirmed by the “release 12” in the title). ETSI uses three numbers (x.y.z) to indicate its document versions. The first final version of a document will be Version v1.0.0. Subsequent final documents will increase the first number "1.x.x" of the version number (1.a.b, 2.c.d, etc.). In these examples, a and c indicate the corresponding "technical" version numbers, while b and d indicate the corresponding "editorial" version numbers.
  - It was published in June, 2019.
  - The document is part of the “Smart cards” family of standards.

3.3 Naming conventions for standardization documents
Examples (3/3)

- DS/EN ISO/IEC 27002:2017 Information technology. Security techniques. Code of practice for information security controls
  - The “DS/EN ISO/IEC” prefix indicates that this standard was first published by ISO/IEC
  - Then adopted as a European Standard (EN), and then as a Danish standard (DS)

3.4 National, Regional and International standardization
Geographical scope of organizations and standards (1/2)

- Recognized SDOs have **national**, **regional or international geographical** scope, and so do the formal standards they produce:
  - ISO, IEC and ITU are official **international** standard organizations, with a worldwide scope.
  - CEN, CENELEC and ETSI are officially recognized as **European** bodies for standardization.
  - PASC is a regional SDO the **Pacific** area.
  - DIN, UNE, ANSI, and BIS are national SDOs in, respectively, **Germany, Spain, USA, and India.**

3.4 National, Regional and International standardization

Geographical scope of organizations and standards (2/2)

Standardization Structures:

	National level e.g. Germany	Regional level e.g. Europe	International
General	DIN	cen	ISO
Electrotechnology	DKE VDE DIN	CENELEC	IEC
Telecommunications	DKE VDE DIN	ETSI	ITU

3.4 National, Regional and International standardization

Do standardization practices fit 100% that schema?

- ETSI publishes standards that are adopted globally, such as the GSM family of standards.
- PASC does not produce standards, but it supports the participation of the region's SDOs in the ISO and IEC activities.
- In the USA there are approx. 200 organisations producing American National Standards (ANS). These are SDOs, accredited by ANSI, the only National SDO.
  - ANSI is the only official representative of the United States at ISO and IEC.

3.4 National, Regional and International standardization

Cooperation and coordination (1/2)

- The objective is to ensure that organizations make **the best use of their resources:**
  - to support **information exchange**,
  - to increase the **transparency** of procedures,
  - and to **reduce the possibility of duplicating** work unnecessarily at a national, regional or international level.

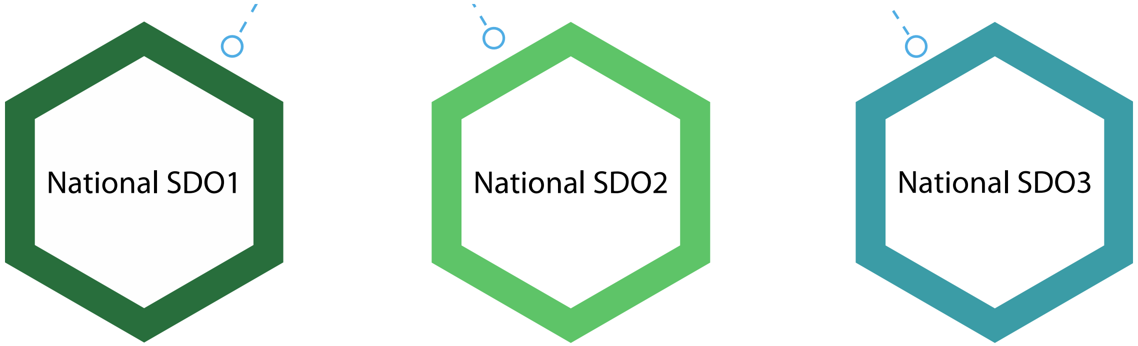
3.4 National, Regional and International standardization

Cooperation and coordination (2/2)

- **International** standardization usually takes **precedence** over **regional** standardization, which again takes precedence over **national** standardization.
- Ideally, approved **international standards** are simultaneously **adopted as regional** standards, and then as **national standards** in region's countries.

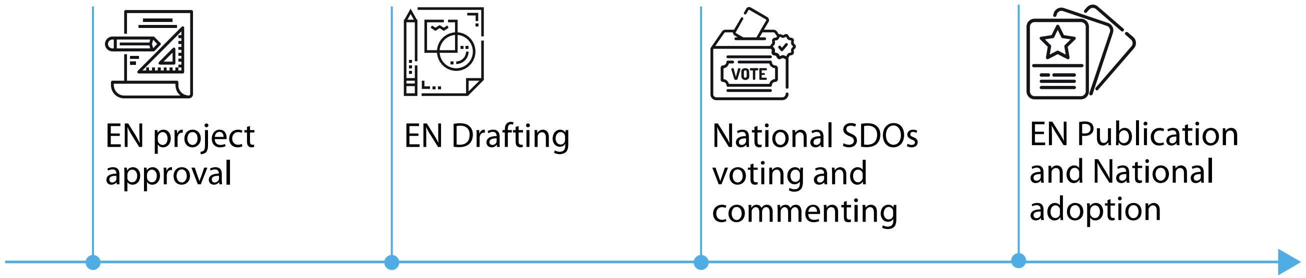
Cooperation and coordination: NSOs

- National SDOs (NSOs) **represent** their own countries' standardization activities in regional and international SDOs.
- They support national experts to **track regional and international standards**,
- They **adopt international standards** as national standards.
- There is **only one NSO per country**.



3.4 National, Regional and International standardization
Cooperation and coordination in Europe

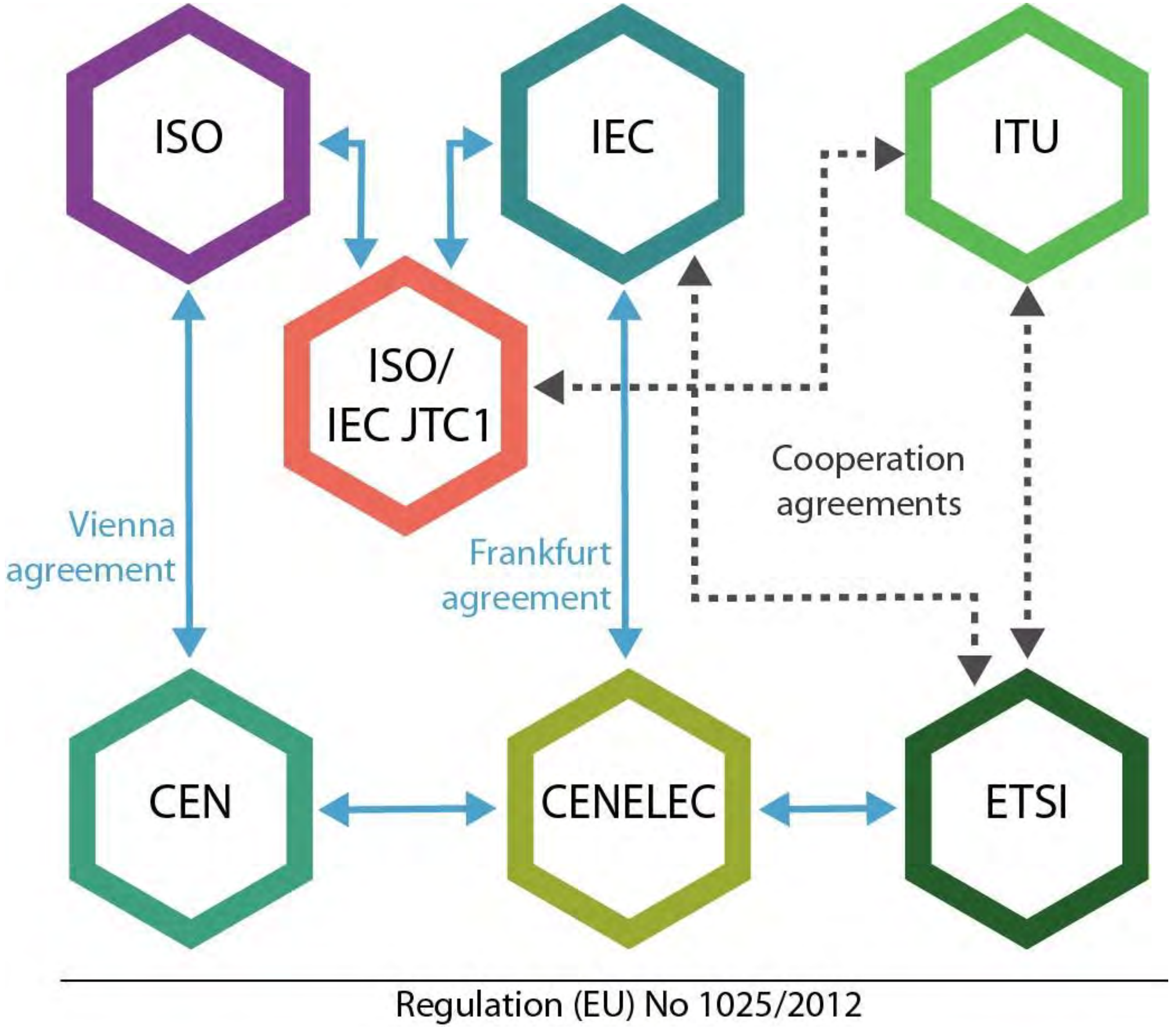
- Coordination among European and National standardization activities
  - **European** and their **national** member SDOs **publish periodically their work programmes** and the list of **approved/adopted** standards
  - "**Standstill**": obligation for the National SDOs not to take any action, neither during the preparation of a European Standard (EN) nor after its approval
  - The generic **process of coordination between European and National** standardization can be described as follows: **project approval**, **drafting**, National SDO **voting and commenting**, EN **publication** and **National adoption**.



3.4 National, Regional and International standardization

Cooperation and coordination

- There are **cooperation and coordination** agreements between **European** and international SDOs
  (modified from Jakobs, 2008)



3.4 National, Regional and International standardization

The Vienna agreement between ISO and CEN

- The **Vienna agreement** provides rules and methods for the ISO-CEN collaboration.
- **ISO standards** are **automatically approved as European Standards**, and they are **adopted as national** standards by **each CEN national SDO** member, e.g.
  - ISO 9001:2015 Quality management systems – Requirements.
  - EN ISO 9001:2015 (European standard).
  - UNE-EN 9001:2015 (Spanish standard).
- **30% of CEN standards** are developed under the **Vienna agreement**.
- The agreement **recognizes** the particularities of the **single European market**, and foresees the participation of ISO members in CEN standards urgently required in EU.

3.4 National, Regional and International standardization
Frankfurt Agreement between IEC and CENELEC

- The **Frankfurt agreement** provides rules for the collaboration between IEC-CENELEC:
  - Around **80%** of all European electrotechnical standards are identical to or based on IEC International Standards.
  - New electrical **standards projects are jointly planned** between CENELEC and IEC, and where possible most are carried out at international level.
    - E.g., IEC 62236-3-2:2008 Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus is based on EN 50121-3-2:2006

3.4 National, Regional and International standardization

Guidance for the regional/national adoption of international standards

- **ISO/IEC Guide 21** provides guidance on Regional or National adoption of International Standards and other International Deliverables:
  - It provides methods for the **adoption of International** Standards (and other international deliverables) **as regional or national standards**
  - It defines a system for **indicating the degree of correspondence** between International Standards and their national or regional adoptions

3.4 National, Regional and International standardization

Other examples of coordination and cooperation

- **ISO and IEC** formed **ISO/IEC JTC 1** to avoid duplicative or possibly incompatible standards
- A guide contains a set of procedures for cooperation between **ITU-T and ISO/IEC JTC 1**
- **ITU and ETSI** have established a Memorandum of Understanding (MoU)

3.4 National, Regional and International standardization

3GPP, an example of international coordination (1/2)

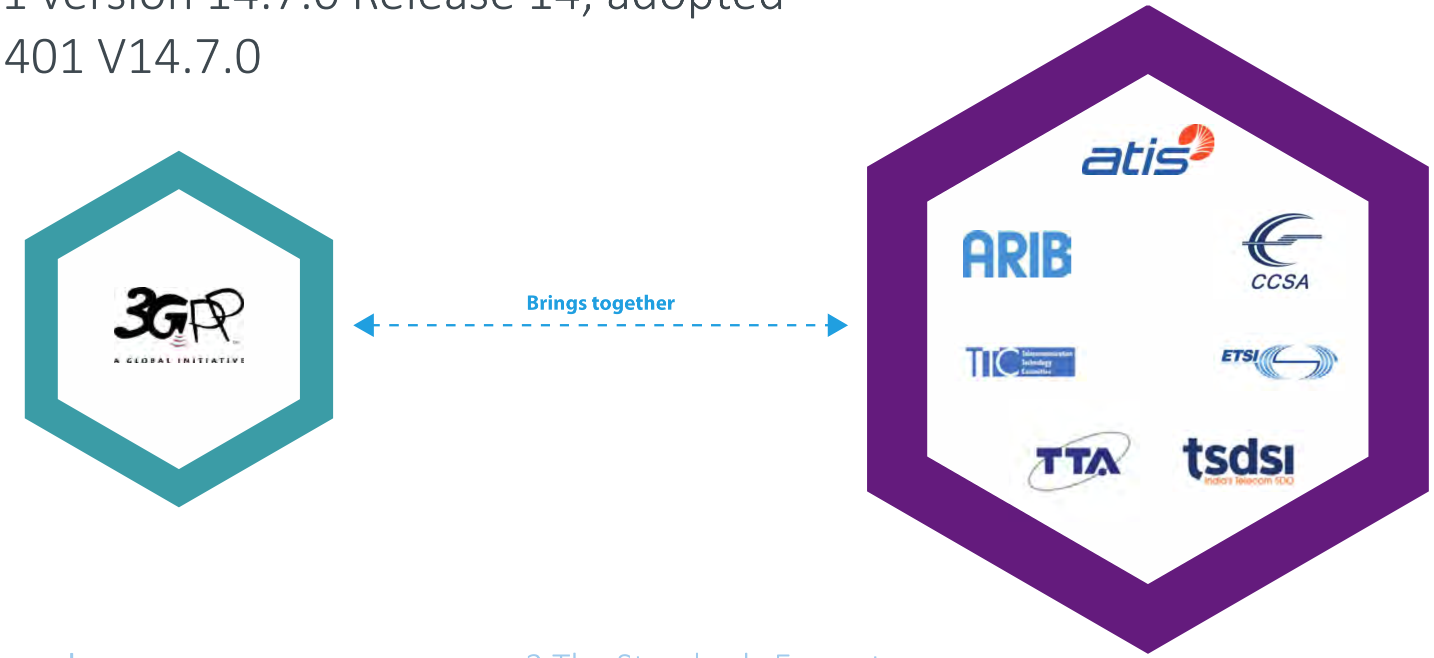
- The 3rd Generation Partnership Project (3GPP)
  - Includes organizational members from **America, Asia and Europe**.
  - Provides them with a **stable environment** to produce reports and specifications about **mobile communication** technologies, a field in constant evolution.
  - SDOs participating in 3GPP **transpose an identical text of 3GPP** deliverables as the corresponding deliverables

3.4 National, Regional and International standardization

3GPP, an example of international coordination (2/2)

- Adoption of a 3GPP specification by ETSI:
  - There is a process through which a 3GPP specification text is adopted and published by ETSI.
  - When requested by the European Commission, the document may be adopted as a European Standard.

- Example:
  - 3GPP TS 23.401 version 14.7.0 Release 14, adopted as ETSI TS 123 401 V14.7.0



3.5 Standards supporting regulation, legislation, and policy making

- **Governments establish policies** through regulations, laws, and other instruments.
- When **implementing policies**, authorities are regularly required to **define technical specifications** to be complied with. **Specifications** may result from different processes:
  - **Developing** their own specifications.
  - **Using** the technical specifications contained in **existing standards**.
  - **Requesting new standards** to be developed for this purpose.

3.5 Standards supporting regulation, legislation, and policy making

Regulations referring to standards

- **Referencing standards** improves **efficacy and efficiency** in Public Administration.
  - It **avoids** the need of regulations having **to describe technical attributes**, such as requirements on performance, on testing limits, etc.
  - It **simplifies** their content and it **increases their common understanding**.

- **Regulations can reference standards** in several ways, including:
  - **by copying the technical specifications** or parts of the standards,
  - **by mentioning them implicitly or explicitly**, with the title and with/ without the date, and with **an optional, privileged or binding reference**.
- It is **recommended that regulations only refer** to the relevant standard and **avoid citing** parts from it.

3.5 Standards supporting regulation, legislation, and policy making
EU's Standardization requests (1/2)

- The European Commission invites the European Standardization Organizations (ESOs: CEN, CENELEC and ETSI) to produce formal standards through **Standardization Requests** (a.k.a. Standardization mandates)
- About a **fifth of all European standards** are developed following a standardization request from the European Commission to the European Standardization Organizations (ESOs).

EU’s Standardization requests (2/2)

- The EU **process** can be **summarized** as follows:
  - **Draft requests** are drawn up by the Commission **through a process of consultation** with a wide group of interested parties, including ESOs, EU countries, and social&industrial partners.
  - Before being formally sent to the ESOs, they are **submitted for a vote to the "Committee on Standards”**, defined according to the Regulation (EU) 1025/2012.
  - **The ESOs**, which are independent organizations, **have the right to refuse** a request, but this is **very unusual**.
  - The **standardization requests** issued by the European Commission are **available in a specific database**.

3.5 Standards supporting regulation, legislation, and policy making

EU's Standardization requests: Example

- In 2005 the European Commission sent a **standardization request**, called Mandate 376:
  - "To develop a standard that specifies the functional accessibility requirements for publicly procured ICT products and services, so that they can be used by citizens with and without disabilities".
- In 2015 the CEN/CENELEC/ETSI published **EN 301 549** "Accessibility requirements suitable for public procurement of ICT products and services in Europe".
- In 2016, the **Directive** (EU) 2016/2102 on the accessibility of the websites and mobile applications of public sector bodies was approved. It references EN 301 549:
  - "[..] content of websites that fulfils the relevant requirements of European standard EN 301 549 [..] shall be presumed to be in conformity with the accessibility requirements [..]".
- Later on, new standardization requests were issued for addressing uncovered accessibility aspects in the EN, which were relevant to the directive.

3.5 Standards supporting regulation, legislation, and policy making

EU's harmonized standards

- As per the Regulation (EU) 1025/2012, a **harmonized standard is a European standard** developed by a ESO, following a **standardization request**.
- They are developed for the purpose of **being referenced by regulation**.
- They are voluntary and imply the **presumption of conformity**: compliance with these standards is the recommended but not exclusive method to meet essential requirements.
- This process requires that the Harmonized Standards are **published in the Official Journal of the European Union (OJEU)**.

3.5 Standards supporting regulation, legislation, and policy making

EU's harmonized standards (1/4)

- **Harmonized standard EN 301 549** V3.2.1 (2021-03)
- In 2017 there was a **new request (M554**) to produce a new version of the EN 301 549 standard that would become a **harmonized European standard**.
  - That new version should address, among other things, uncovered aspects of the accessibility of mobile applications that are relevant to the Directive.
- As a response to M554, two versions of the harmonized standard have been published.
  - The most recent version is **EN 301 549 V3.2.1 (2021-03)**
  - It includes a table which maps the relevant provisions from the standard to the accessibility requirements set out in Article 4 of Directive (EU) 2016/2102

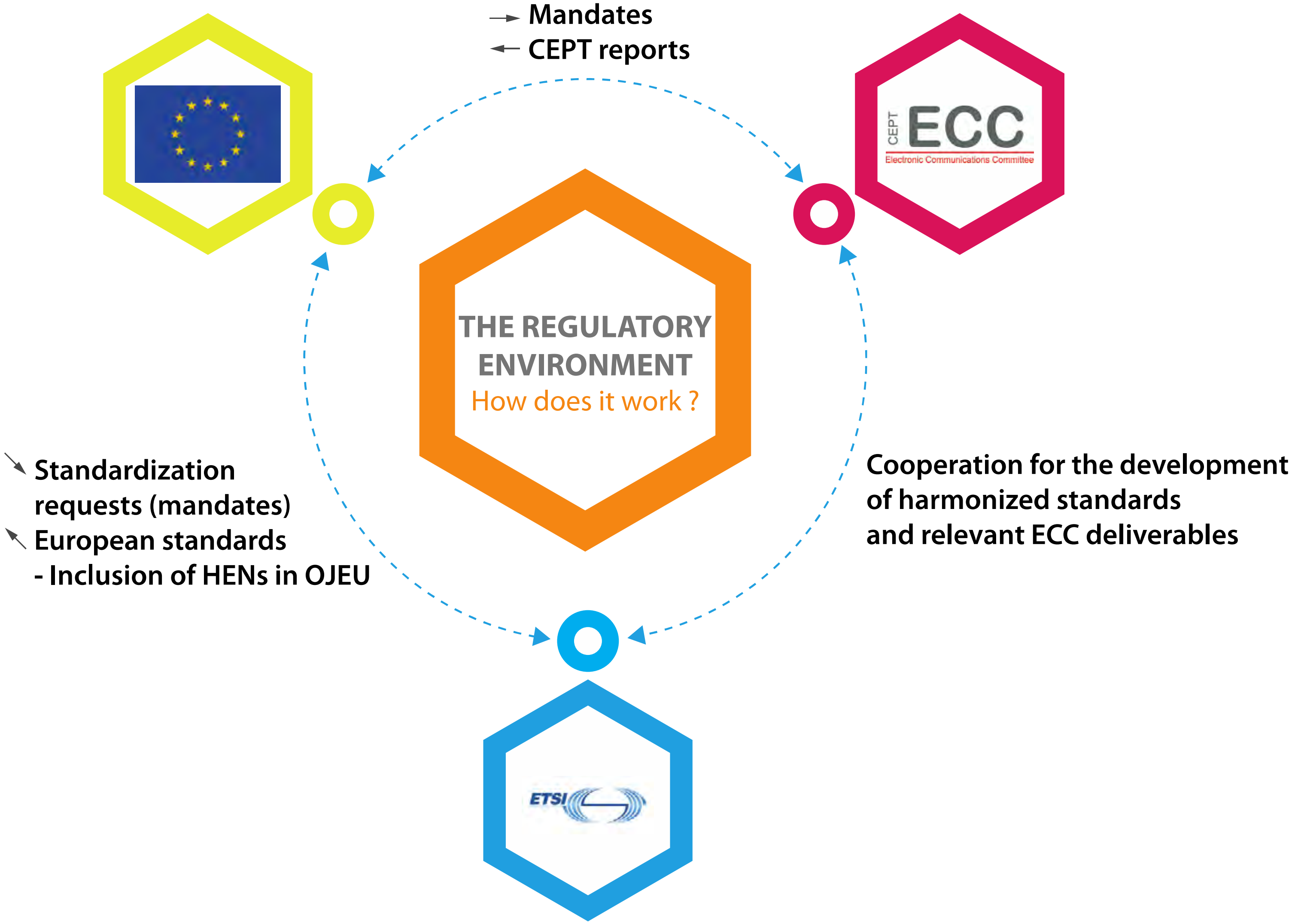
3.5 Standards supporting regulation, legislation, and policy making

EU's harmonized standards: Examples (2/4)

- Radio Equipment Directive (RED), applicable from 13 June 2016.
  - It associates three entities: the European Commission (**EC**), the Electronic Communications Committee (**ECC**) of the European Conference of Postal and Telecommunications Administrations (**CEPT**), and **ETSI** as an ESO.
  - Any provider that wants to place a transmitting or receiving radio equipment on the European market and operate it by using the radio spectrum must meet the requirements of the RED.
  - Harmonized standards developed after the RED allow manufacturers to enter the market with a presumption of conformity.

3.5 Standards supporting regulation, legislation, and policy making

EU's harmonized standards: Examples (3/4)



3.5 Standards supporting regulation, legislation, and policy making

EU's harmonized standards (4/4)

- **CE marking**
  - Identifies a product as complying with the health and safety requirements contained in European legislation.
- **The requirements of the CE Marking process are as follows:**
  - Identify applicable directive(s).
  - Identify the harmonized standards concerned.
  - Verify the product's specific requirements.
  - Identify whether a conformity assessment by a notified body is necessary.
  - Test the product's conformity with the relevant requirements and, if necessary, have tests performed by a notified body.
  - Establish the required technical documentation.
  - Affix the CE marking and complete the Declaration of Conformity.

List of abbreviations: Chapter 3

- 3GPP: Third Generation Partnership Project
- AFNOR: Association Française de Normalisation (French Standards Association)
- ANS: American National Standard
- ANSI: American National Standards Institute
- API: Application Programming Interface
- ARIB: Association of Radio Industries and Businesses
- ATIS: Alliance for Telecommunications Industry Solutions
- BIS: Bureau of Indian Standards
- BS: British Standard
- BSI: British Standards Institution
- CCC: Car Connectivity Consortium
- CE (Marking): Conformité Européenne (European Conformity)
- CEN: Comité Européen de Normalisation (European Committee for Standardization)
- CENELEC: European Committee for Electrotechnical Standardization
- CEPT: Conférence Européenne des Postes et des Télécommunications

List of abbreviations: Chapter 3

- CWA: CEN Workshop Agreement
- EC: European Commission
- ECC: Electronic Communications Committee
- EEA: European Economic Area
- ETFA: European Free Trade Association
- EM: Electromagnetic Compatibility
- EN: European Standard
- ES: ETSI Standard
- ESO: European Standards Organization
- ETSI: European Telecommunication Standards Institute
- EU: European Union
- GSMA: Global System for Mobile Communications (GSM) Association
- HGI: Home Gateway Initiative
- HTML: HyperText Markup Language
- IAB: Internet Architecture Board

List of abbreviations: Chapter 3

- ICT: Information and Communication Technology
- IEC: International Electrotechnical Commission
- IEEE: Institute of Electrical and Electronics Engineers
- IETF: Internet Engineering Task Force
- IS: International Standard
- ISO: International Organization for Standardization
- ISO/IEC JTC 1: Joint technical committee 1 of ISO/IEC
- IT: Information Technology
- ITU: International Telecommunication Union
- ITU-T: International Telecommunication Union—Telecommunication Sector
- IWA: ISO Workshop Agreement.
- JTC: Joint Technical Committee
- M2M: Machine-to-Machine
- MoU: Memorandum of Understanding
- NSO: National Standards Organization
- OASIS: Not-for-profit consortium, the acronym stands for Advancing Open Standards for the Information Society

List of abbreviations: Chapter 3

- OEM: Original Equipment Manufacturer
- OJEU: Official Journal of the European Union
- OMG: Object Management Group
- PAS: Publicly Available Specifications
- PAS (ISO): ISO Publicly Available Specification
- PASC: Pacific Area Standardization Conference
- PDF: Portable Document Format
- RED: Radio Equipment Directive
- RFC: Request for Comments
- RSC: Radio Spectrum Committee
- SC: Sub-Committee
- SDO: Standards Development Organization
- SME: Small or Medium-sized Enterprise
- Std: Standard
- TBT: Technical Barriers to Trade

List of abbreviations: Chapter 3

- TC: Technical Committee
- TR: Technical Report
- TS: Technical Specification
- TV: Television
- UML: Unified Modelling Language
- UNE: Spanish Association for Standardization
- US: United States
- W3C: World Wide Web Consortium
- WCAG: Web Content Accessibility Guidelines
- WG: Working Group
- WI: Work Item
- WLAN: Wireless Local Area Network
- WS-Security: Microsoft Web Services Security specification
- WSP: Wireless Short-Packet (protocol)
- WTO: World Trade Organization

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4 The Production of Standards

Contents

4 The Production of Standards

4 The production of standards

- The learning objectives of this section are:
  - Understand the development process and methodology for producing high-quality standards
  - Learn about important guiding principles, such as consensus, impartiality
  - Be able to identify the most important management bodies and their roles inside SDOs
  - Understand which are the most important parties in the SDO structure, as well as in technical committees
  - Know how to initiate a new standard and how to become a member of an SDO.
  - Know and understand the most relevant capabilities that make an efficient delegate of a technical body
  - Learn the main tasks that SPs s have to perform during standardization meetings, in the interval between standardization meetings and inside their company or organization to achieve the most out of standardization
  - Understand the additional duties of a national SDO delegate

4.1 The production of standards

- Formal standardization of high quality requires
  - Understanding the code of good practice that lies behind the formal standardization
  - Satisfying a set of criteria relative to the requirements contained in the standard
  - The involvement of different types of standardization professionals
- Production of standards is closely linked
  - To the organization of SDOs that are responsible to provide a suitable environment
  - To the organizations participating in the SDO activities and technical committees
- Standardization professionals (SP) are individuals active in standardization tasks
  - Standardization experts (SE) are a sub-category of SP who contribute to the content of standards
  - Their relevant technical skills, experience and soft competencies are linked to the tasks they fulfil
  - They interact with their peers, both inside the standardization group and within their own organization

4.2 The standardization scene

Conditions to meet to prepare quality standards

- The standardization scene relates to both the standardization process and the standardization structure and operation
- The standard development process is the procedure applied towards the production of a standard document
- What is needed to prepare standards?
  - Code of good practice with basic principles should be observed, as advocated by WTO TBT: transparency, openness, impartiality, balance, consensus, effectiveness, relevance, development dimension, coherence
  - The production of a standard follows a well-defined procedure, that may vary depending on the SDO policies
  - Different steps allow the comprehensive standardization of a technology, a function or a system and are usually documented in dedicated or grouped in more integrated standards
  - SDOs are organizations with a well-defined structure to manage and administer the activities of their members

4.2 The standardization scene
Fundamental principles: transparency and openness

- A set of fundamental principles and mechanisms foster the production of standards:
  - These principles are listed in annex 2 of the WTO G/TBT/1 which gathers the WTO decisions and recommendations since 1995.
    - The next paragraphs give a broader view of these main principles and complement them with an additional view of how these principles could have been circumvented, or even trampled, in some seldom cases of real life to serve specific interests
  - Transparency
    - The draft standard is made easily available to all the technical body members throughout its development steps with sufficient time to give them the opportunity to submit comments
    - However, a standard might well be put forward for approval at very short notice, with little notification given to peer working group members, who are deprived from the possibility to read and carefully analyse the document before its approval
  - Openness
    - The standardization process is easily accessible on a non-discriminatory basis to any interested stakeholder at all stages, from SDO policy development and standard draft commenting, to the approval and dissemination of the standards
    - However, industry fora / consortia may disregard this principle and have closed meetings and membership restricted only to companies with a specific industry interest

4.2 The standardization scene
Fundamental principles: impartiality and balance

- A set of fundamental principles and mechanisms foster the production of fair standards:
  - Impartiality
    - The standardization process is managed by a group of diverse stakeholders with varied interests and avoids being influenced, e.g., by funding or by one interest group
    - The standard development process will not give privilege to, or favour the interests of particular suppliers, countries or regions
    - However, it might be possible for a standard that it is proposed to meet the interest of a particular supplier or governmental entity. A major player dominating the market may be reluctant to have any standard at all and might try to slow down the process by adopting a difficult and demanding attitude
  - Balance
    - All representatives are allowed to express their position and comments and every representative opinion is considered
    - However, it might happen in some cases that the valid opinion of a participant is noted and not further considered to be part of the standard, because it hampers the objectives of a specific group of interest. SDO governing rules tend to avoid this situation.

4.2 The standardization scene

Fundamental principles: consensus and effectiveness

- A set of fundamental principles and mechanisms foster the production of fair standards:
  - Consensus
    - A standard is approved by a large majority of the group of stakeholders. Every effort is made to reach unanimity. The views of all stakeholders are taken into account
    - Consensus does not necessarily mean unanimity. When full consensus cannot be achieved, the approval of a standard may be obtained for example, through a voting process (depends on the SDO established procedures)
    - However, actions might be taken to silence the objections of one or a group of stakeholders, for example by providing the final version of a draft document with a very short notice
  - Effectiveness
    - Standards are developed when they have been proven as feasible and appropriate, based on scientific and technological developments
    - It is good practice, when drafting a standard, to validate it with experience from a few implementations and testing events
    - However, some standards may be developed to describe an emergent technology which is not yet mature, but whose supporters want to reach the market early and prevent the development of other competing technologies

4.2 The standardization scene

Fundamental principles: relevance to market needs and development dimension

- A set of fundamental principles and mechanisms foster the production of fair standards:
  - Relevance to market needs
    - The standard responds to market and regulatory needs and does not try to distort the global market
    - Standards enable implementation by different providers and competition in the market. IPR policies ensure transparent procedure and strategy plans are periodically revised to analyze and follow the market evolution and their stakeholders’ needs
    - However, it might happen that a stakeholder tries to develop a standard to consolidate its position in the market
  - Development dimension
    - The standardization process is open to all interested parties and encourages the participation of developing countries
    - The standardization process should be neutral and not favour characteristics of specific countries or regions when different needs exist in other parts of the world
    - However, it might happen in practice that technical regulations and standards are published to protect domestic industries

4.2 The standardization scene

Fundamental principles: coherence and viability

- A set of fundamental principles and mechanisms foster the production of fair standards:
  - Coherence
    - The standardization contributes to the coherence of the market and prevents the introduction of a technology and/ or ICT solution that conflicts or overlaps with the standards developed in another SDO
    - Collaboration and cooperation rather than competition with other SDOs is essential
    - For example, the Global Standards Collaboration (GSC) group annually brings together the world's leading telecommunications and radio standards organizations to share information in a number of important technical areas.
    - However, in the practice of standardization that SDOs or consortia are requested by competing interest groups to work in parallel towards standards for technologies targeting the same market. They fragment the market and hinder its development
  - Viability and stability
    - Recognized SDOs must guarantee viability and stability of the standardization process and of their IT infrastructure in the long run, even at times of budget restrictions

4.2 The standardization scene
Openstand initiative (2012)

- Endorsed by IEEE, IAB, IETF, Internet Society and W3C
- 5 similar principles with the same objective applied to the standardization processes that supported the creation of the Internet and Web
  - Cooperation between SDOs
  - Adherence to: Due process; Broad consensus; Transparency; Balance; Openness
  - Collective Empowerment
  - Availability
  - Voluntary Adoption

4.2 The standardization scene
Some questions put forward in literature papers

- Pros of openness:
  - Opening the effective participation in the standardization process to any organization minimizes the possibility that a standard reflects only the interests of a limited set of stakeholders
  - The growth of Internet would not have been as rapid without universal availability of TCP/IP protocols or HTML
  - According to the results of a survey by the European Commission (Galasso 2015), among the countermeasures to tackle the problem of ICT lock-in, the most used is "to define ICT strategies and architectures on open source and open standards"
- Cons of openness:
  - The higher the level of participation, the more difficult it is to reach consensus
  - It is indeed difficult to develop standards with no proprietary technology involved
  - Hence, there is intense debate within SDOs about whether to include proprietary technology, and how this should be done

4.2 The standardization scene
Some questions put forward in literature

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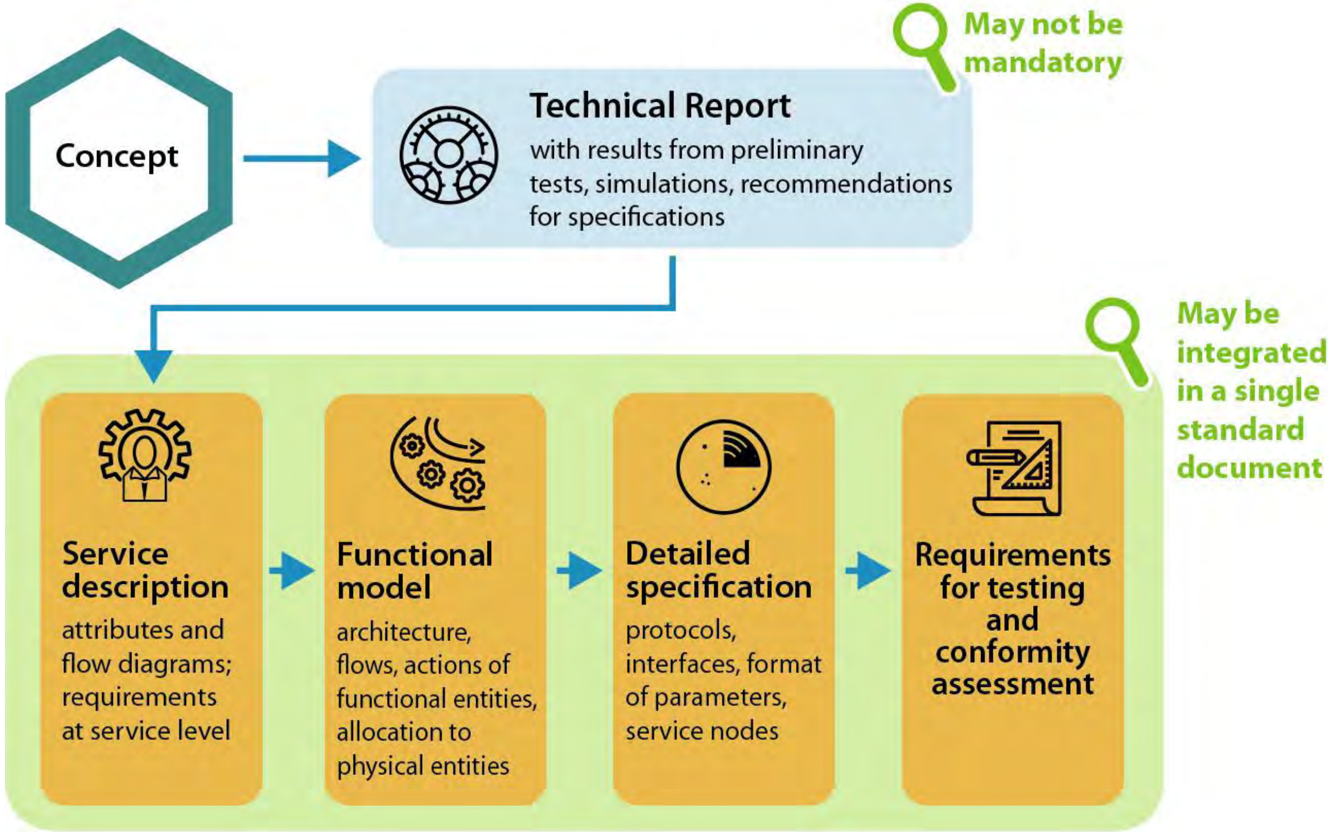
4.2 The standardization scene
Obtaining standardization results of good quality

- Measures for high-quality requirements in a standard :
  - Necessary: specify only what is required to implement and meet the standard’s objectives. They do not impose a particular approach to implementation
  - Unambiguous: it is impossible to interpret the normative parts of the standard in more than one way
  - Comprehensive and accurate: contain all the information necessary to understand their meaning, either directly or by reference to other documents
  - Precise: expressed clearly and exactly, without unnecessary detail that might confuse readers
  - Well-structured: the individual elements of the requirement are all included in an appropriate manner, easy to read and to understand
  - Consistent: no contradiction among the different requirements within the standard, nor with any other related standard
  - Validated and testable: there are clear and obvious means of devising a test to demonstrate that an implementation complies with the requirements
  - Easily accessible: standards are available to the general public and are developed, approved and maintained via a collaborative and consensus driven process
  - Up-to-date: maintenance, evolution or withdrawal needs are regularly assessed

4.2 The standardization scene
Standardization steps of an ICT system

- The exhaustive standardization of an ICT system usually follows a well-proven methodology that includes several stages (ITU Recommendation I.130 for ISDN) adopted since by a large number of other standardization groups



4.2 The standardization scene
The process for producing standard documents

- The preparation of a standard document follows a well-defined procedure, that may
  - Differ according to the SDO
  - Be more or less formal depending on the type of organization: a standard from an industrial alliance is often developed faster than a standard from a recognized SDO
- It consists of five phases:
  - (1) inception,
  - (2) conception,
  - (3) drafting,
  - (4) approval and publication, and
  - (5) maintenance

4.2 The standardization scene

The process for producing standards: step 1 - Inception

1 - Inception: Identify needs

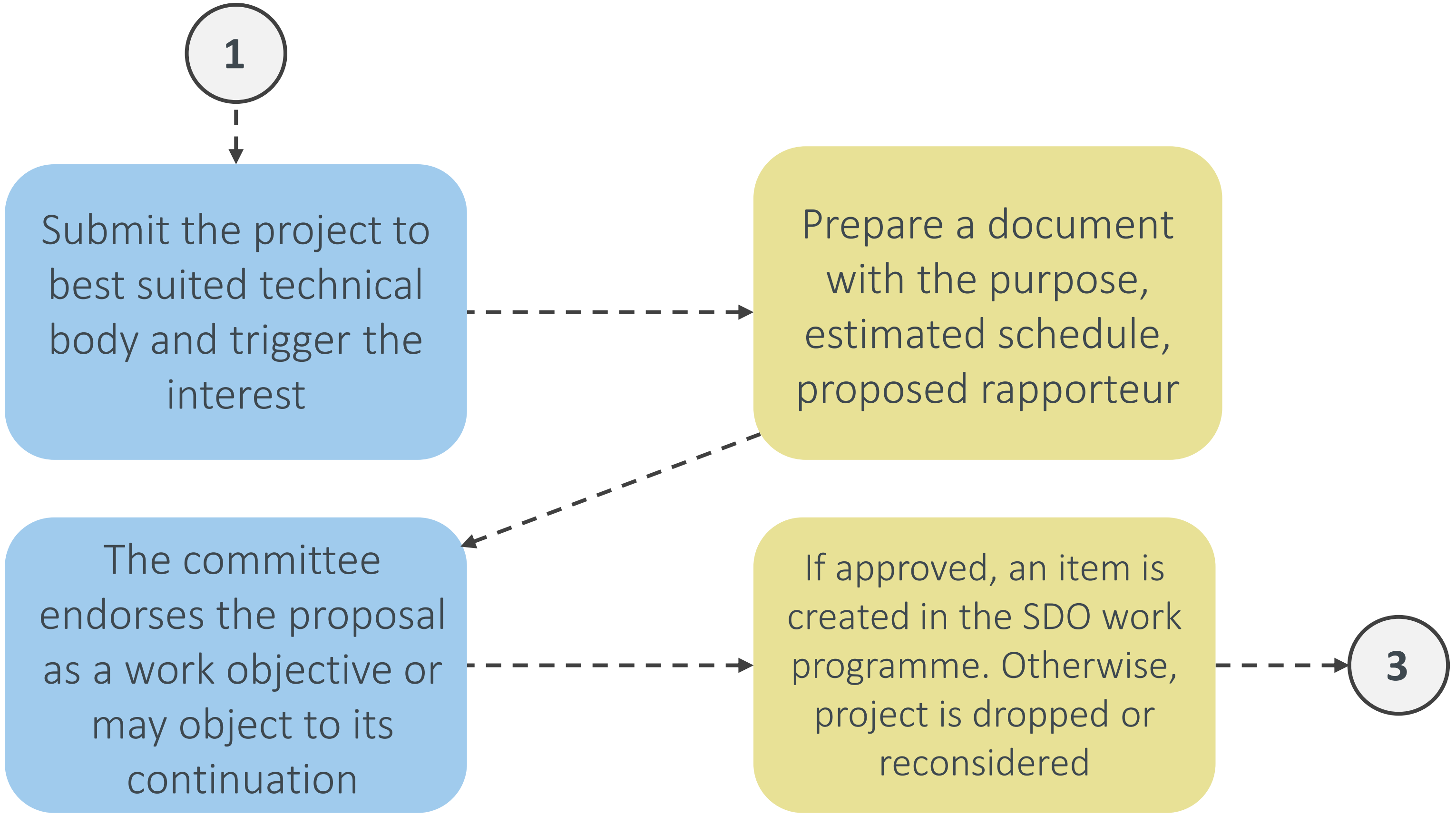
Identify a need for a concept or process to be standardized

Find interested delegates: a standard is the result of the collaboration and consensus of a group

2

4.2 The standardization scene
The process for producing standards: step 2 - Conception

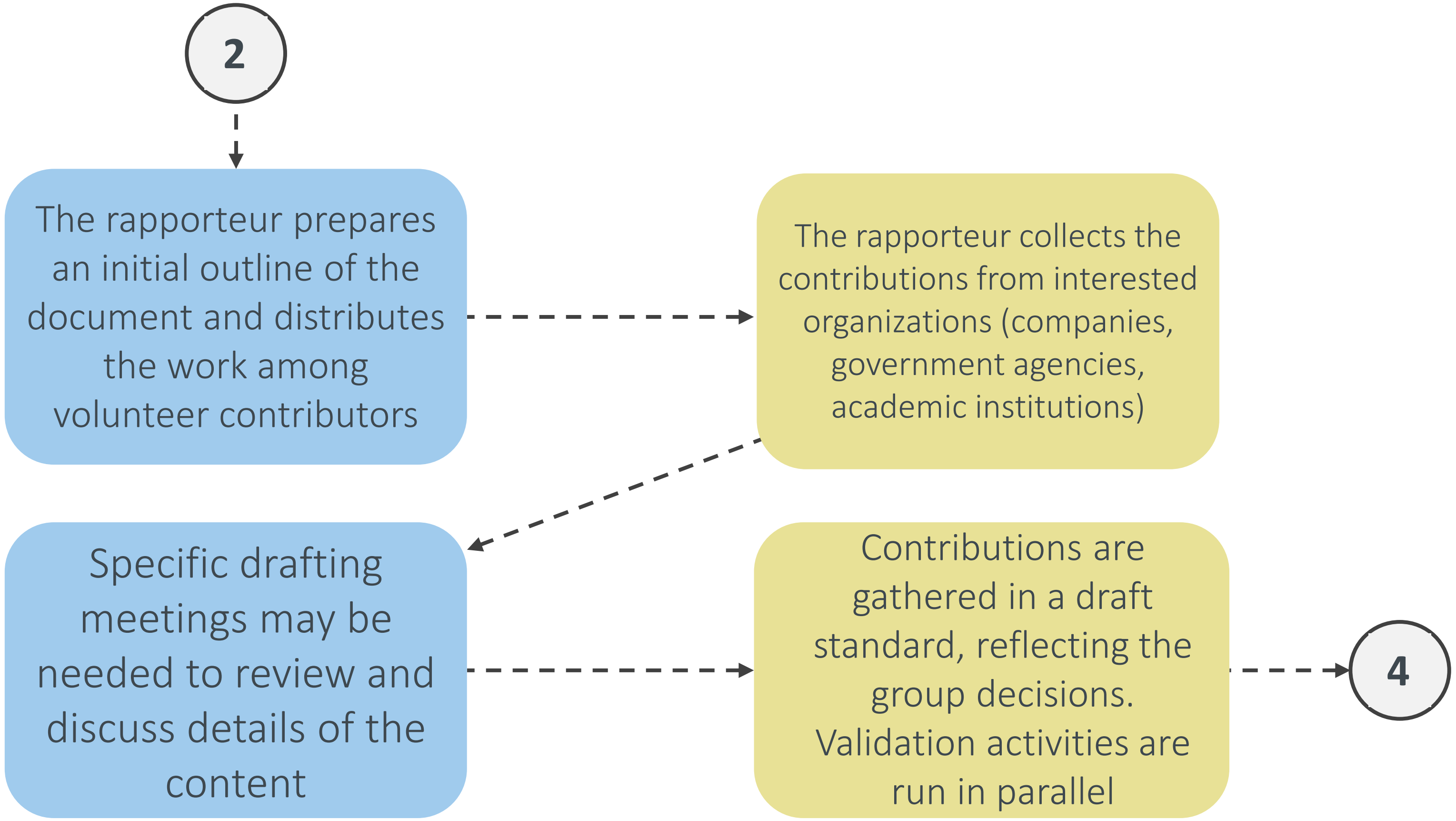
2 – Conception: define scope and work plan



4.2 The standardization scene

The process for producing standards: step 3 - Drafting

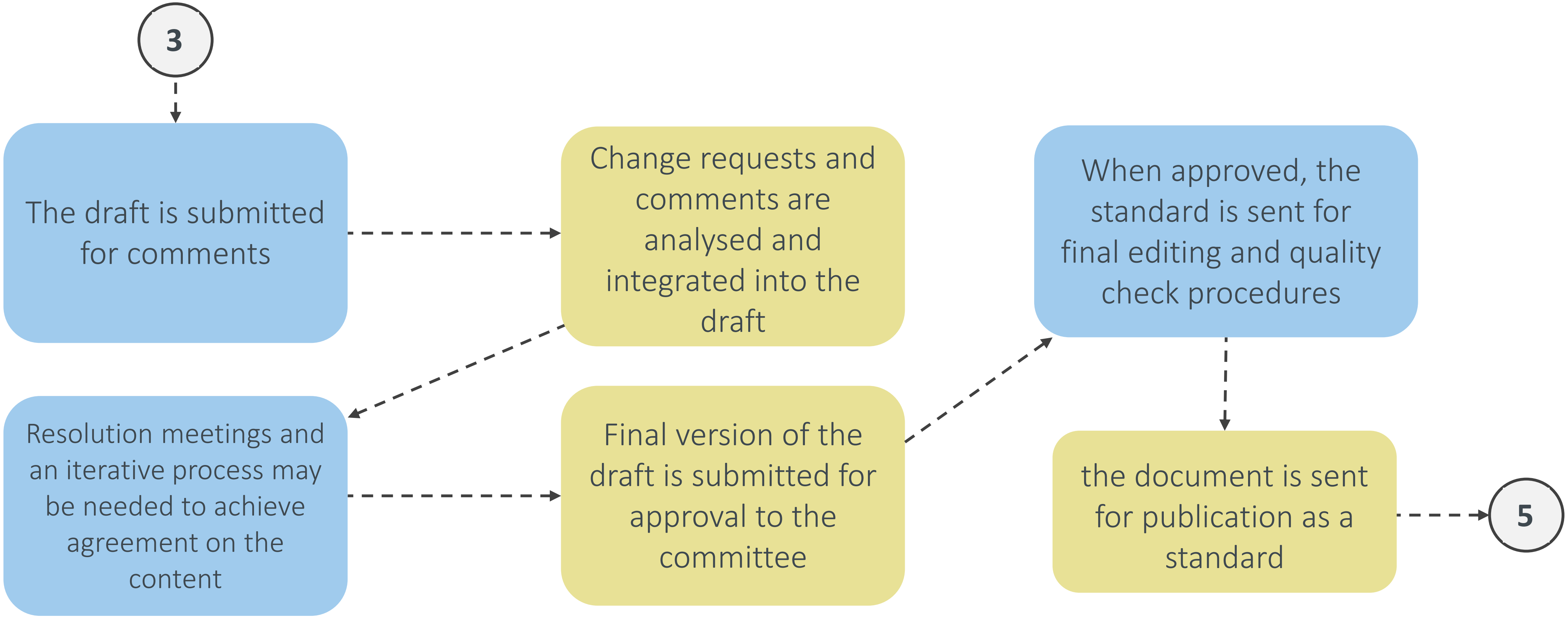
3 – Drafting: prepare new or revised standard



4.2 The standardization scene

The process for producing standards: step 4 – Approval and publication

4 – Approval and publication: achieve consensus on the draft standard and officially issue the new or revised standard



4.2 The standardization scene

The process for producing standards: step 5 – Maintenance

5 – Standard maintenance: update, evolve or withdraw standard content

4

If corrections or maintenance of the standard are identified after its publications (maybe from one week to several years after publication), the whole process is restarted to update the standard or create a new standard and obsolete this one

1

4.2 The standardization scene

Example of the CEN/CENELEC standardization process

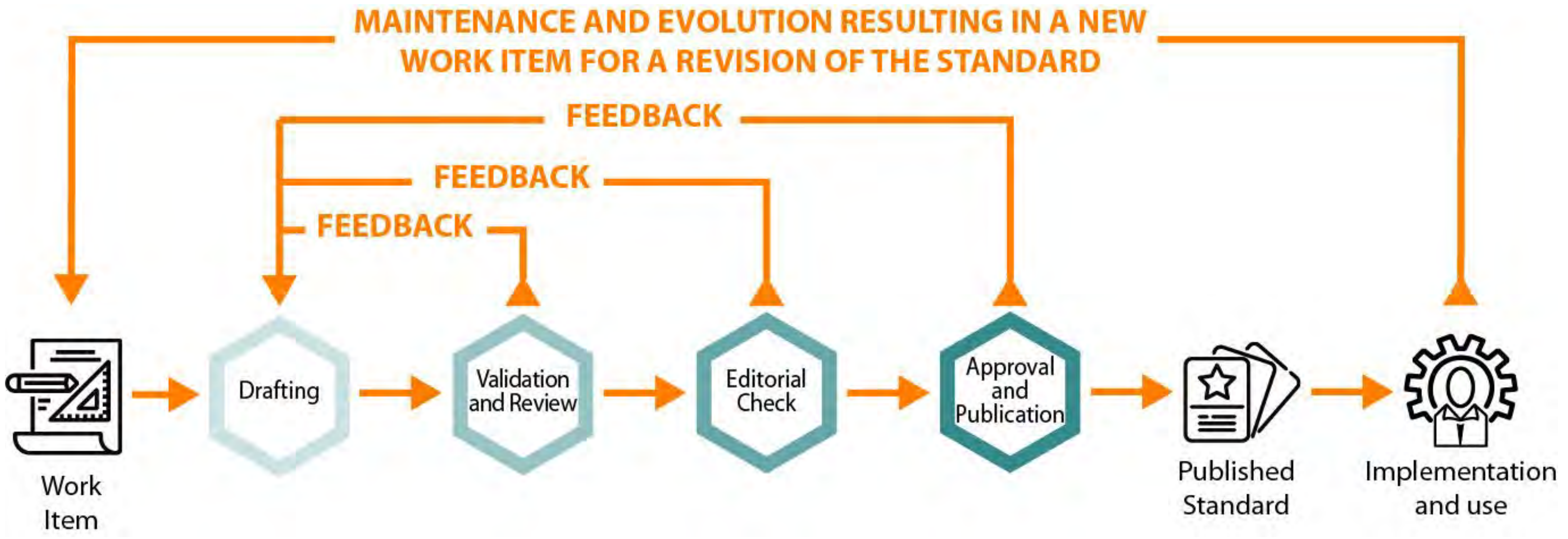
- Top-down approach

1. **Proposal - evaluation and decision**
2. **Drafting and consensus building**
3. **Public enquiry**
4. **Consideration of comments**
5. **Approval of the standard**
6. **Publication**

4.2 The standardization scene

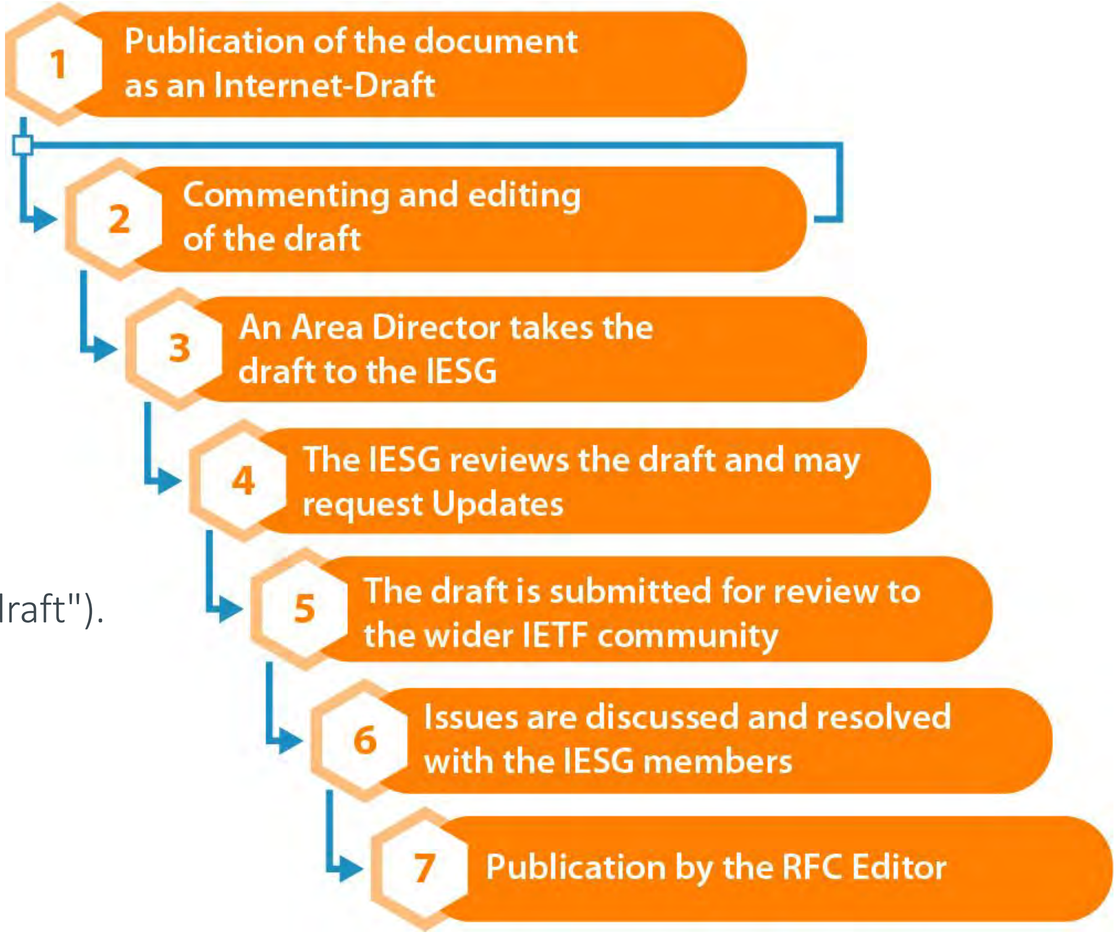
Example of the ETSI standards development process

- Top-down approach as well



4.2 The standardization scene
Example of the IETF development process

- Getting an RFC published
  - Bottom-up process



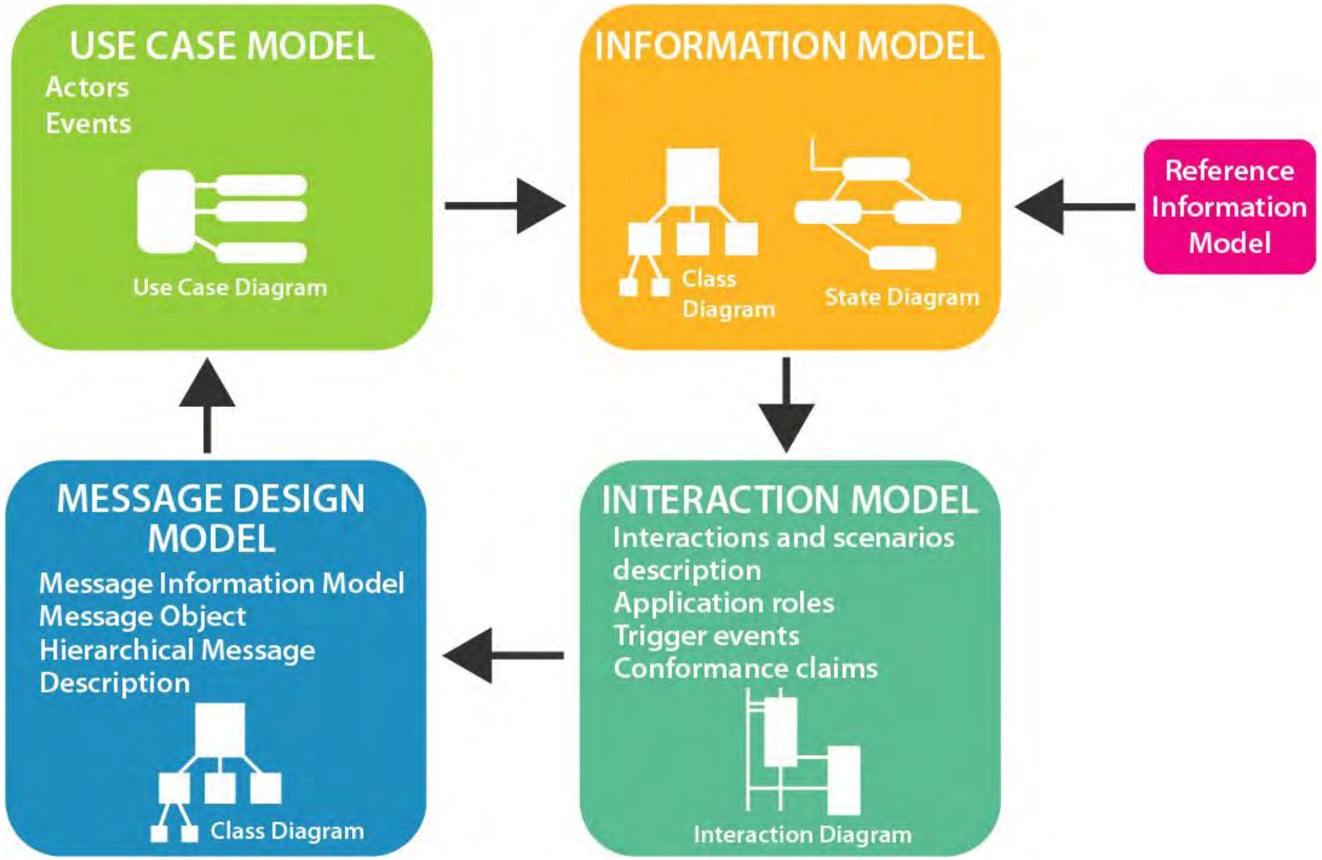
An IETF standard is published as an RFC ("Request for Comments").

An RFC starts out as an Internet-Draft (often called an "I-D" or just "draft").

IESG: Internet Engineering Steering Group

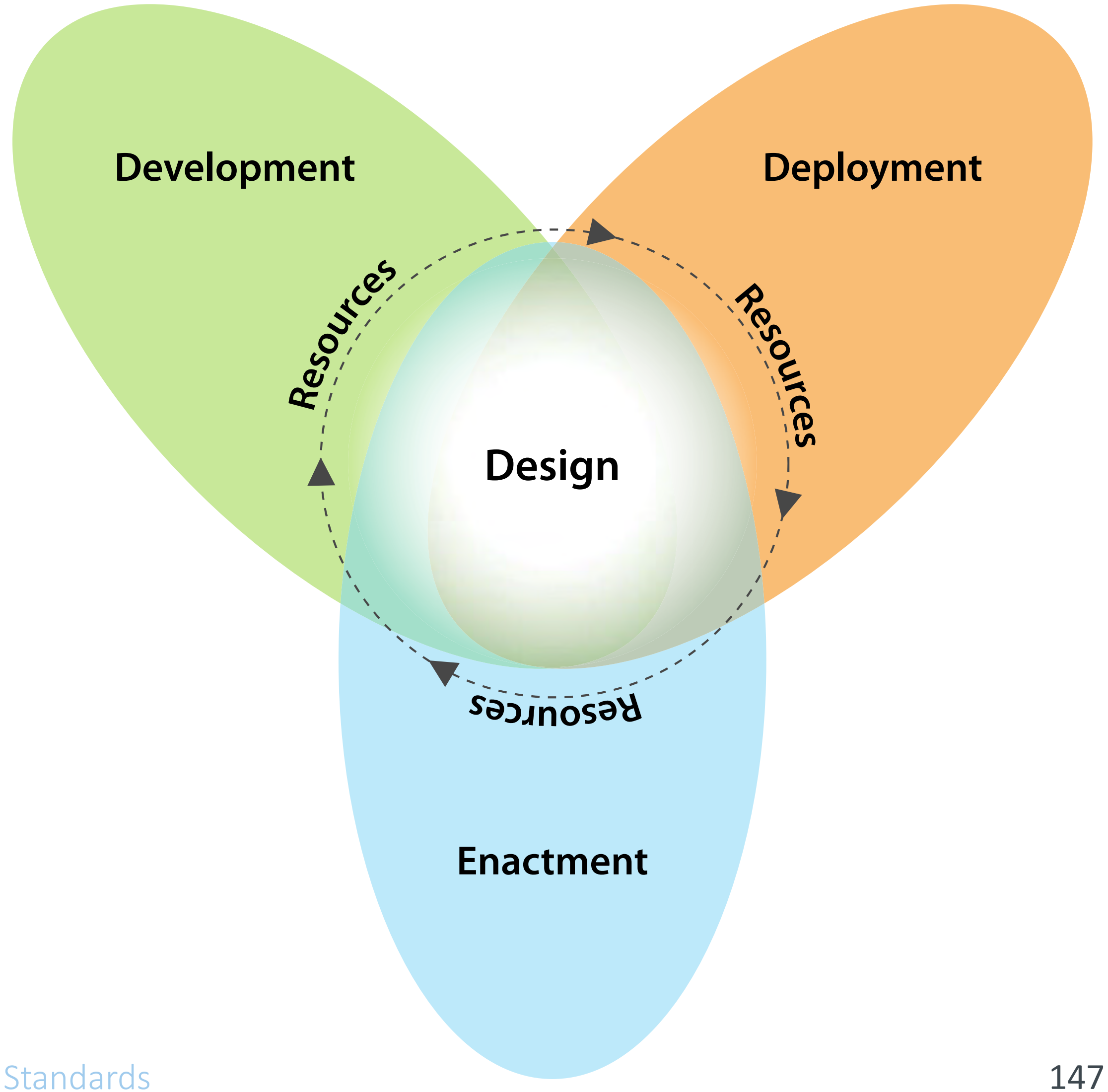
4.2 The standardization scene
Example of the HL7 development process

- Process based on models and an object-oriented methodology:
  - Health Level Seven (HL7) Version 3 Message Development Framework (Beeler, 1998)
  - Diagram of the message development framework:
    - starting from a Use Case Model,
    - leading to an Information Model,
    - triggering an Interaction Model
    - and derived in a Message Design Model



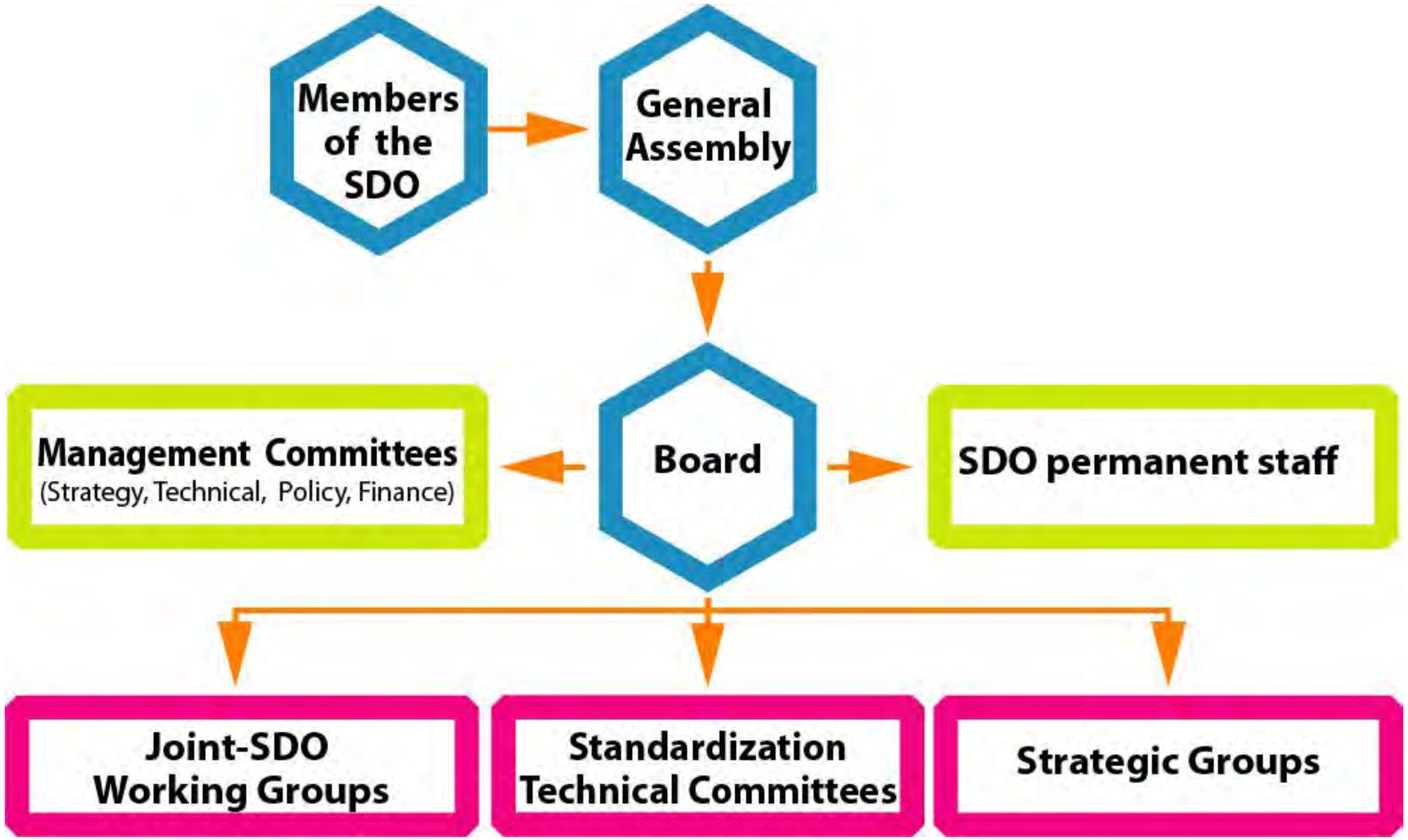
4.2 The standardization scene
Example of the Integrative Design Model

- Integrative Design Model methodology: based on a cycle of user-developer relations.
  - The cycle of standards development is shown as a three-phase model (development, deployment and enactment / validation) where design activities occur throughout the whole standards development life cycle (Millerand & Baker, 2010)



4.2 The standardization scene
Governance and Structuring of an SDO

- The governance of an SDO is usually organized as a hierarchical structure



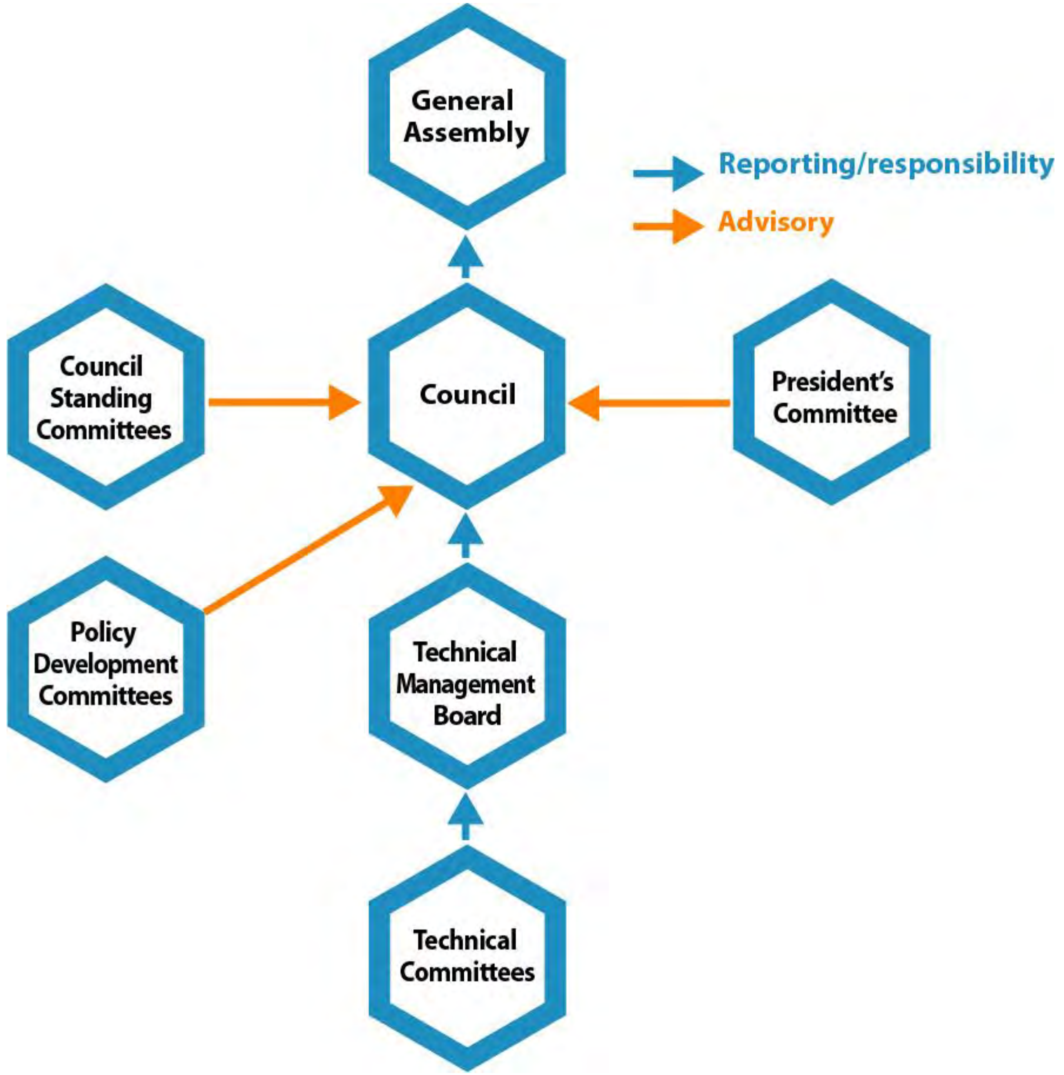
4.2 The standardization scene

Governance and Structuring of an SDO: financing

- Financial options are important to guarantee the impartiality of the standards development process
- Financing should be capable of covering all the activities related to the production of standardization deliverables for products and services
- It may also cover the administrative expenses incurred by the preparation, monitoring, inspection, auditing and evaluation necessary for the purposes of implementing
- Funding may come from different sources, such as direct financing from governing authorities, membership fees, income from the sales of standards, and income from certification activities and their operations

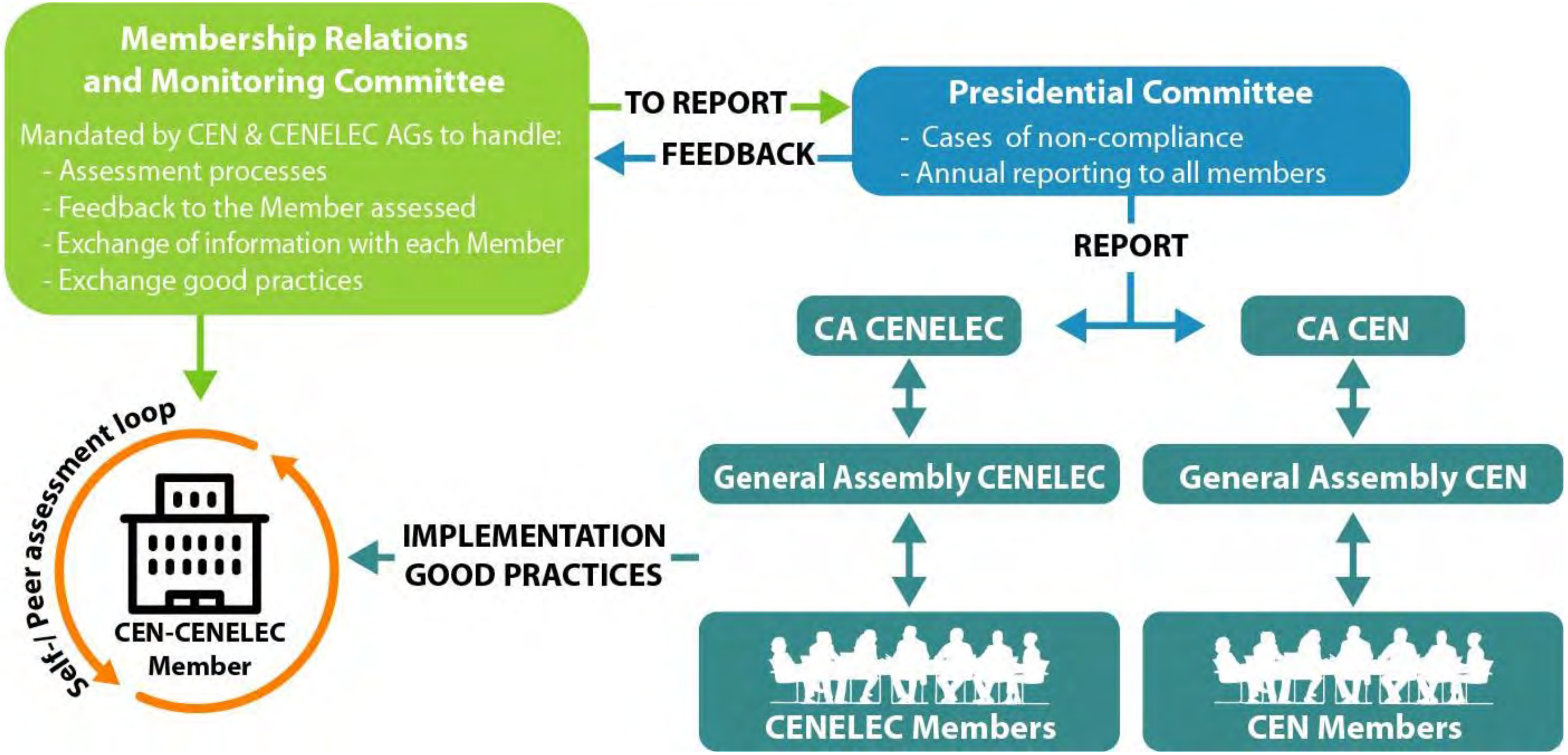
4.2 The standardization scene
Example - ISO structure and governance

- The ISO General Assembly is attended by ISO's Principal Officers and delegates nominated by the member bodies or national representatives.
- The ISO Central Secretariat – ISO/CS – is responsible for supporting the governance and policy, advisory structure, and the operations of ISO. It assists the development process and publishes the standards

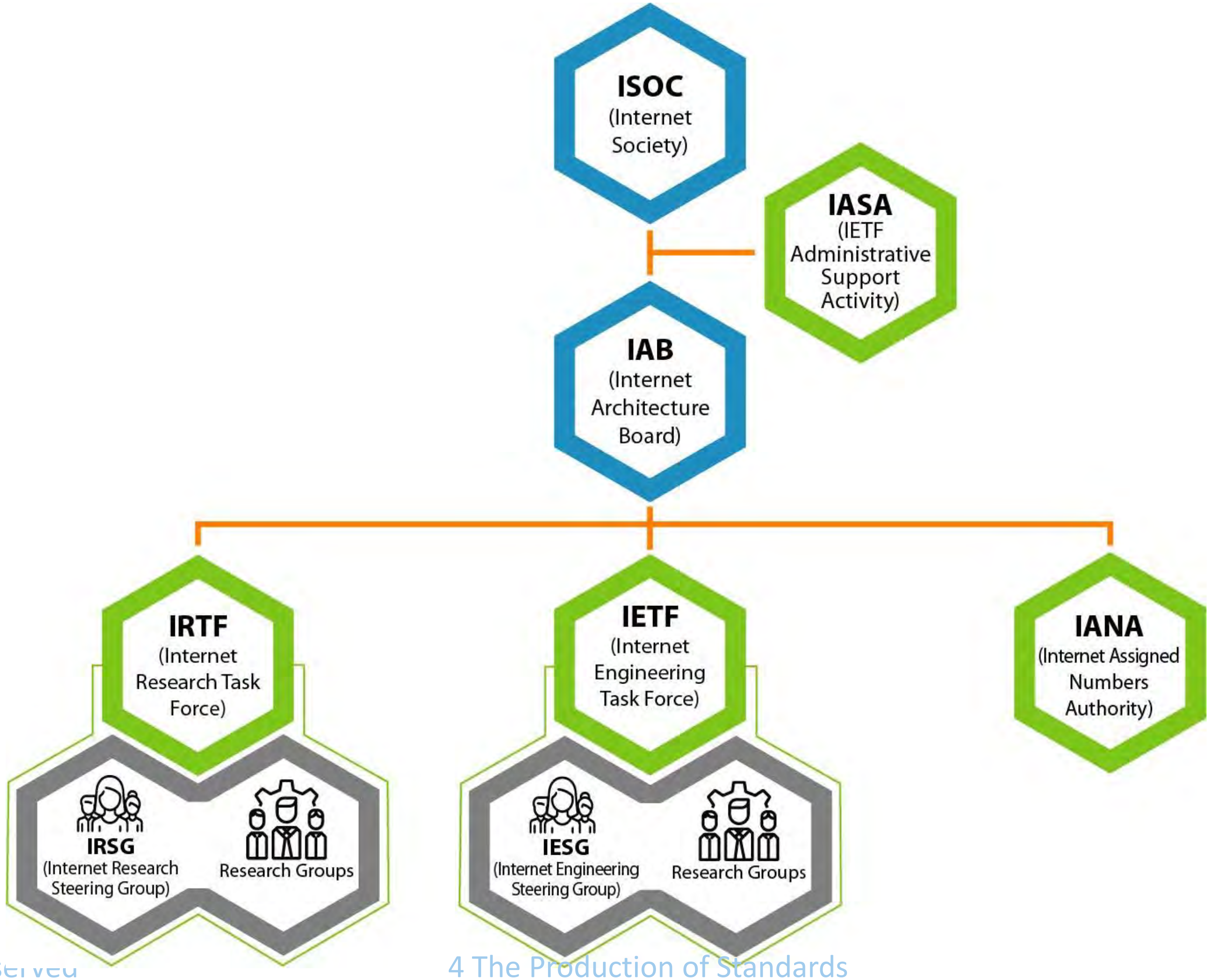


4.2 The standardization scene
Example - CEN-CENELEC cooperation model

- CEN and CENELEC are two ESOs that complement each other
- They have implemented a close cooperation agreement to avoid duplication of standards



4.2 The standardization scene
Example - IETF structure and governance

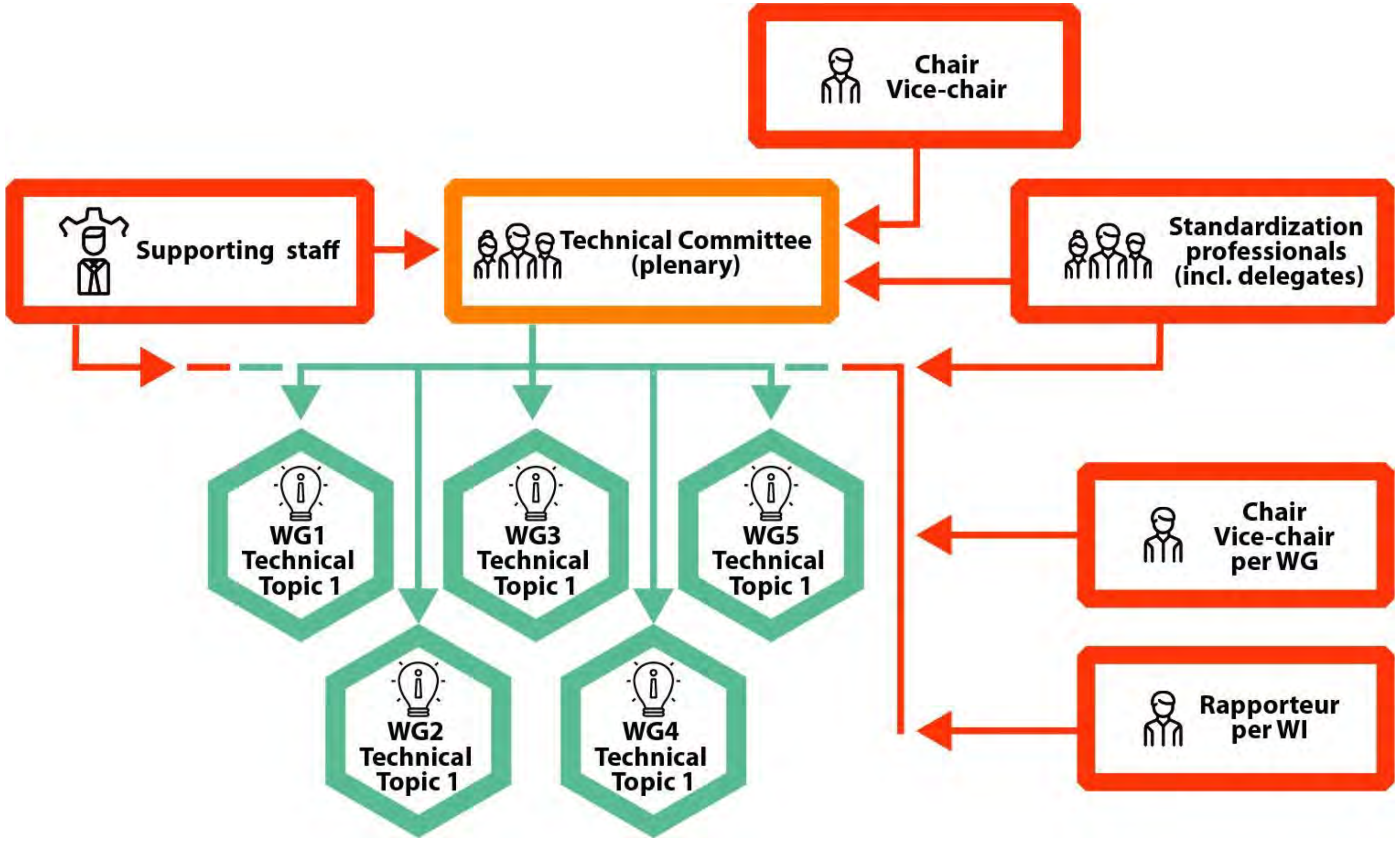


4.2 The standardization scene
Structuring of an SDO: membership

- Who can contribute to standardization?
  - All stakeholders interested in the development of standards
- End users hardly ever participate in standards development
  - Even if they are the beneficiaries of the products and processes normalized
  - They suffer from a lack of technical background and often sufficient financing
  - So most often, they are represented by corporate users or societal organizations
- This is also often the case for small companies (SMEs).

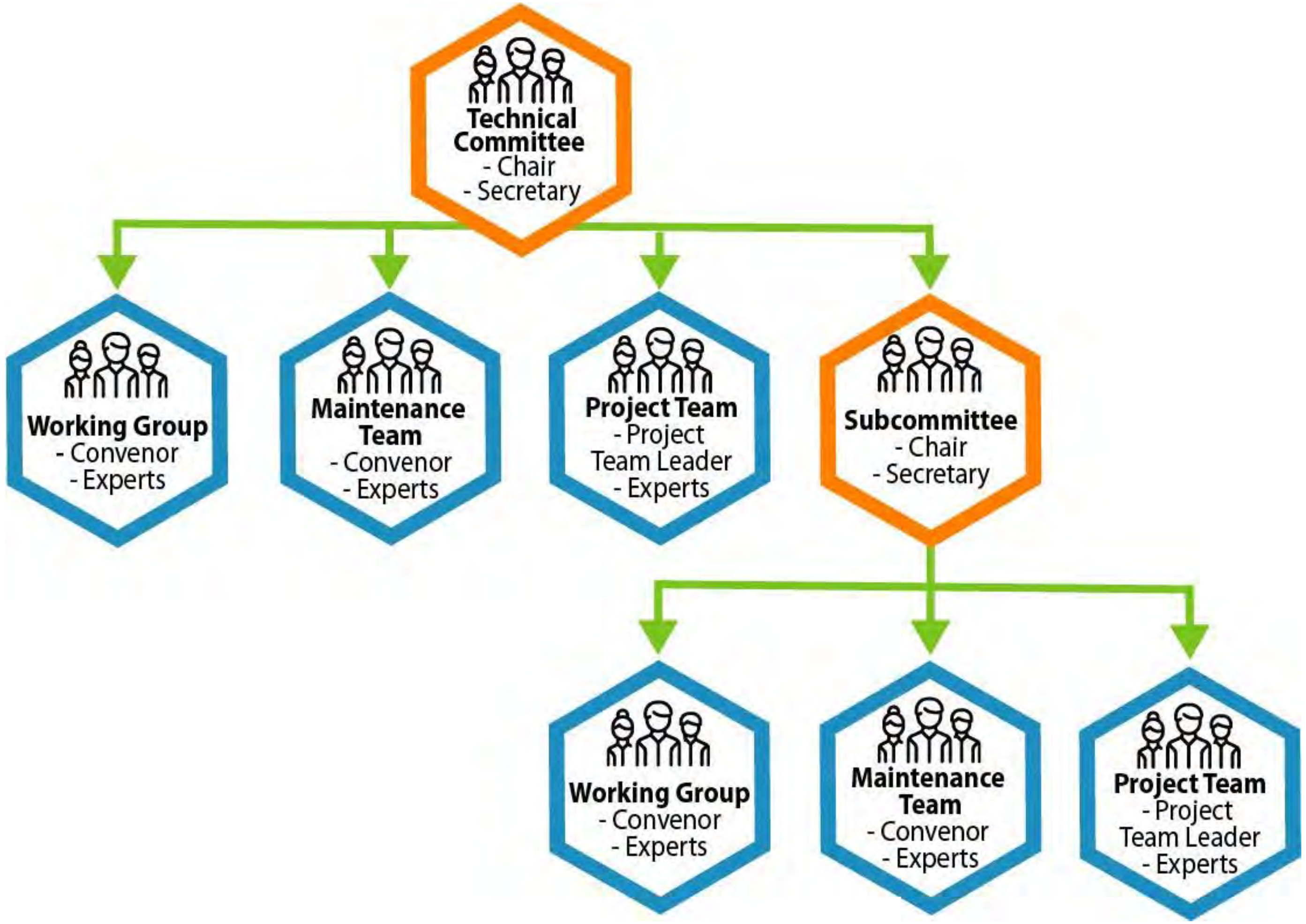
4.2 The standardization scene
Structuring of an SDO: technical committees

- Similarly, technical committees adopt a hierarchical structure
  - Sufficiently large committees establish sub-committees (SC) (or working groups, WG) to focus on specific tasks and topics. The number of sub-committees depends on the size of the parent committee
  - Small committees may not have sub-committees (flat structure)



4.2 The standardization scene

Example: Structuring of an IEC Committee



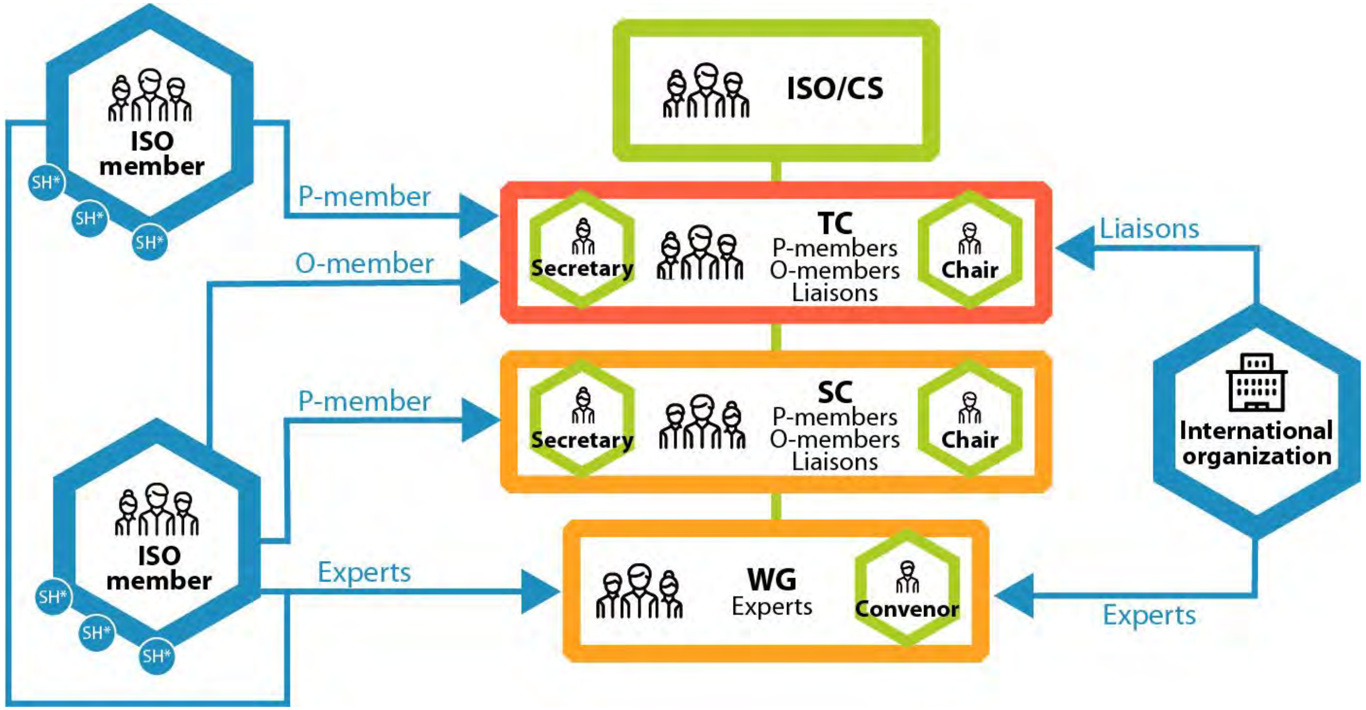
4.3 Roles and competencies of a standardization professional

- Who is the standardization professional?
  - The *standardization professional (SP)* works in a corporate organization, often in industry, national administration, research or academic organization, consumer or professional association, or as a staff member of an SDO and is involved in standardization activities
  - S/he is often nominated to represent her/his organization in an SDO committee
  - S/he does not need to have an engineering degree, but needs to be knowledgeable about the technical matters to be standardized
  - S/he carries out, but also often coordinates, most of the tasks and activities to be performed in the standardization process, with the help of the other peer SPs and her/his company’s staff
  - Some actors also often name this job "standardization engineer" or "standardization scientist"
- We call a standardization expert (SE) an SP who contributes to the content of standards (no well-defined and agreed term for this position)

4.3 Roles and competencies of an SP
Professionals involved in the standard development process

- Who are the professionals who participate to the standard development process?
  - In the committee / sub-committee
    - Chairman (vice-chairman) of the committee
    - Standardization experts
    - Standard proposer
    - Rapporteur
    - Liaison representative
  - In the SDO permanent staff
    - Technical Officer
    - Final editor
- Delegates are appointed by their respective member organizations
- Tasks and responsibilities depend on the role they play in the committee

Example from ISO

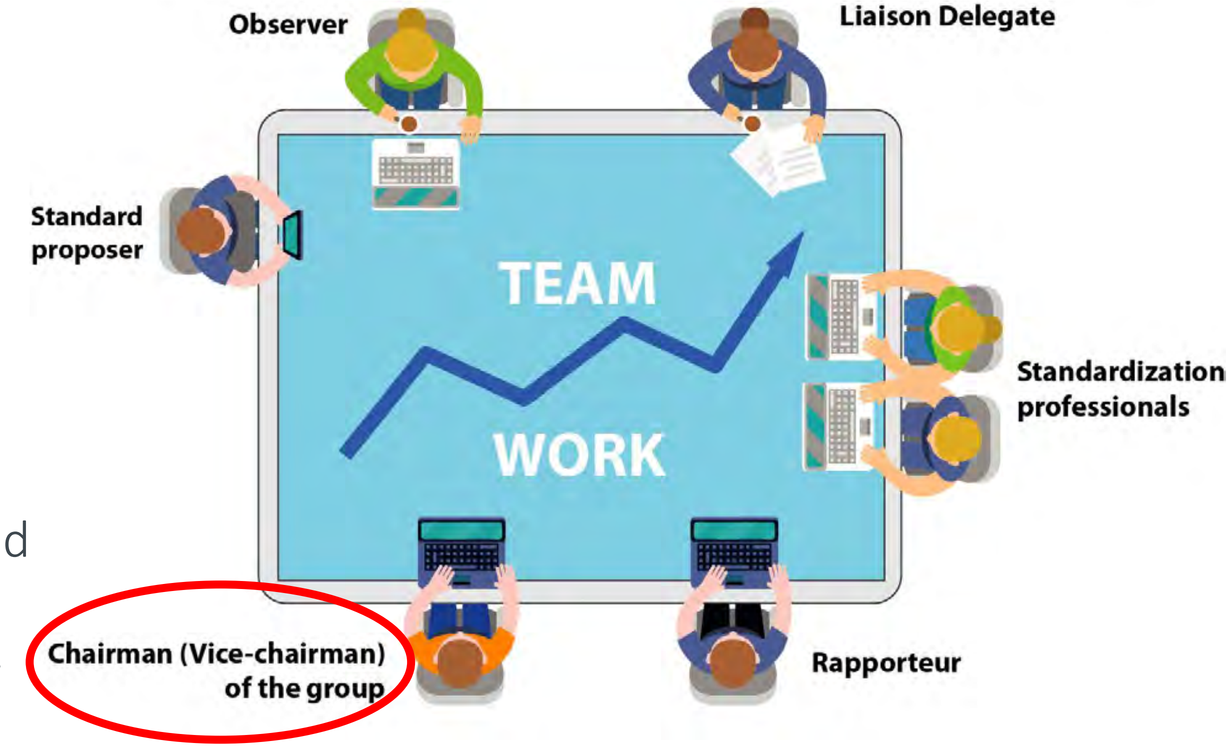


4.3 Roles and competencies of an SP
The chairman (vice-chairman)

Professionals involved in standard development process and their responsibilities

- In the committee / sub-committee

- **Chairman (vice-chairman)**
  of the committee:
  - Leads the activities of the group
  - Manages the committee meetings
  - Takes appropriate actions and decisions
  - Ensures that the work programme is completed in due time
  - Provides guidance to the SDO permanent staff
  - Represents the committee at external meetings

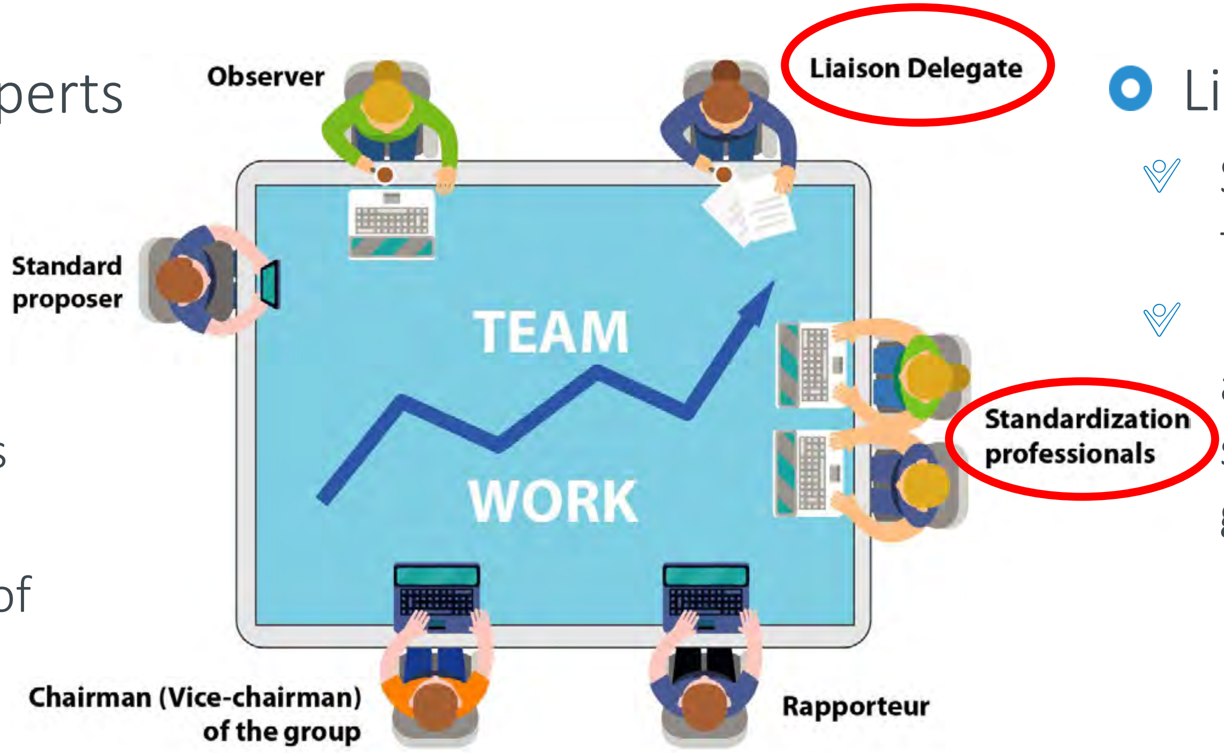


Professionals involved in standard development process and their responsibilities

- In the committee / sub-committee

Standardization experts

- Provide technical expertise and knowledge in the technology
- Submit contributions and change requests
- Discuss the content of the drafts and make technical decisions



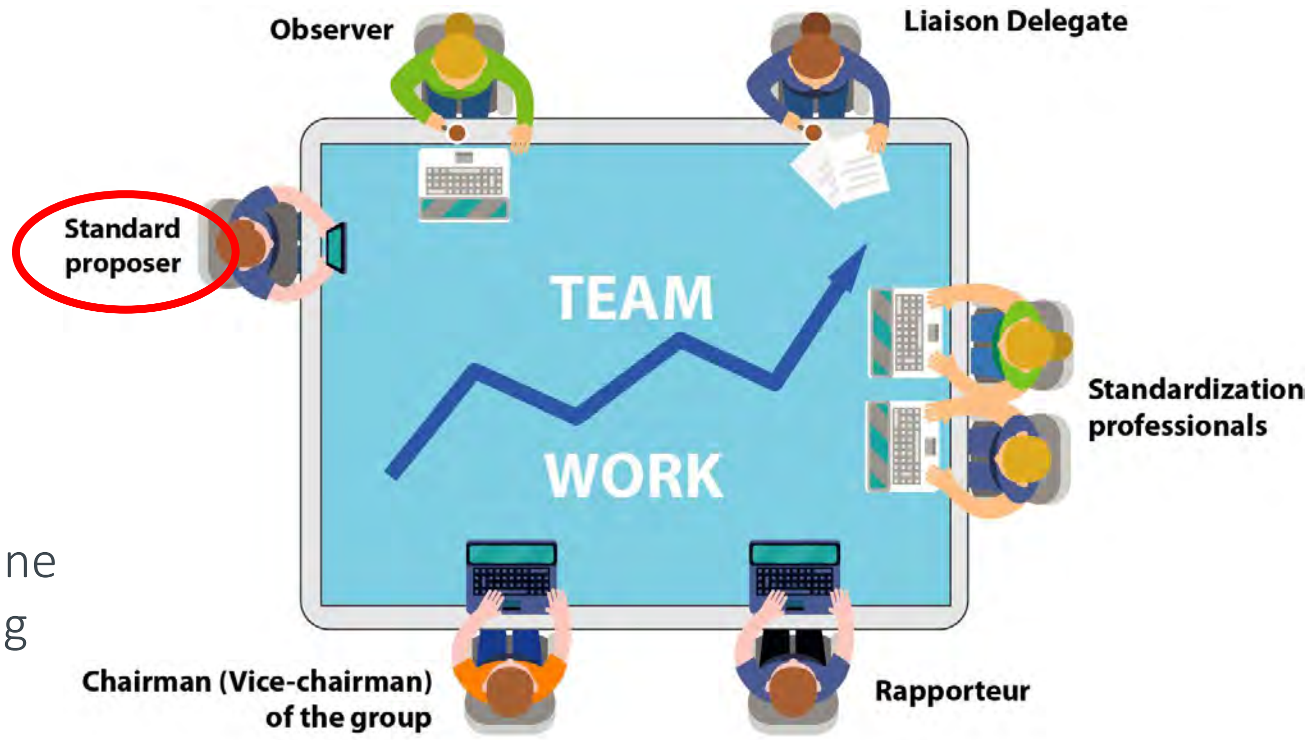
Liaison delegates

- Serve as a link between two TCs or WGs
- Report to each WG about the activities and standards of the other group

4.3 Roles and competencies of an SP
How to propose a new standard

Professionals involved in standard development process and their responsibilities

- In the committee / sub-committee

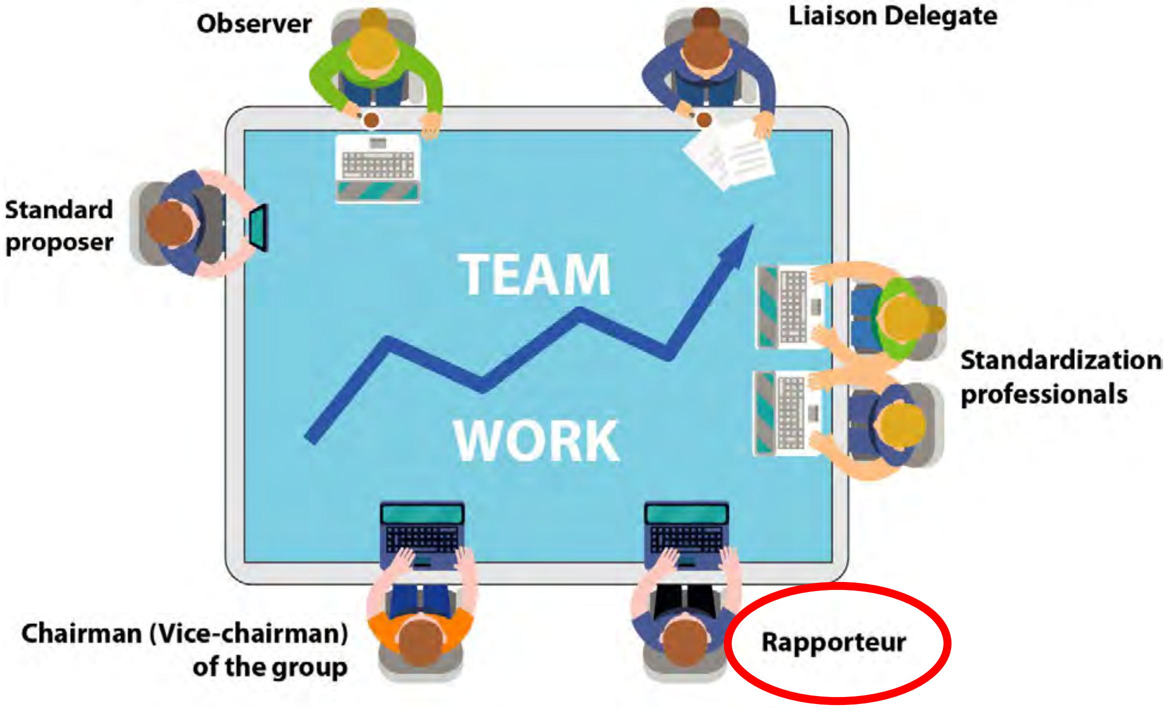


- **Standard proposers**
  - Detect a market need for a new standard based on the information received from her/his own company or organization (inception phase)
  - Submit a proposal to the members of a committee, with the target topic and timeline and triggers the discussion during a meeting
  - Receive support and interest from other members (conception phase)

4.3 Roles and competencies of an SP
The rapporteur of a draft standard

Professionals involved in standard development process and their responsibilities

- In the committee / sub-committee



- **Rapporteur**
  - Takes responsibility of the standard under development (drafting phase)
  - Serves as editor of the draft document
  - Leads drafting and comment resolution meetings
  - Collects contributions and comments from peer experts
  - Aims at obtaining the largest consensus possible on the content of the standard (approval phase)

4.3 Roles and competencies of an SP
Informal collaboration structure of SPs around the rapporteur

- SPs are often informally divided by nature into two circles around the rapporteur:
  - inner circle made of the SE who are active in the drafting of a standard
  - wider (sub-)committee SPs that conducts monitoring activities according to its interest in the development of the standard

4.3 Roles and competencies of an SP
The technical officer

Professionals involved in standard development process and their responsibilities

- In the permanent staff of the SDO

- **Technical officer**
  - Provides administrative support to the committee chairman, rapporteur and SPs about the standardization technical process, its procedure and the work programme content (maintenance phase) and schedule
  - Organizes the approval of the standard
  - Enforces the compliance with the SDO standardization policies
  - Performs an ongoing check of the standard during its drafting (editorial quality , project consistency …)
  - Works in strict impartiality and has no decision right

4.3 Roles and competencies of an SP
The final editor

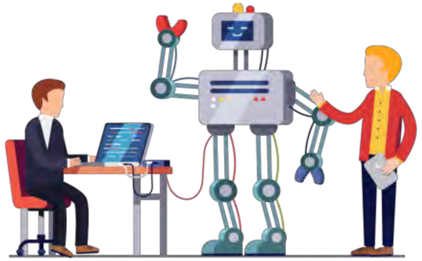
Professionals involved in standard development process and their responsibilities

- In the permanent staff of the SDO

- **Final editor**
  - Performs a final editorial check of the approved standard
  - Corrects the text in collaboration with the authors / rapporteurs
  - Responsible for the official publication of the standard

4.3 Roles and competencies of an SP
Competencies and skills of a standardization professional

- Which skills should the ICT professional demonstrate and develop to be more comfortable and efficient as a standardization professional?
- A standardization expert should demonstrate a mix of
  - Hard / Technical knowledge ("skills")
  - Soft capabilities ("competencies")
  - See also Blind and Drechsler (2017)



4.3 Roles and competencies of an SP
Hard/technical skills

- Understanding and management of technical content (ICT or domain specific):

Specific hard / technical skills
knowledge in mathematics, sciences and engineering (technical teams professionals)
Learning skills to follow the rapid evolution of the technology
Focus on architecture, influence the conception, development and implementation of technical innovations
Understand their impact, with professional and ethical responsibility
Understand and structure complex systems, respecting all sorts of technical and non-technical constraints
Manage the relationships and interactions between the designed systems
Problem solving skills, identifies and formulates technical problems, generalizes across problems
Able to find innovative approaches to resolve an issue
Design and conduct experimental proofs of concept

4.3 Roles and competencies of an SP
Hard/technical skills (cont.)

- Understanding and management of ICT standardization:

Specific hard / technical skills
Experience in the field of ICT standardization
Understand the interactions and relationship between the different SDOs and their standards
Understand the international standardization strategy
Understand the process, rules and good practices applied by the SDO towards the approval of a standard
Understand the context of the committee activities
Able to identify the gaps and visualize innovative trends and solutions
Able to keep up with the pace of the work and not slow down the progress of the standardization work

4.3 Roles and competencies of an SP
Hard/technical skills (cont.)

- Understanding and management of organization strategy:

Specific hard / technical skills
Experience of her/his organization and its technologies, products, business fields
Apply the organization’s process management
Work towards achieving strategic and operational goals by taking critical success factors into account
Understand customers / users’ needs
Able to commit to the organization goals

4.3 Roles and competencies of an SP
Soft / personal competencies

- Communication competencies:

Specific soft / personal competencies
Communicate, listen, articulate, and expose clearly her/his views
Write clear, concise and user-friendly standards and technical documents
Raise issues on drafts and suggest changes
Design appropriate visual aids to prepare presentations and reports
Understand and work in the language used by the SDO, in other words the national official languages at national bodies, often English, French or German in European and international organizations

4.3 Roles and competencies of an SP
Personal skills (cont.)

- Social competencies:

Specific soft / personal competencies
Cooperate easily with her/his organization teams and fellow SPs
Persuade others with her/his own opinions and views, but at the same time, is able to listen to peer SPs and respect others' opinions
Manage negotiation and cooperation, in other words how to influence people and organizations
Re-evaluate her/his own standpoint if required, in response to external conditions and internal needs
Leadership capabilities to steer the group towards a satisfactory technical solution and consensus
Inspire trust in her/his decisions
Coordinates the many skillsets and knowledge in her/his business organization

4.3 Roles and competencies of an SP

Personal skills (cont.)

- Personal competencies:

Specific soft / personal competencies
Willing to keep learning and transfer her/his skills to peer experts
Firm when necessary and show confidence in conflict management
Flexible and able to choose, whether a compromise is acceptable
Remain open-minded when receiving criticism
Network and collaborate easily with peer delegates

- Methodology competencies:

Specific soft / personal competencies
Read a large number of documents, essentially the committee documents and draft standards
Organize and prioritize her/his work, project management capabilities
Deliver tasks and documents within the planned deadlines
Take initiative and work autonomously
Uses recent electronic and collaborative tools such as mailing lists, word processors, web and FTP services, wikis, phone and web conferencing
Willing to travel to attend meetings to discuss specific matters more directly with peer experts

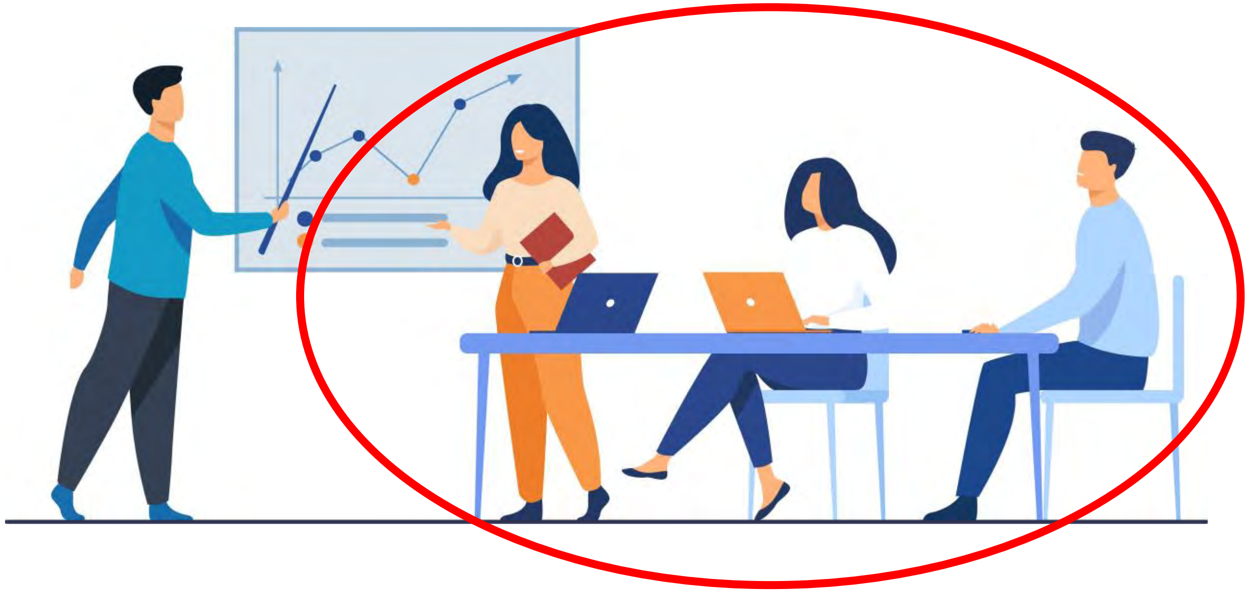
4.4 Professional activities of a standardization expert

- What are the main professional activities of a standardization expert?
  - During standardization meetings at the SDO premises: participate in standardization meetings, including interim periods such as networking breaks, …
  - Between meetings: write or review standardization documents and collaborates with his colleagues inside her/his own company: relevant technical teams, as well as marketing teams and management teams

4.4 Activities of the standardization expert

During committee meeting

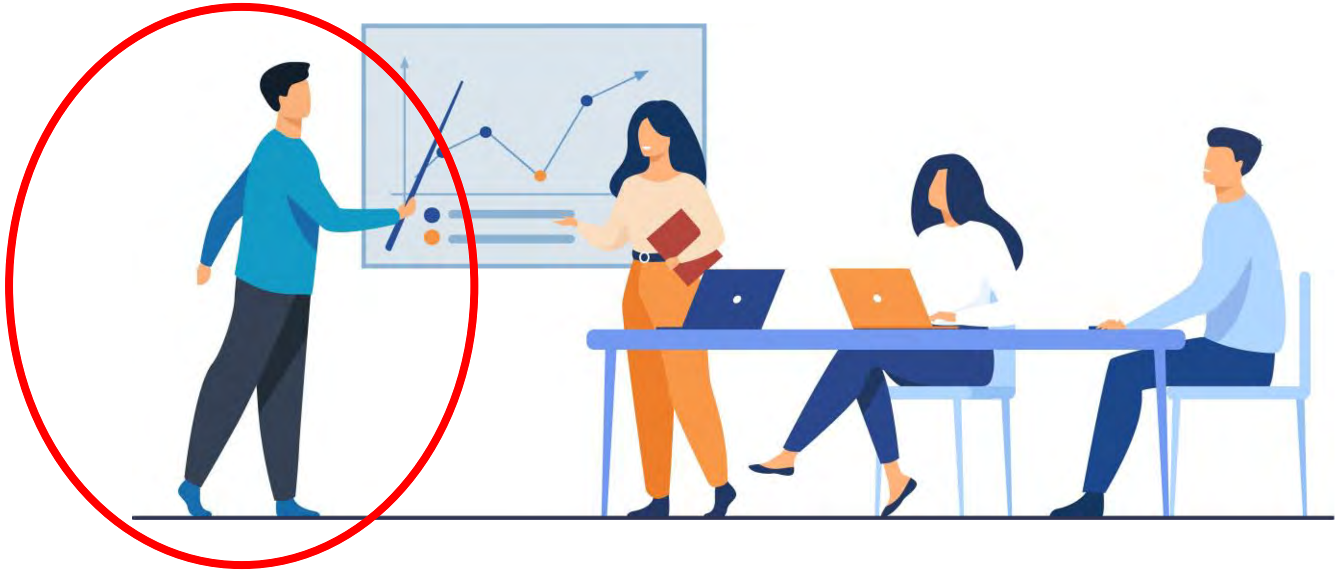
- When s/he attends **standardization meetings** as **committee** member, the standardization expert
  - Has prepared by reading the draft documents and contributions
  - Gets involved in the discussions, while bringing in her/his own knowledge on the topics discussed
  - Participates in the decision-making process
  - As liaison officer, presents activities that are taking place at other WGs/SDOs



4.4 Activities of the standardization expert

As rapporteur at standardization meeting

- When s/he **attends standardization meetings** as **rapporteur** of a standard, the standardization expert
  - Presents the latest version of the draft standard to her/ his peers
  - Explains what changes have been made since the previous version
  - Presents a status report and the main ideas to be discussed
  - Collects questions, while triggering discussions and trying to provide answers to clarify the topic
  - Suggests compromises to obtain consensus on a possible solution



4.4 Activities of the standardization expert
During networking time at standardization meetings

- During **standardization meetings breaks or networking time**, the standardization expert
  - Discusses with peers to resolve blocking issues or build compromises
  - Raises awareness about new concepts or processes that may need to be standardized and finds supporters for triggering a new standard
  - However, official decisions are always taken and reported during the formal meetings

4.4 Activities of the standardization expert
Interval between standardization meetings

When **in her/his office**,

- The standardization expert who acts as **rapporteur**
  - Updates the current draft to prepare the next version
  - Organizes drafting meetings where the content of the draft is discussed
  - Triggers and distributes writing tasks among the SE who are willing to contribute. Collects contributions and obtains input from other SE
  - Has more resources to investigate the IPRs related to the topic under standardization owned by her/his company

- If s/he is **not** the **rapporteur**, the standardization expert
  - Prepares contributions and change requests to draft standards
  - Reviews existing drafts and contributions that have been submitted to the next committee meeting
  - Uses traditional and digital working tools: word processor, IM, phone, collaborative shared workspace and conference tools

4.4 Activities of the standardization expert

Involved in the technical activities of a corporate company

- **Inside his/her company**, the standardization expert interacts with **relevant technical teams** and
  - Reports on recent standardization activities and trends, especially the latest standards approved and the liaison reports received from other SDOs
  - Explains the standards to the development teams and how to use them to accelerate the product-to-market process
  - Leads or participates in the activity of building prototypes that demonstrate the effectiveness of new technologies to be standardized and the correctness of the standards requirements

4.4 Activities of the standardization expert

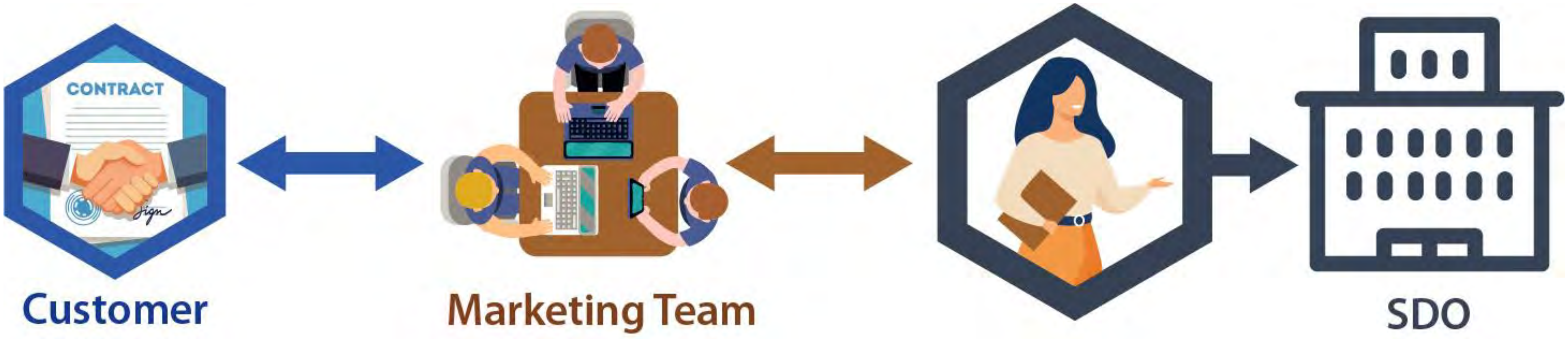
Involved in the technical activities of a corporate company (cont.)

- **Inside his/her company**, the standardization expert interacts with **relevant technical teams** to:
  - Define or updates the terminology for a common understanding of the projects of the in-house projects according to the terms used in the standards
  - Contribute to the organization's knowledge management and dissemination
  - Extend her/his knowledge about existing and future technologies, concepts and developments
  - Try to prevent that the technical teams create proprietary solutions when not appropriate

4.4 Activities of the standardization expert

Involved in the marketing activities of the company

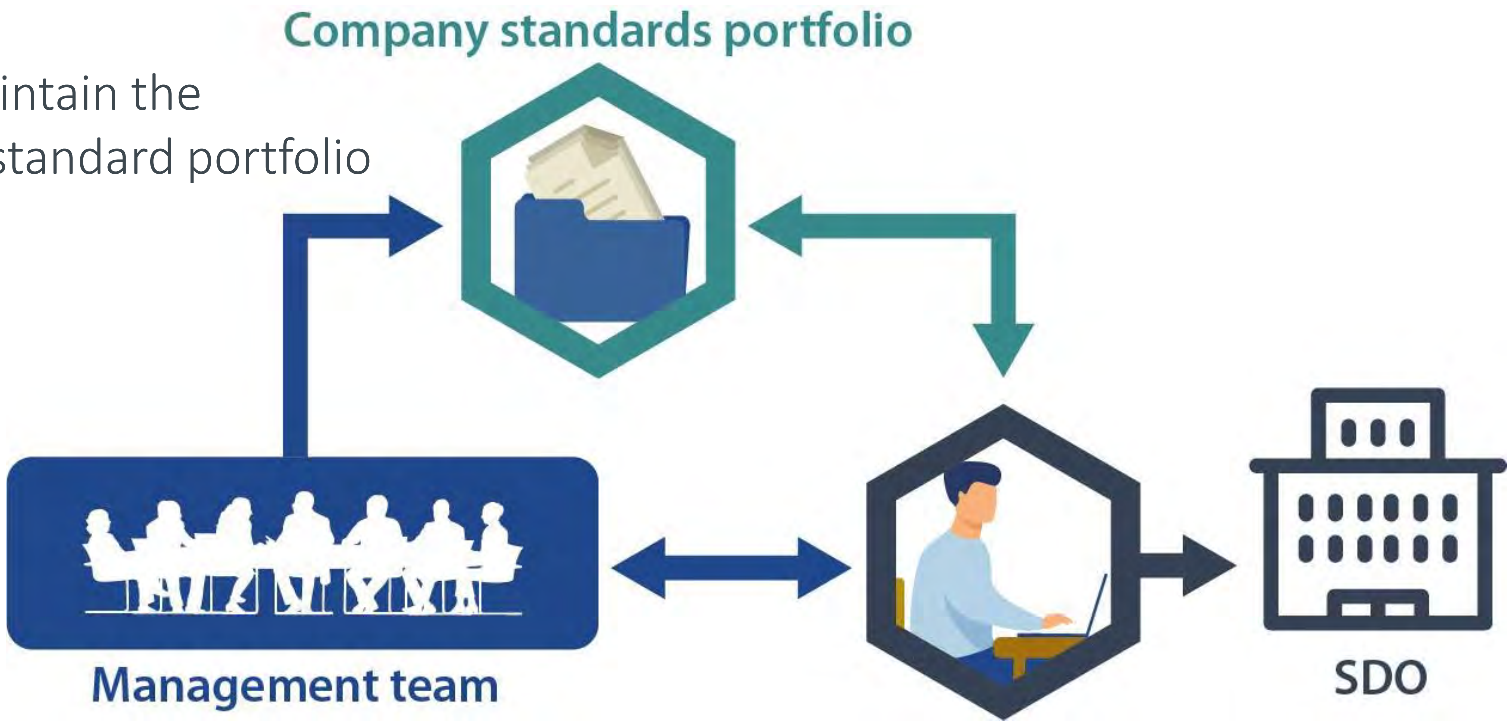
- **Inside his/her company**, the standardization expert interacts with **marketing teams** to:
  - Know and understand the development strategy of the business units to trigger relevant standards
  - Understand and analyse the customer's feedback and identify potential standardization gaps
  - Envision the new standards required to address these customers' needs and prepare proposals to start their development



4.4 Activities of the standardization expert

Involved in the management activities of the company

- **Inside his/her company**, the standardization expert interacts with the **management team**, together with the technical and marketing teams to:
  - Understand the company's strategy with respect to its standards portfolio and standardization strategy
  - Analyse which SDO memberships are of interest and ensure that the company is active at the relevant standardization groups
  - Analyse how to organize and maintain the contributions to the company's standard portfolio



4.4 Activities of the standardization expert

Further activities as a national delegate

- When the standardization expert is a **national delegate**, s/he performs the following additional duties:
  - Represent the point of view of her/his country in the standardization group as a member of her/his NSB
  - Trigger at national level the adoption, promotion and dissemination of international or regional (for example European) standards and the withdrawal of conflicting national standards
  - Organize meetings of national stakeholders to collect their positions (national technical mirror committees)
  - Facilitate and coordinate the local involvement in the standards by all types of national players: providers, academia, societal stakeholders and national authorities

4.5 Case study: the 3rd Generation Partnership Project (3GPP)

- The 3rd Generation Partnership Project (3GPP) covers cellular telecommunications network technologies standardization at global level
  - Provides its members (international SDOs) with a stable environment to produce reports and specifications about mobile communication technologies, a field in constant evolution
  - Standardization in 3GPP considers maintenance of 2G and 3G, bug fixes in 4G and specification of 5G and requirements for 6G
- 3GPP committee structure: 3 Technical Specification Groups (TSGs)
  - addressing a sub-system of the cellular communications system (Service & System Aspects [SA], Radio Access Network [RAN], Core Network and Terminals [CT])
  - Each TSG has established working groups (WGs) to address dedicated working topics: SA1, SA6, RAN2
- Delegates represent a very wide variety of technical skills, from system architects to specialists such as radio or security experts.

4.5 Case study: the 3GPP (cont.)
Methodology of 3GPP standardization

- 3GPP specifications are developed using the three-stage methodology defined in ITU-T Recommendation I.130
- It is defined in 3GPP TR 21.900 clause 4.1
  - Stage 1: general description of the service offered by the ICT system to users and its objectives from the user's perspective
  - Stage 2: functional model to meet those objectives. It includes the architecture of the system broken down into functions with their capabilities and their information interactions
  - Stage 3 develops a specification of the detailed technical requirements
  - It is common practice to publish test specifications or conformance test suites for each of the standards developed in stage 3 – Stage 4
  - It is often appropriate to start with the production of a feasibility study prior to formal specification work and evaluate the different options that can be envisioned – "Stage 0"

Glossary: Chapter 4

- **Committee**: set of standardization professionals working on a specific topic. It can be a full organization (for example CEN) or a sub-group of an organization.
- **Conformance test suites**: test suites that verify that a product or function complies with a standard.
- **Drafting**: Iterative writing of the different clauses of a draft standard.
- **Rapporteur**: standardization professional responsible for the drafting of a specific standard.
- **Semantic**: set of data helping to define the meaning of a concept.
- **Specification**: Set of rules that competing products must comply with to enable their interoperability.
- **Standardization professional**: Professional working in a corporate organization, often industry, in a national organization, in a research or academic organization, or in a consumer or professional association and involved in standardization.
- **Standardization expert**: Standardization professional who contributes to the content of standards.
- **Standardization stakeholder**: Party impacted by the publication of standards, e.g., corporate organizations, user groups, or national authorities.
- **Standards strategy**: Plan of action designed to obtain a standards portfolio in line with corporate business goals.
- **Technical body**: Generic term designating technical committees, sub-committees and working groups that bring together delegates to produce standards.

List of abbreviations: Chapter 4

- 3GPP: Third Generation Partnership Project
- CEN: Comité Européen de Normalization (European Committee for Standardization)
- CENELEC: European Committee for Electrotechnical Standardization
- CT: Core Network and Terminals
- ESO: European Standards Organization
- FTP: File Transfer Protocol
- GSC: Global Standards Collaboration
- ETSI: European Telecommunication Standards Institute
- HL7: Health Level Seven
- HTML: HyperText Markup Language
- IAB: Internet Architecture Board
- IANA: Internet Assigned Numbers Authority
- IASA:IETF Administrative Support Activity
- ICT: Information and Communication Technology
- IEC: International Electrotechnical Commission
- IEEE: Institute of Electrical and Electronics Engineers
- IESG: Internet Engineering Steering Group
- IETF: Internet Engineering Task Force
- IM: Instant Messaging
- IPR: Intellectual Property Rights
- ISDN: Integrated Services Digital Network
- IRTF: Internet Research Task Force
- IRSG: Internet Research Steering Group
- ISO: International Organization for Standardization
- ISO/CS: ISO Central Secretariat
- ISOC: Internet Society
- ITU-T: International Telecommunication Union - Telecommunication Sector
- RAN: Radio Access Network
- RFC: Request for Comments
- SA: Service & System Aspects
- SC: Sub-Committee
- SDO: Standards Developing Organization
- SE: Standardization Expert
- SME: Small or Medium-sized Enterprise
- SP: Standardization Professional
- TBT: Technical Barriers to Trade
- TC: Technical Committee
- TCP/IP: Transmission Control Protocol/Internet Protocol
- TSG: Technical Specification Group
- WG: Working Group
- WTO: World Trade Organization

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5 Standardization and Innovation

Contents

5 Standardization and Innovation

- The learning objectives of this section are:
  - Getting insights into the interdependencies between innovation and standards/standardization.
  - Understanding how standardization and innovation can benefit each other.
  - Learning some concrete examples how standardization and standards can boost innovation.
  - Understanding the relationships between research and standardization, in particular, how standards and standardization can be leveraged during the research process.
  - Learning about the ways, in which standards and standardization can support innovation, both as a process and as an output in the sense of a technology or product, in particular, so-called innovation potential in standardization.

5.1 Interdependencies standardization and innovation

Introduction to innovation

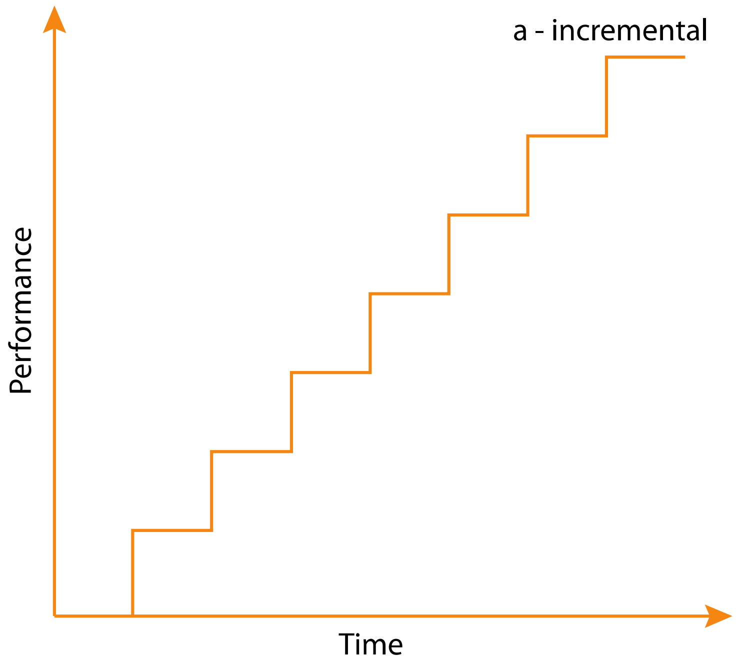
- Innovation defined by Schumpeter (1934):

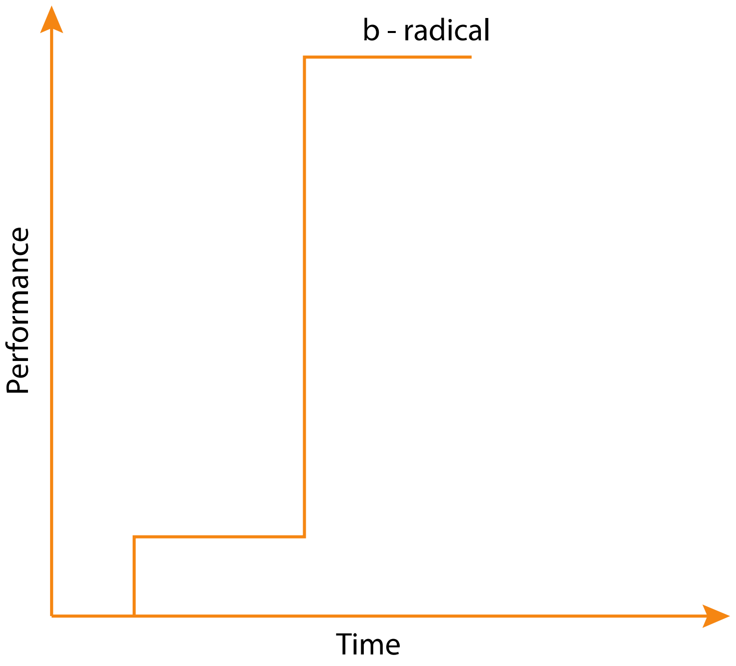
> *"The commercialization of all new combinations based upon the application of new materials and components, the introduction of new processes, the opening of new markets, and/or the introduction of new organizational forms."*

- Innovation is more than an invention: It includes the commercialization of the invention!
- Innovation may concern materials, processes, products/services, components, markets, and/or organizational forms

5.1 Interdependencies standardization and innovation
Introduction to innovation

- Degree of novelty and value-added:
  - **Incremental:** Minor improvements of existing technology (evolutionary). E.g., improvement of processing power and storage capacity of computers
  - **Radical:** Totally new technology (revolutionary). E.g., transition to quantum computers





5.1 Interdependencies standardization and innovation
Introduction to innovation

- Types of innovation (depending on novelty level):
  - **New-to-the-Firm:** Adoption of an existing technology that is new to the company
  - **New-to-the-Market:** Known technologies that are being transferred into a new market
  - **New-to-the-World:** Ground-breaking innovations (global level)
  - **Disruptive:** New technology eventually displacing established competitors (Bower and Christensen 1996)
  - Even the adoption of an existing technology is understood as innovation activity. The ability of companies to accommodate existing innovation is called **absorption capacity** (Cohen and Levinthal 1990).

Source: OECD (2005)

5.1 Interdependencies standardization and innovation
Traditional view of standardization and innovation

- **Standardization:** Keeping things the same
- **Innovation:** Development of new things

"Standardization and innovation give the impression of being opposites."
Perera (2010)

Standards are "the flux between freedom and order".
David (1995)

5.1 Interdependencies standardization and innovation

New perspective on standardization and innovation

- Standards as **innovation-hampering:**
  - Standards contain "static" solutions that are intended to be used repeatedly; they are static, because the solution seems to be "frozen" during a certain time period
  - Only when there is the necessity to develop another solution, the old one makes place for the new one
  - Standards induce a Lock-in effect
    - High costs of replacing the hardware
    - Switching costs incurred by users when they learn how to work with a new standard (education costs)
    - Penguin effect: New standard would only be attractive if others would use it
- But Standards can also **promote innovation**:
  - Standards allow an early market uptake and support the achievement of critical mass (→ agreed upon best practice)
  - Standards ensure compatibility allowing for innovation to take place based on other innovations
  - Standards allow technology transfer and facilitate research
  - ...

Source: De Vries (2006, p. 40)

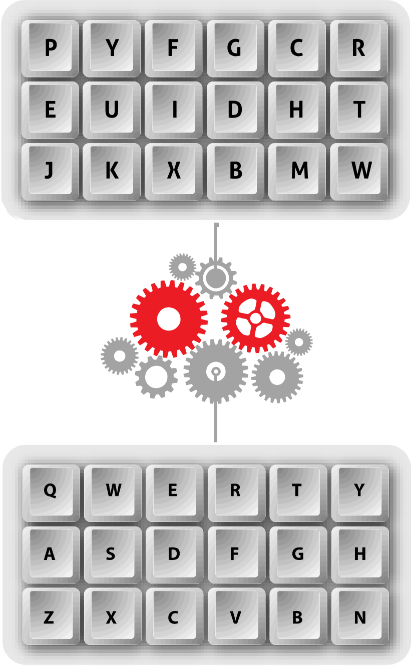
5.1 Interdependencies standardization and innovation

Example: QWERTY vs. DVORAK keyboard (First Version of the Story)

- Innovation-hampering:

Lock-in in the old technology:

- High costs of replacing the hardware everywhere
- Switching costs (education costs) incurred by users when learning how to work with a new standard
- Penguin effect: New standard would only be attractive if others would use it (typists & keyboard manufacturers) - so everyone is waiting for the other to go for the new technology

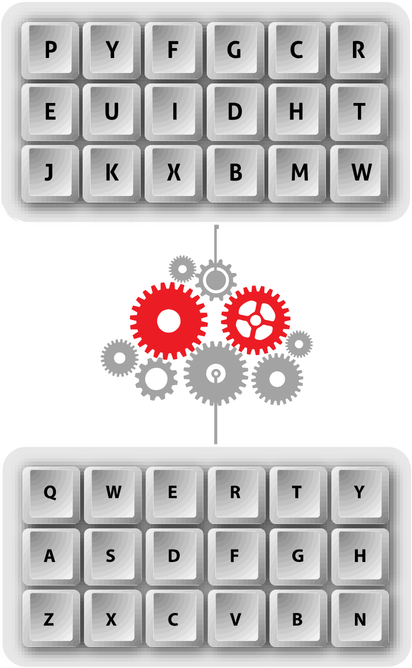


- QWERTY developed in the 1879s to slow down the speed of typist in order to make the keys less likely to jam
- Design based on the frequency of use of the letters of the alphabet
- Since the typewriter is replaced by electronic devices QWERTY no longer makes sense
- Still the superior DVORAK design with improved ergonomics could not establish itself in the market

Source: De Vries (2006, p. 40)

5.1 Interdependencies standardization and innovation
Example: QWERTY vs. DVORAK keyboard (First Version of the Story)

- Innovation-fostering:
  - QWERTY is only the standard for the interface between human and machine: The machine itself has been innovated from mechanic to electronic based on the standard
  - QWERTY is used world-wide and enables suppliers (hardware, software and education) to benefit from economies of scales: This way the invention had a greater chance to become an innovation
  - An improved machine without a standard interface would not have been acceptable for the customers



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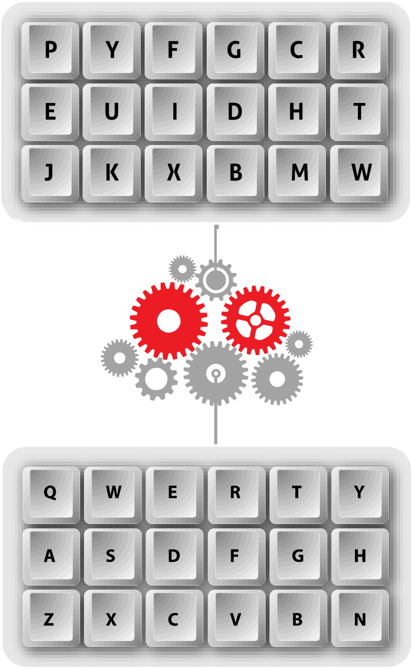
- Still the superior DVORAK design with improved ergonomics could not establish itself in the market

Source: De Vries (2006, p. 40)

5.1 Interdependencies standardization and innovation

Example: QWERTY vs. DVORAK keyboard (Second Version of the Story)

- Putting in question the popularized story:
  - **Implicit Hypothesis** in the widespread story: "an established standard can persist over a challenger, even where all users prefer a world dominated by the challenger, if users are unable to coordinate their choices."
  - If DVORAK was truly superior, then there would have been innovative entrepreneurial activity that would have capitalized on the benefits of DVORAK, leading users to switch.



- Is DVORAK really superior to QWERTY?
- Is DVORAK really better in terms of faster learning and improving typist productivity?
- What about the experiments that do not necessarily confirm that DVORAK is better than QWERTY?
- What about the ergonomic perspective?

Source: Liebowitz and Margolis (1990)

5.1 Interdependencies standardization and innovation

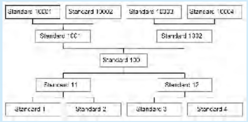
Standards as an enabler for innovation-driven growth

- So what have we learned?
    1. Standardization can constrain innovation activities,
    2. But standardization supports trade and subsequent innovation
- Let us move this on a higher level by using an analogy:

Optimizing the pruning and training of a tree to maximize fruitfulness

similarity

Optimizing the design of a standards system to maximize innovation-led growth



Source: Swann (2000)

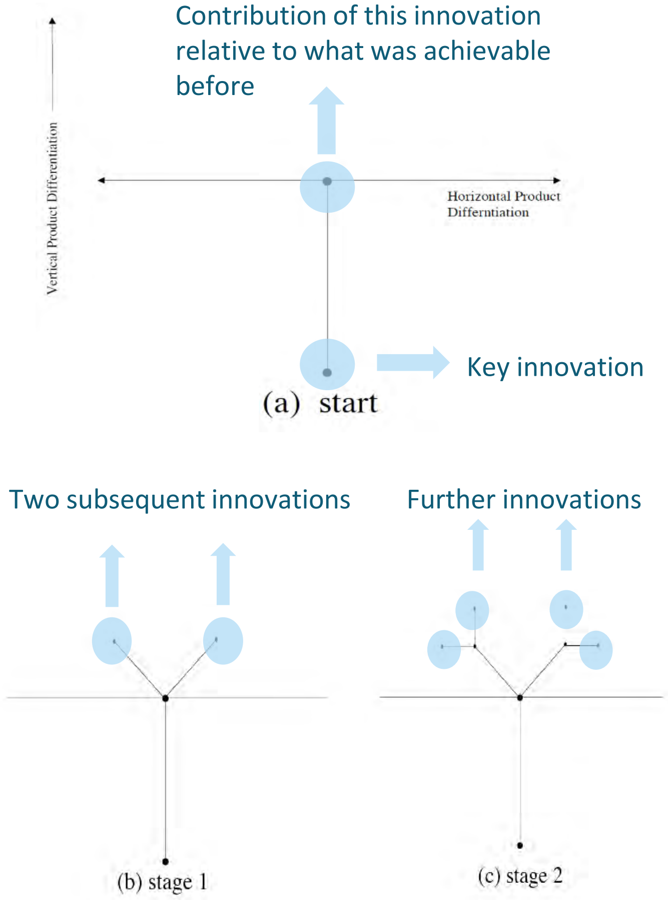
5.1 Interdependencies standardization and innovation

Standards as an enabler for innovation-driven growth

- Why does a tree need pruning?
  - Remove weak, dead and damaged branches to promote healthy growth of wood
  - Thin a dense canopy on a tree to increase air and sunlight, resulting in healthy and increased flowering and fruitfulness
    - The trunk and branch structure plays a key role in determining the vigour of growth, leaves and fruit
    - It is dysfunctional to let all shoots grow: Through pruning the tree has to select a shoot and concentrates its energies into the growth of this individual shoot
  - Give the tree the form desired

Standards as an enabler for innovation-driven growth

- Applying the analogy standards and innovation:
  - **Vertical product differentiation**: The further up the diagram, the greater the performance and/or functionality
  - **Horizontal product differentiation**: Products of different design and configuration but of roughly comparable functionality
  - (a) A key innovation opens up a new area of technological space
  - (b) Subsequent innovations draw on the basic standard
  - (c) Further innovations along vertical and horizontal dimensions can take place.

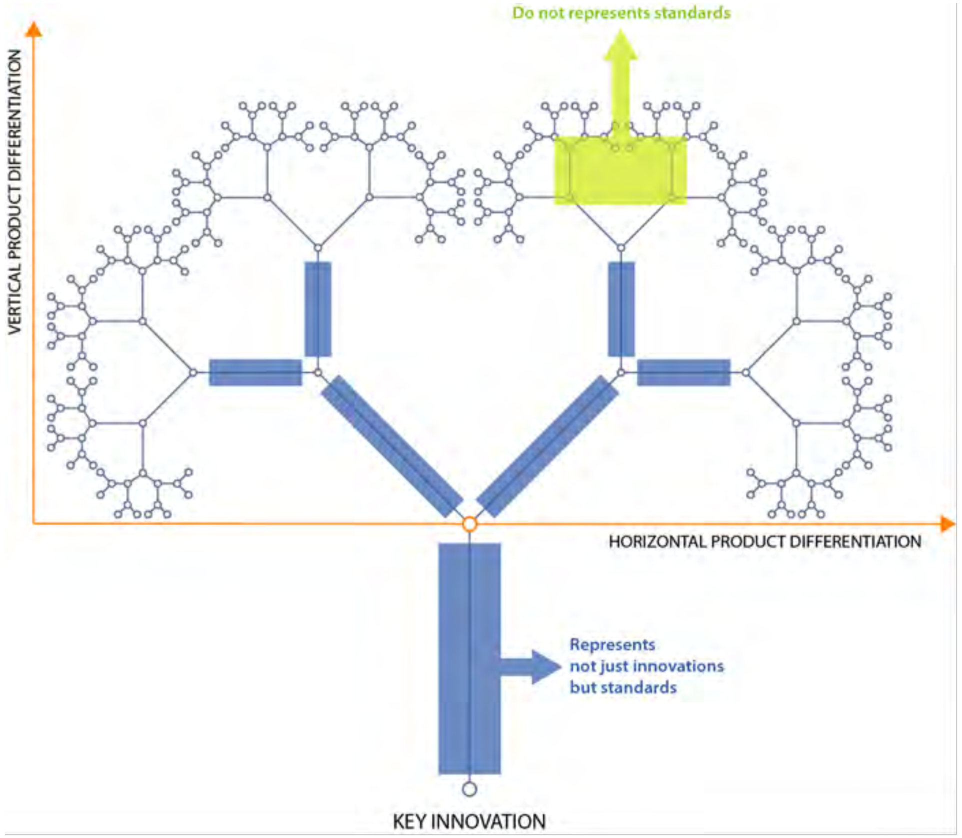


Source: Swann (2000), Abbott (1955)

5.1 Interdependencies standardization and innovation

Standards as an enabler for innovation-driven growth

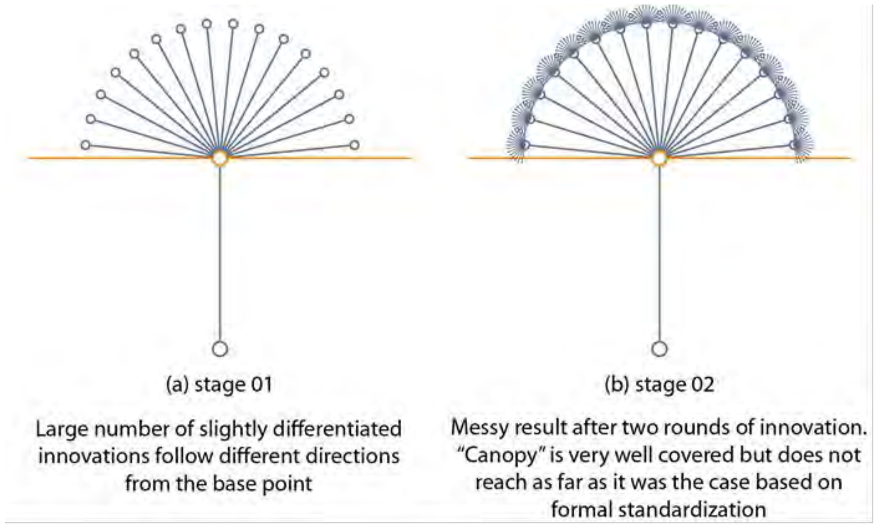
- Pruning eliminates dead and weak branches; standardization limits variety and helps to develop a "strong tree".
  - Tree is analogous to technology.
  - Innovation helps to grow the tree by building a “canopy” of competing products and services
  - Standardization stops messy proliferation, while enabling and shaping innovation
  - The closer the innovations are to a standard, the greater the confidence of consumers and producers



Source: Swann (2000)

5.1 Interdependencies standardization and innovation
Standards as an enabler for innovation-driven growth

- Innovation without standardization:
  - The process of innovation-led growth is taking place
  - Large number of slightly differentiated innovations follow different directions from the base point
  - Each stage shows a substantial amount of innovation → much duplicated effort (potential for economies of scale unused)
  - Messy result after two rounds of innovation
  - "Canopy" is very well covered but does not reach as far as it is the case based on formal standardization



Source: Swann (2000)

5.1 Interdependencies standardization and innovation
Standards as an enabler for innovation-driven growth

- What can be said as conclusion?
  - Standardization limits variety, but it helps to develop a “strong tree”
  - Innovations help to grow the tree, but standardization stops messy proliferation by holding back subsequent messy growth

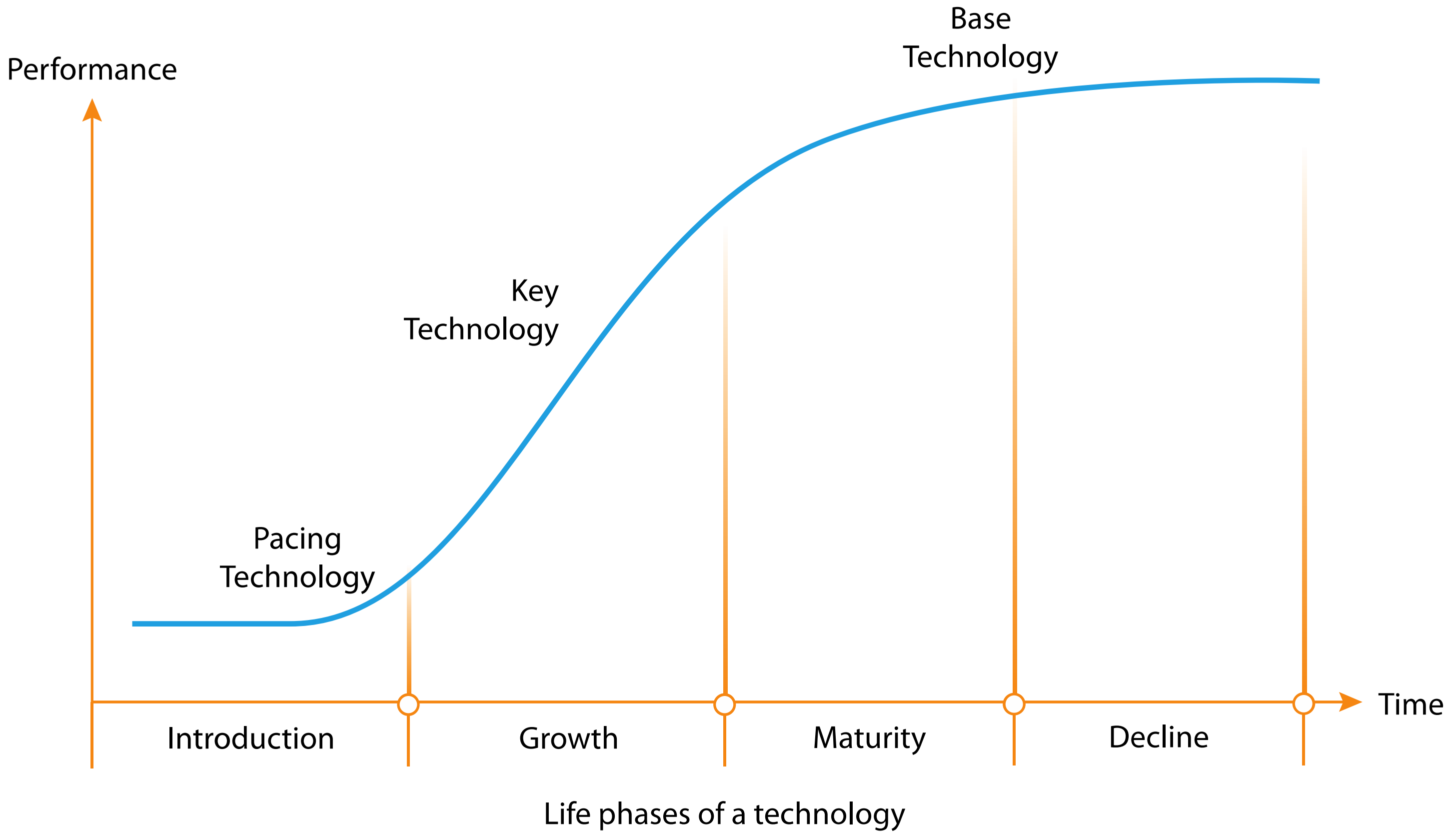
Source picture: pngall.com

Source: Swann (2000)

5.1 Interdependencies standardization and innovation

Standardization and the Technology Life Cycle

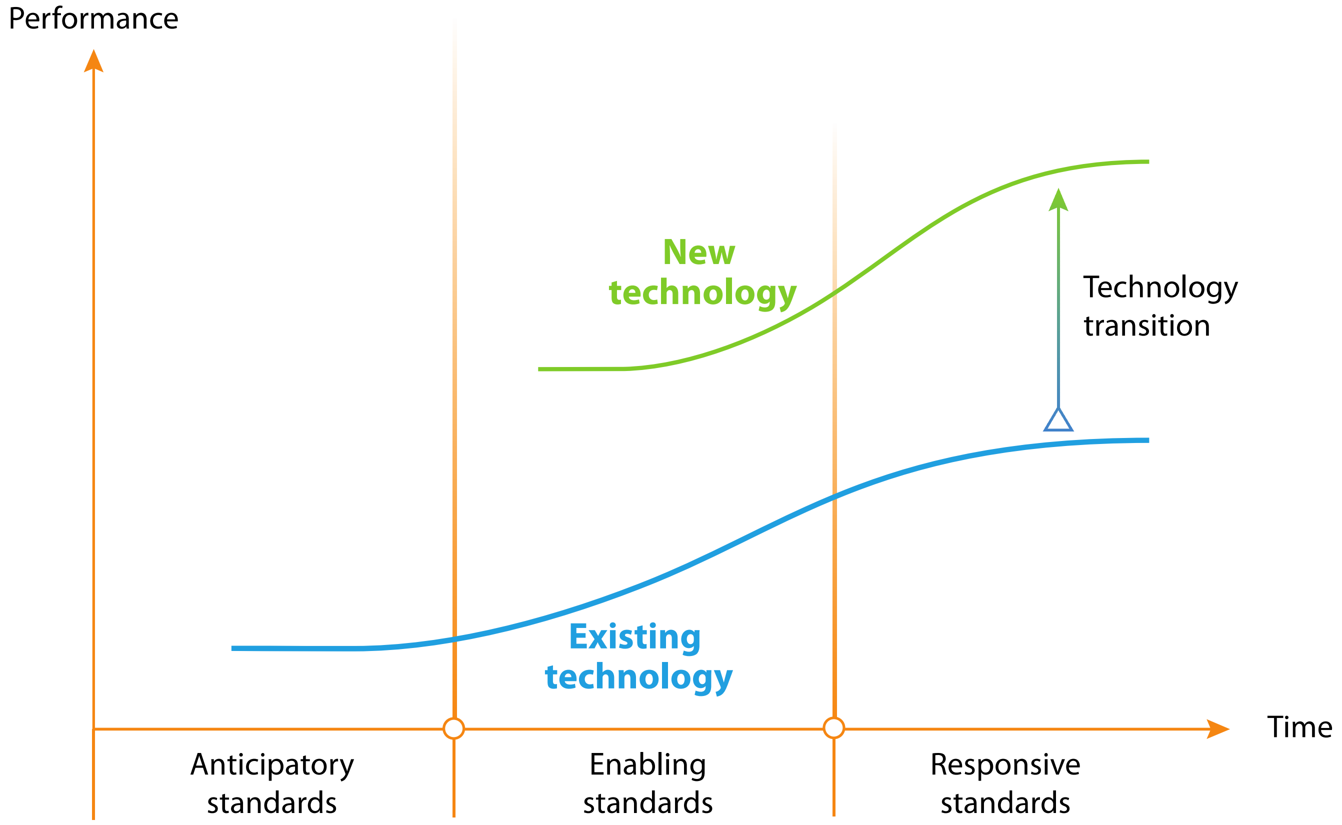
- The Technological Life Cycle (TLC) describes the level of commercial return and improvement in technological performance, depending on the investments in R&D
- Different phases:
  - Introduction
  - Growth
  - Maturity
  - Decline



Source: Translated from Brockhoff (1999)

5.1 Interdependencies standardization and innovation
Standardization and the Technology Life Cycle

- Standards can be related to the Technology Life Cycle
- Three types of standards are worth introducing:
  - Anticipatory
  - Enabling
  - Responsive



Source: Sherif et al. (2005)

5.1 Interdependencies standardization and innovation
Anticipatory standards

- Anticipatory standards are “forward-looking” answers to expected interoperability problems; they are indispensable for successful network systems
- The Specification of anticipatory standards runs in parallel to the development of prototypes, pilots, field trials to condense available theoretical and practical knowledge
- Anticipatory standards also provide a way of sharing ideas. This is crucial when the risks of collaboration with other competitors are high
- Examples: X.25, ISDN, SSL, Bluetooth, UMTS etc.

Source: Sherif et al. (2005)

5.1 Interdependencies standardization and innovation
Enabling standards

- Enabling standards proceed in parallel with market growth and improvement of technology and products to enhance the agreed-upon design by extending robustness and scale
- Competitive forces and the need to reduce production costs influence the direction, in which the standard will develop
- Enabling standards support the diffusion of technical knowledge and prevent market fragmentation
- Examples: V.90 client modem: Chip manufacturers agreed to collaborate in the standardization process at ITU to develop a design that would work independently of the chipset used

Note: Large standards are a mixture of anticipatory and enabling standards (e.g., GSM)

Source: Egyedi and Sherif (2008)

5.1 Interdependencies standardization and innovation

Responsive standards

- Responsive standards are created at the end of technology development (maturity and decline phases)
- Internal responsive standards (related to processes and practices inside the organization) codify best practices after the dominant design has stabilized
- External responsive standards improve efficiencies or reduce market uncertainties for auxiliary products/services
- External responsive standards may be called "business standards", as they contribute to achieving maximum returns associated with an already established technology
- Example: Transport Layer Security (TLS) is a responsive standard following the establishment of Secure Sockets Layer (SSL) - TLS/SSL are cryptographic protocols to secure communication over the internet

Source: Egyedi and Sherif (2008)

5.2 Research and standardization

Bridging the gap between research and practice

5.2 Research and standardization

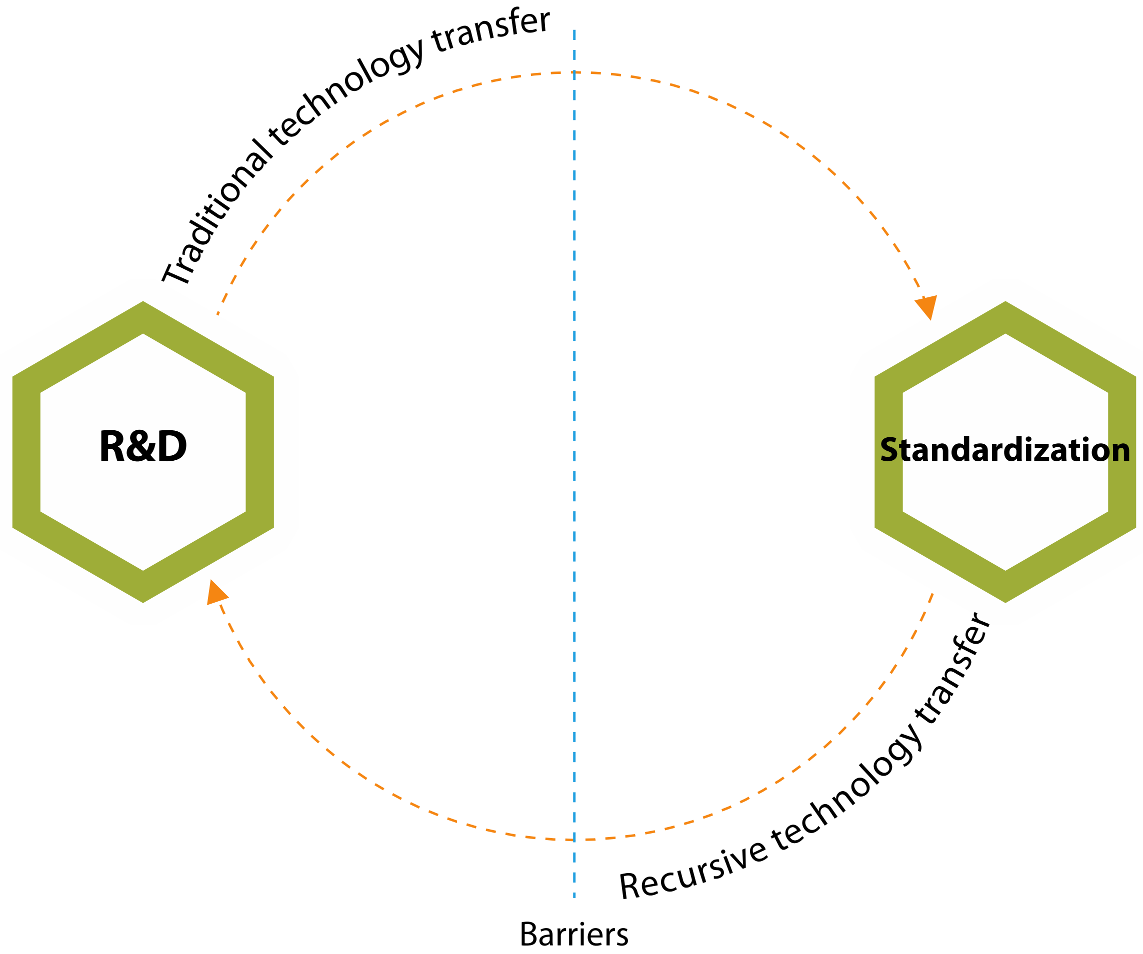
Importance of integrating research results in standards

- Bridging the gap between research and practice by integrating new research/ technologies into standards:
  - Companies that apply these standards absorb the latest knowledge.
  - This mechanism supports the transfer of research results into innovative products/services
- Maximum economic efficiency: Public funded R&D results become public goods through standards
- Standards, in contrast to patents, are more likely to be broadly implemented because all interested stakeholders that participate in the standardization process reach consensus

Source: Perera (2010)

5.2 Research and standardization
Traditional vs. recursive research exploitation

- Research produces knowledge that flows into standards (traditional technology transfer)
- Standards can also serve as a knowledge source for further/new R&D projects
  - Recursive knowledge flow from standardization back to research.
  - This prevents the reinvention of the wheel and stimulates ideas for new research projects

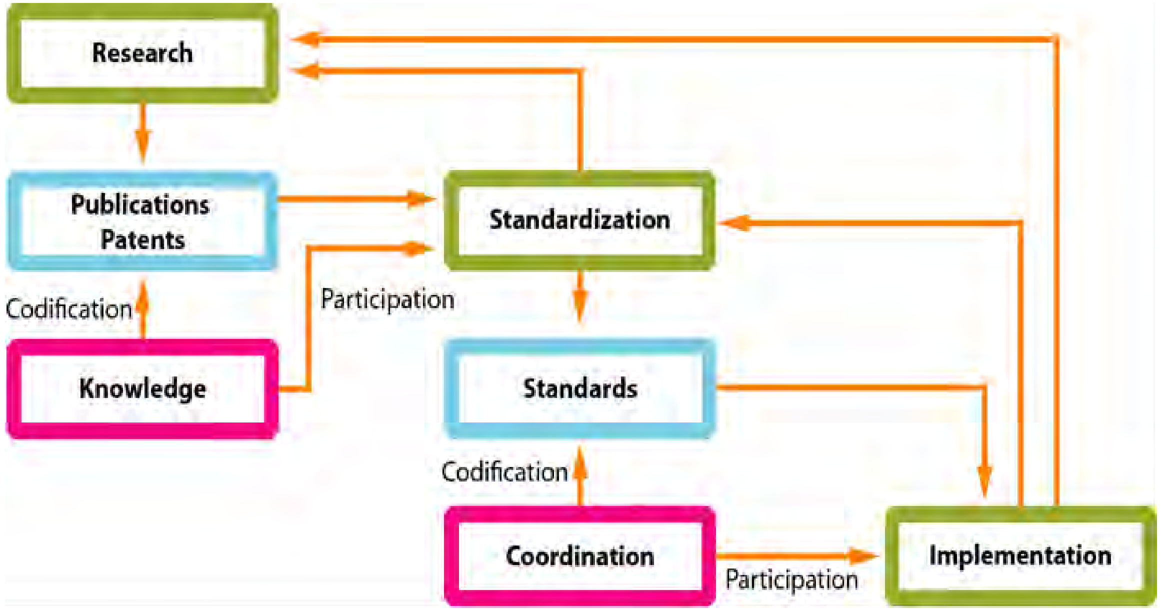


Source: Blind (2013)

5.2 Research and standardization

A Simple technology transfer model

- Standardization as a cooperation and transfer process:
  - Common platform for actors with heterogeneous backgrounds (e.g., research, industry, government, Non-Profit-Organizations (NPOs), consumers)
  - Codification of knowledge and exchange of tacit knowledge
  - Integration of inputs from heterogeneous sources (e.g., knowledge from implementers of technologies and consumers)

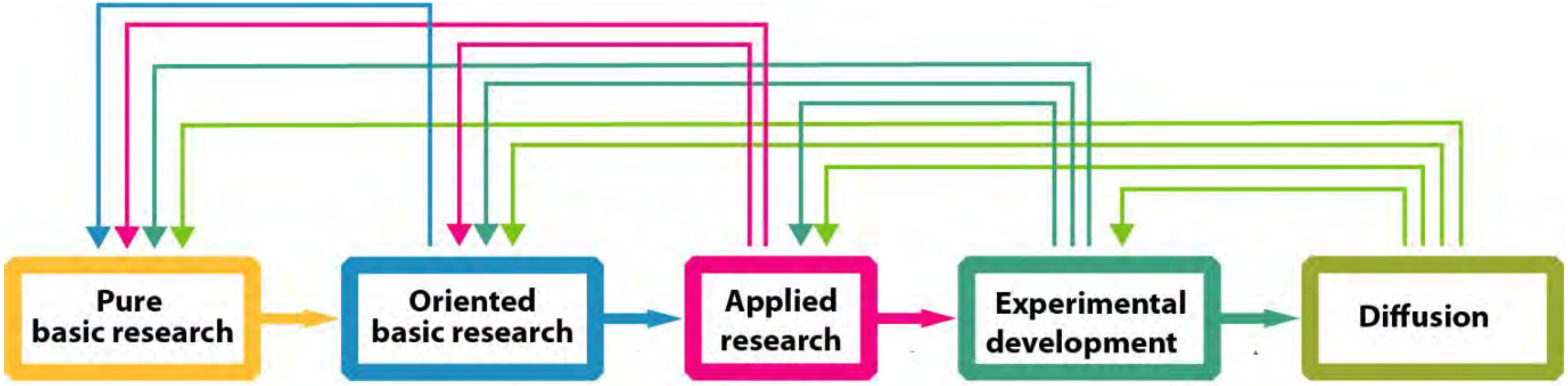


Source: Blind and Gauch (2009)

5.2 Research and standardization

The research and innovation process

- Different phases of the research and innovation process:

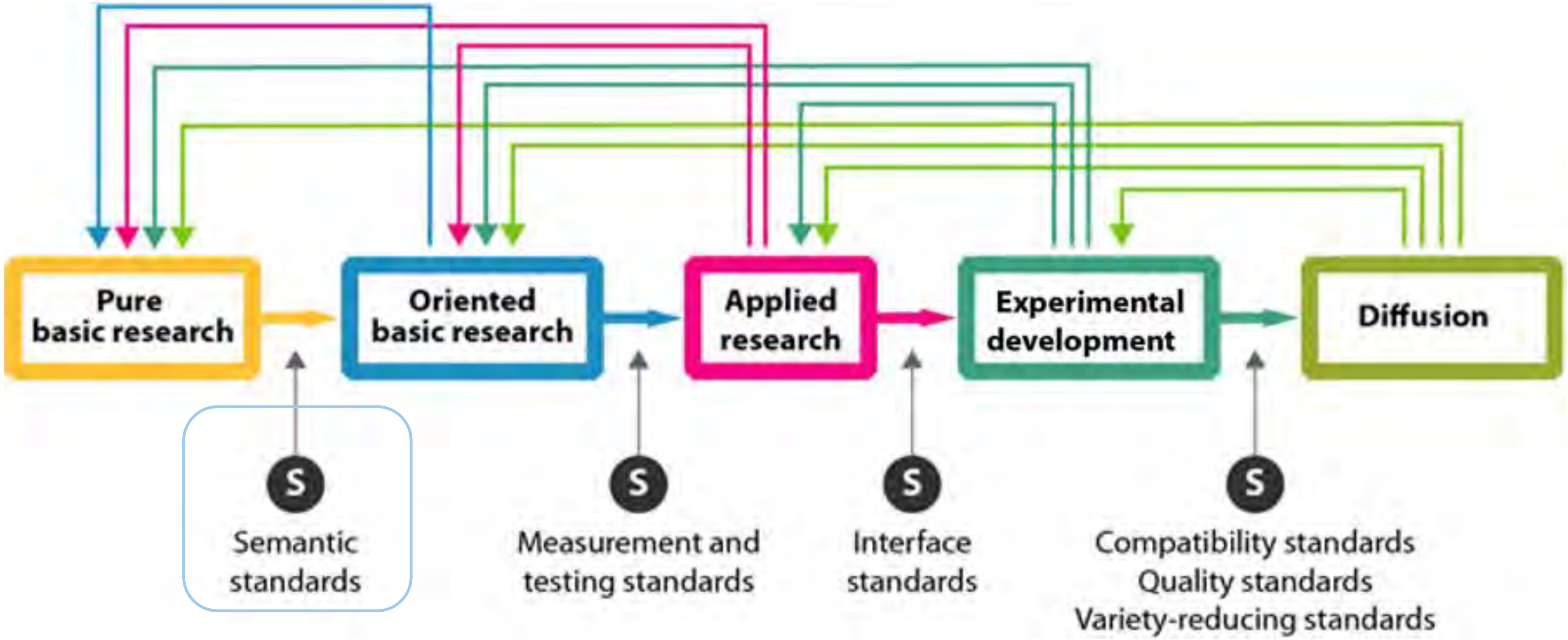


Pure basic research	Oriented basic research	Applied research	Experimental development	Diffusion
Experimental or theoretical work to acquire new knowledge of the underlying foundations	Research carried out with the expectation to produce a base of knowledge likely to form the background to the solution of current or future problems	Original investigation towards an aim or objective; involves the practical application of science	Systematic work using knowledge gained from research and practical experience and producing additional knowledge directed to producing new products	Spread of innovations from first implementation to different consumers, countries, regions, sectors, markets and firms

Source: Blind and Gauch (2009)

5.2 Research and standardization

The interface between research and standardization: a model



Terminology standards…

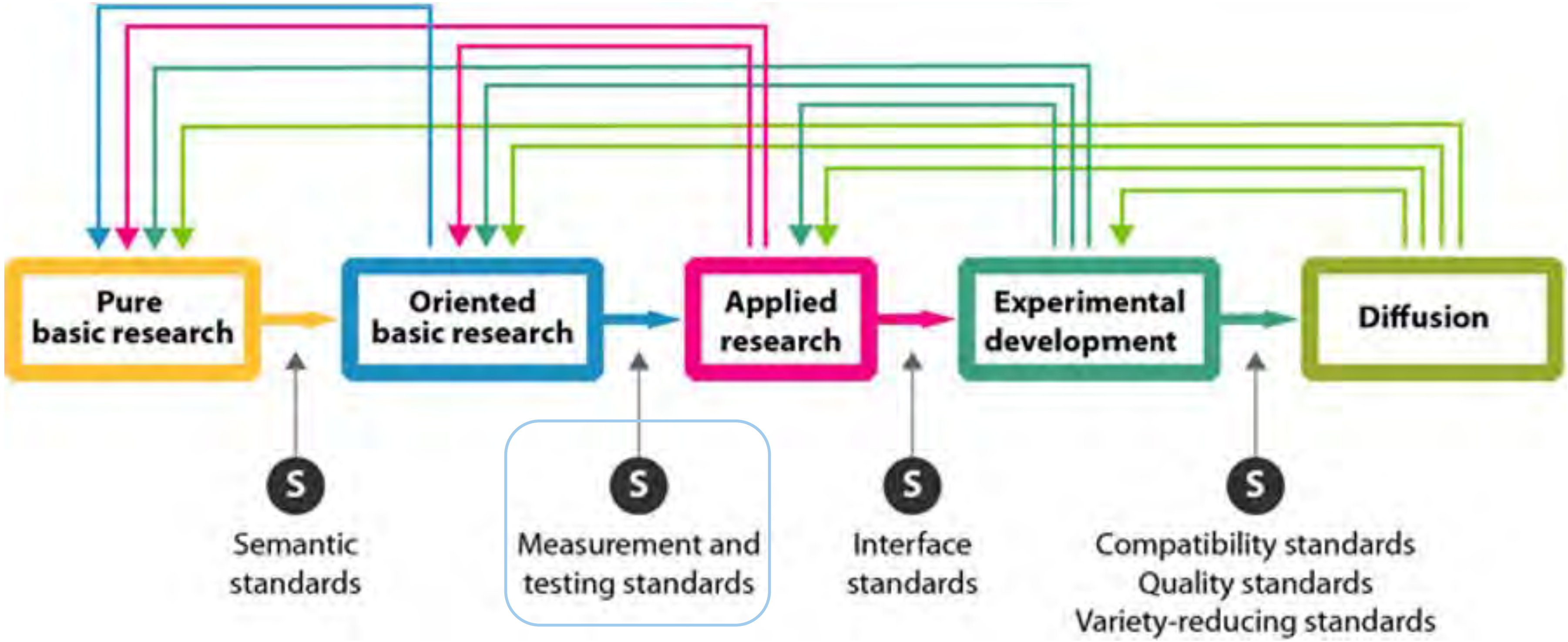
- …facilitate efficient communication
- …are required in basic research as well as in the transfer of knowledge to oriented basic research and subsequent research activities

→ Reduction of information and transaction costs

Source: Blind and Gauch (2009)

5.2 Research and standardization

The interface between research and standardization: a model



Measurement and testing standards…

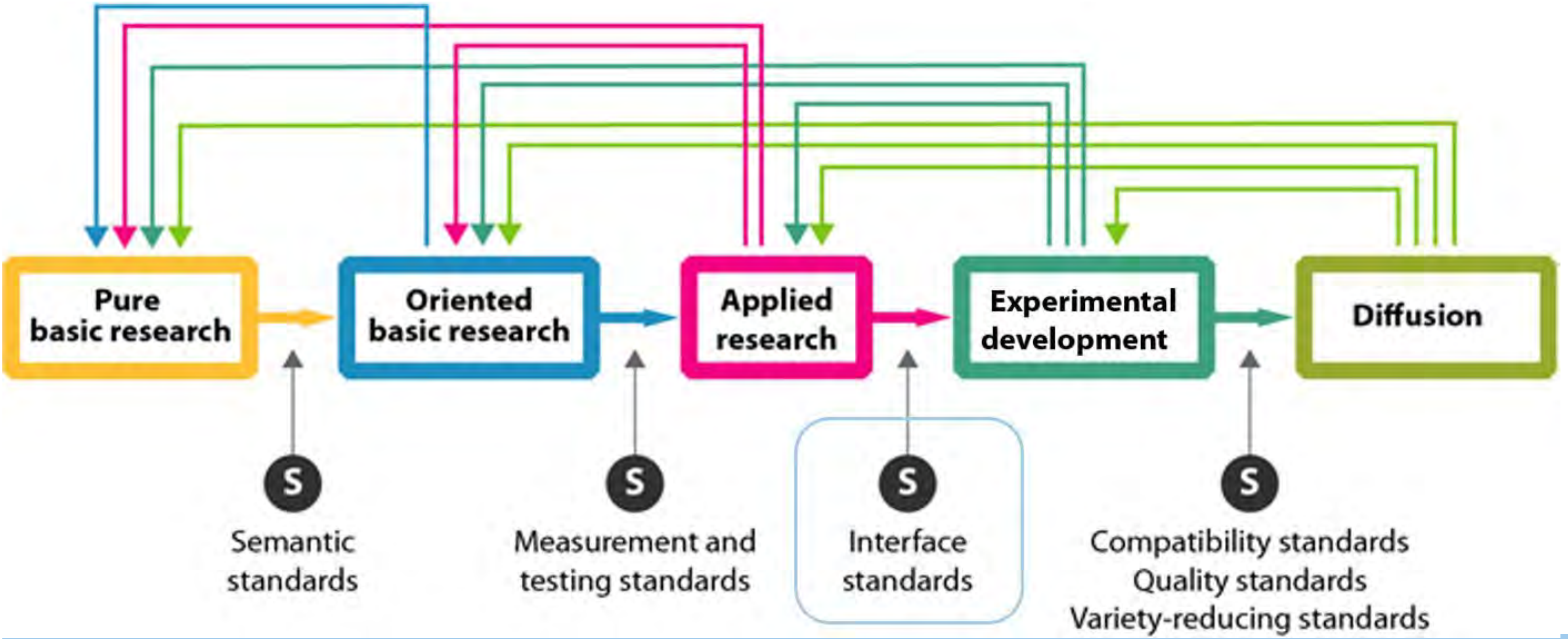
- …support the shift towards product-related developments
- …enable one to check whether specific requirements have been met (e.g., performance criteria)
- …ensure the comparability of the results through agreed upon test methods

→ Reduction of information and transaction costs

Source: Blind and Gauch (2009)

5.2 Research and standardization

The interface between research and standardization: a model



Interface standards…

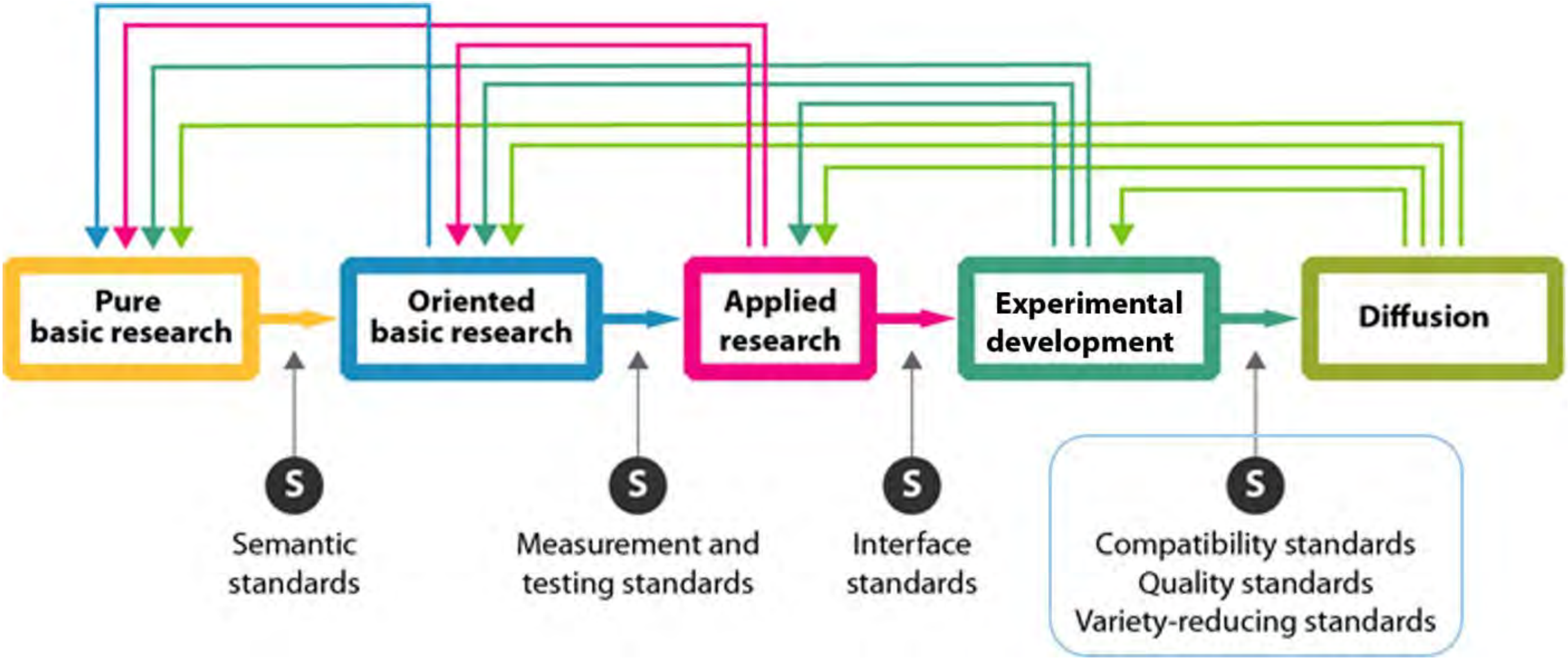
- …support interoperability of components integrated into products or process technology

→ Driving interoperability among components and saving adaption costs

Source: Blind and Gauch (2009)

5.2 Research and standardization

The interface between research and standardization: a model



Compatibility, quality and variety-reducing standards…

- …support the transition of products into mass markets

→ Increased quality as well as reduced health, privacy, and safety risks, while supporting the building of a critical mass

Source: Blind and Gauch (2009)

5.2 Research and standardization

The interface between research and standardization: a model

- Conclusions:
  - Different standards can play different roles at several stages of the research and innovation process
  - Standardization and research are highly interlinked

- **Note:** The boundaries between different steps are not clear-cut as illustrated in the research and innovation process

5.2 Research and standardization

Example: MP3 patent included into ISO (formal) standard

- Research conducted within the Digital Audio Broadcast (DAB) project at University of Erlangen, Germany
- First patent applications filed in 1987 based on the project results
- Fraunhofer Institute for Integrated Circuits IIS (Nuremberg, Germany) started audio encoding research within the DAB project (also in 1987)
- Standardization committee MPEG (Motion Pictures Expert Group) founded in 1989 and included members like Sony, Phillips and EMI
- MPEG released MPEG-1-Layer3, known as MP3, as a standard MP3-player format (in 1992)
- Success of MP3 standards: Sale of more than 100 million MP3-players and more than €100 million license revenues for the Fraunhofer society

Source picture: Fraunhofer IIS

Source: Blind (2009)

5.2 Research and standardization
Current situation in research

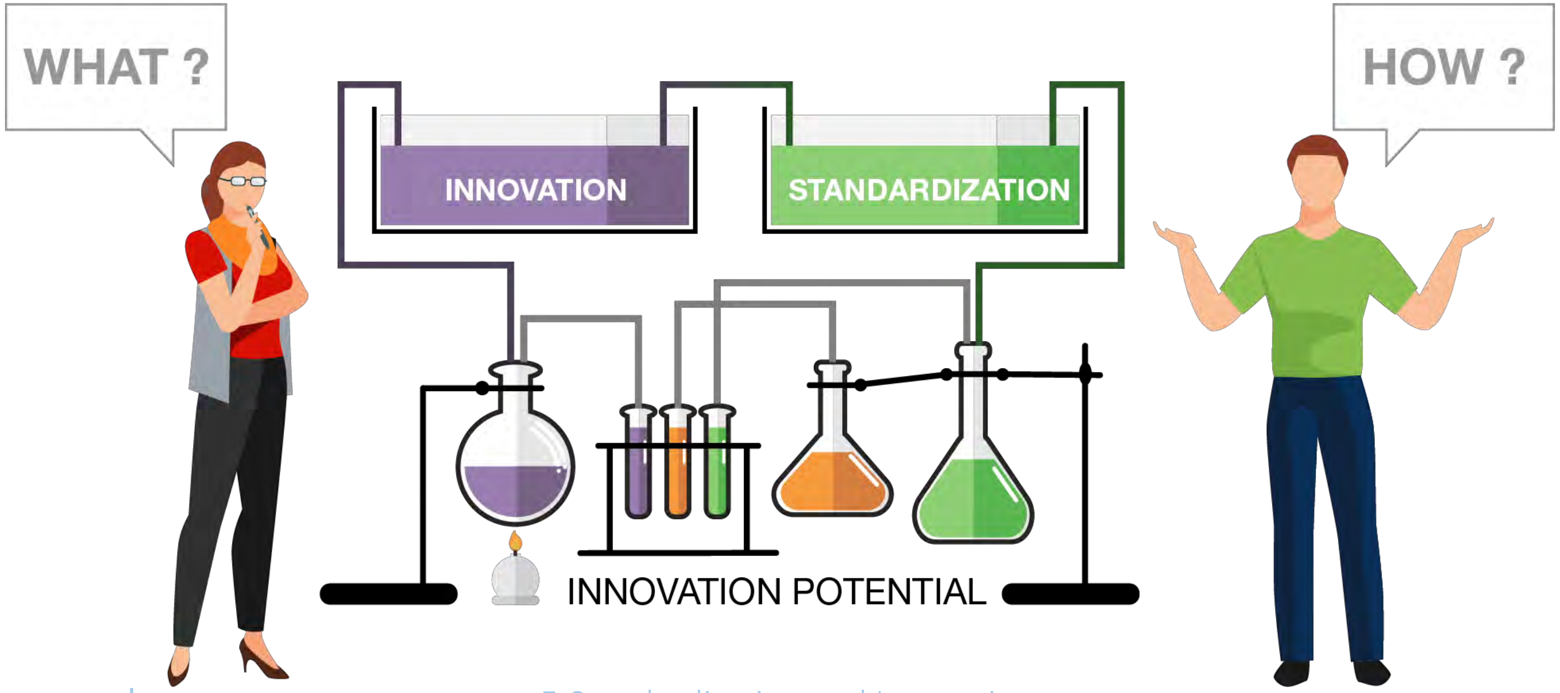
- Critical aspects
  - Currently there is still little awareness of the benefits of standards and standardization among researchers
  - Broad accessibility of standards (in contrast to scientific publications and patents) allows free-riding and has resulted in too few incentives for researchers to engage in standardization
  - Standardization communities often do not acknowledge that expertise from researchers is relevant for the standardization process
  - Time consuming standardization processes may cause delay in the transfer process
- Note, however, that…
  - Patenting processes often take longer than the average standardization process!

Source: Blind (2009 and 2013)

5.3 Formal standardization: A driver for innovation

An introduction

"[…] standardization is an essential part of the microeconomic infrastructure: it enables innovation and acts as a barrier to undesirable outcomes"(Swann 2010, p.9)



5.3 Formal standardization: A driver for innovation
The support of innovation through standardization

- Innovation potentials in standardization

	Opportunities for the support of innovation through standards and standardization	
	Invention-Support…	**Exploitation-Support…**
…through standards	• Exceeding the requirements of standards • Efficient and target-oriented innovation • Stimulating innovation through update of standards and new standards	• Business model innovation (e.g. laboratories)
…through the standardization process	• Stimulating innovation from participation in standardization process (ideas/insight from costumers, competitors and other stakeholders)	• Innovation communication • Absorption of innovation during standardization process

Source: Abdelkafi and Makhotin (2014), p.46

5.3 Formal standardization: A driver for innovation

The support of innovation through standardization

- Innovation potentials in standardization

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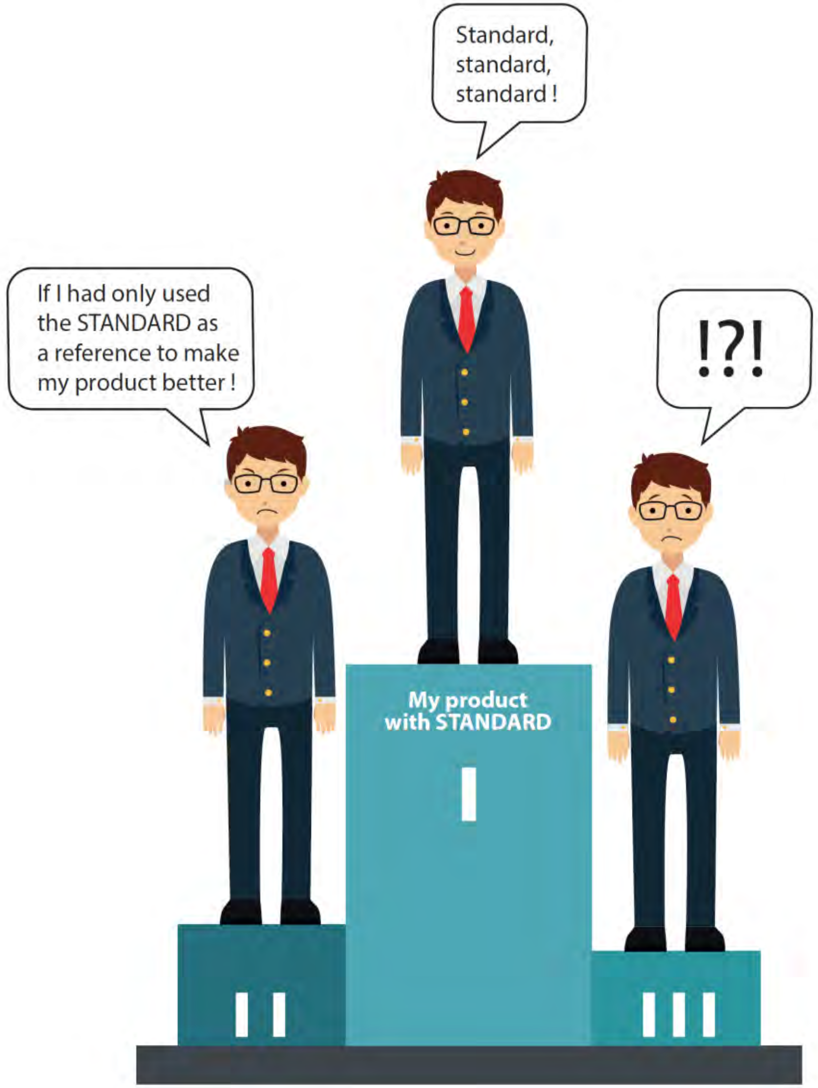
Table title: **Opportunities for the support of innovation through standards and standardization**

Source: Abdelkafi and Makhotin (2014), p.46

5.3 Formal standardization: A driver for innovation

Exceeding the requirements of standards

- Exceeding the requirements of standards
  - Knowing the basic requirements, which are captured by standards, companies are able to develop "out-of-the box" solutions
  - Possible reasons for companies to go beyond the requirements defined by the standards are: special-purpose customer requests, marketing reasons, previous experience or hedging against uncertainties



Source: Abdelkafi and Makhotin (2014)

5.3 Formal standardization: A driver for innovation

Efficient and target-oriented innovation

- Efficient and target-oriented innovation
  - SDO Standards provide a useful framework for the development of new products
  - Standardization increases the effectiveness of R&D activities and enables the transfer of innovations from one sector to another

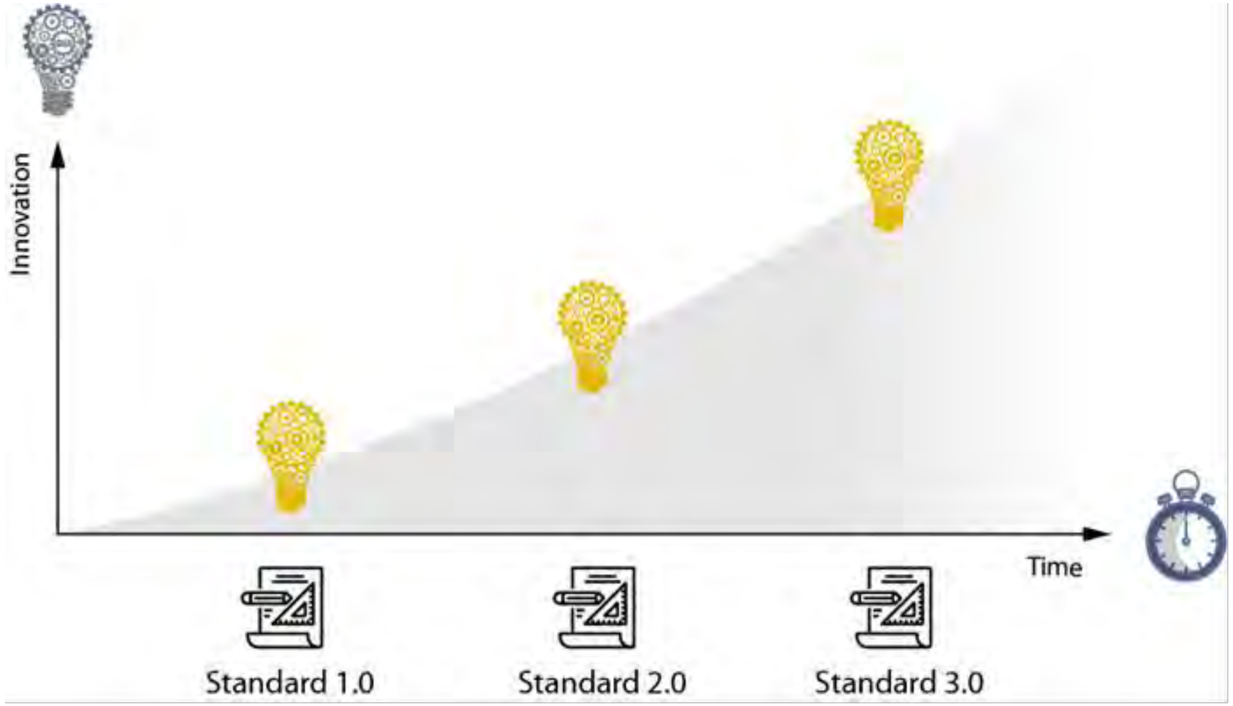
"The set of standards in our enterprise is the basic prerequisite for us in order not to develop products for the trash can." (a security company)

Source: Abdelkafi and Makhotin (2014)

5.3 Formal standardization: A driver for innovation

Stimulating innovation through update of standards and new standards

- Innovation impulses through new and updated standards
  - Innovation impulses result from the update of an existing standard or after introducing a new one. When standards are changed over time, companies are obliged to comply, leading to incremental innovations
  - The updates of standards can be perceived as a burden for the company because of additional development efforts



Source: Abdelkafi and Makhotin (2014)

5.3 Formal standardization: A driver for innovation

The support of innovation through standardization

- Innovation potentials in standardization

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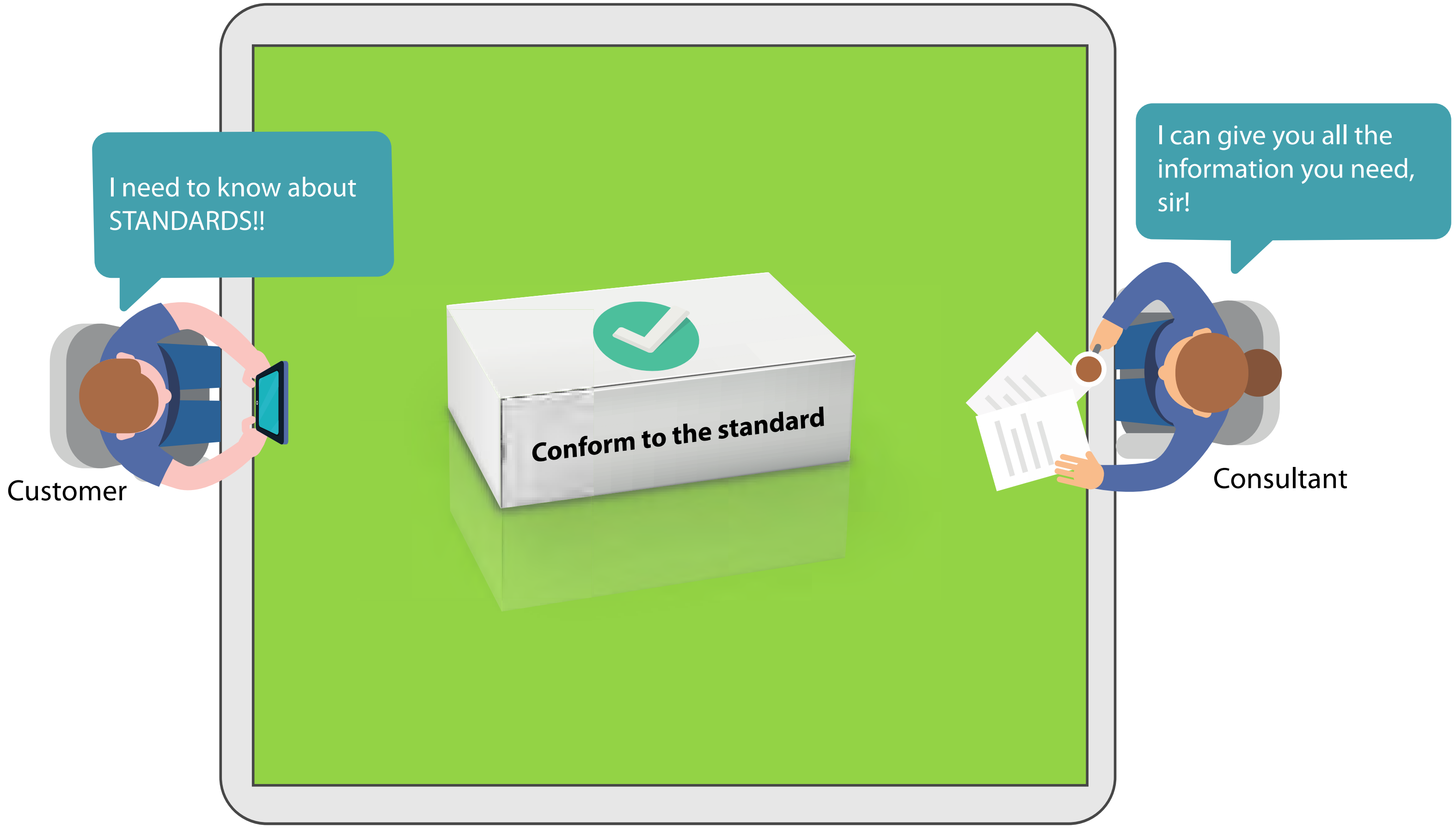
Source: Abdelkafi and Makhotin (2014), p.46

5.3 Formal standardization: A driver for innovation

Business model innovation

- Business model innovation
  - Standards can lead to new business models, such as test labs, consulting firms, and certification organizations



Source: Abdelkafi and Makhotin (2014)

5.3 Formal standardization: A driver for innovation
The support of innovation through standardization

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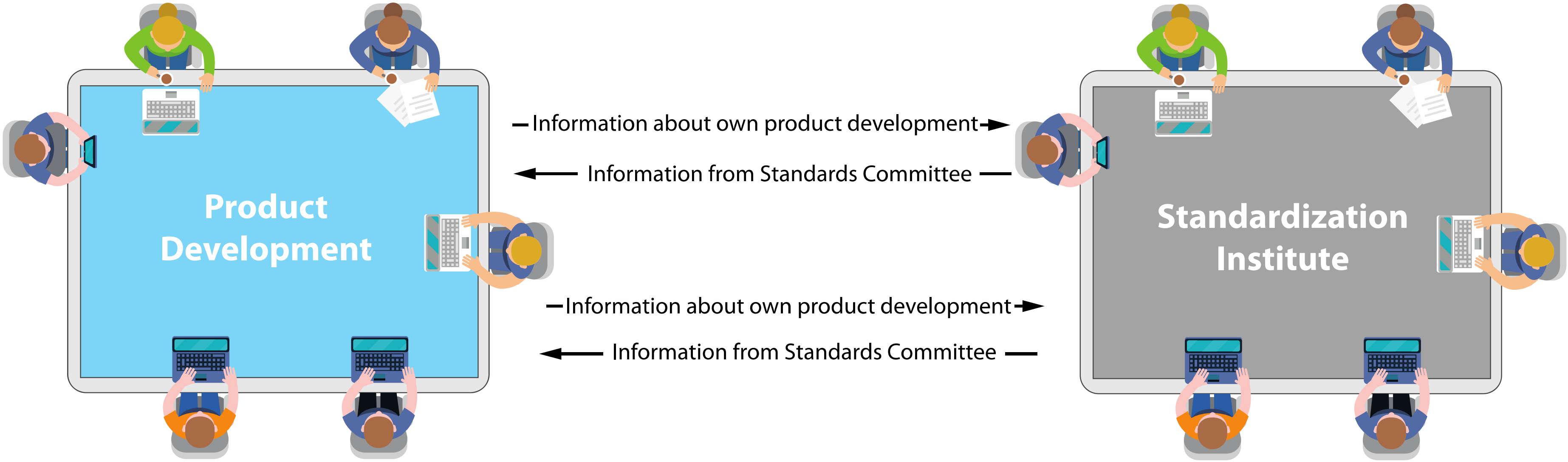
Source: Abdelkafi and Makhotin (2014), p.46

5.3 Formal standardization: A driver for innovation

Stimulating innovation from participation in standardization process

- Stimulating innovation through participation in standardization
  - Companies can achieve a competitive advantage (differentiation), depending on how well and how quickly they can fulfil the requirements of a new standard
  - Standardization creates opportunities for the development of differentiated products:
    - Synchronizing the company’s R&D process with the standard development process
    - Differentiation through the development of customer-tailored standards portfolios



Source: Abdelkafi and Makhotin (2014)

5.3 Formal standardization: A driver for innovation

The support of innovation through standardization

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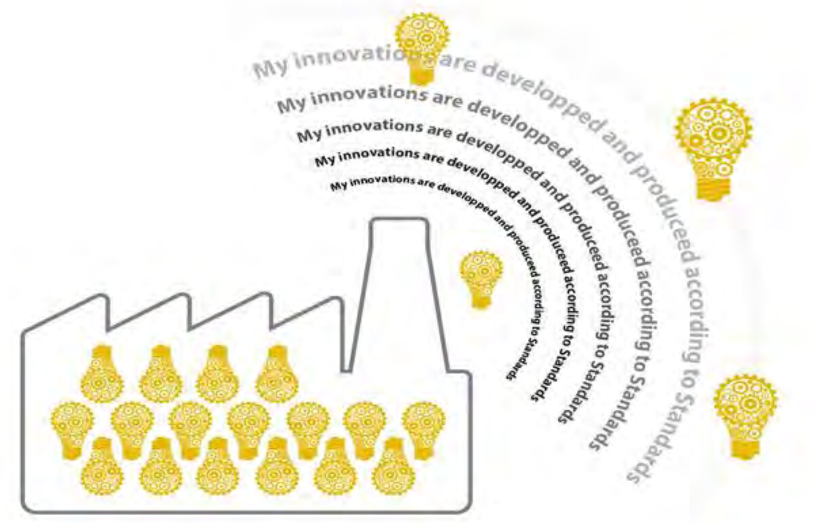
Source: Abdelkafi and Makhotin (2014), p.46

- Innovation communication
  - Companies that participate in standard setting processes signal know-how and high competence to the outside, which is especially important in B2B field
  - Innovation communication with standards helps companies to build trust with their clients especially in areas with rapid technology development

> *"We inform our customers about our activities in the standard setting process. So they know what we are doing. They are quite happy to receive this up-to-date information." (Nanotechnology company)*

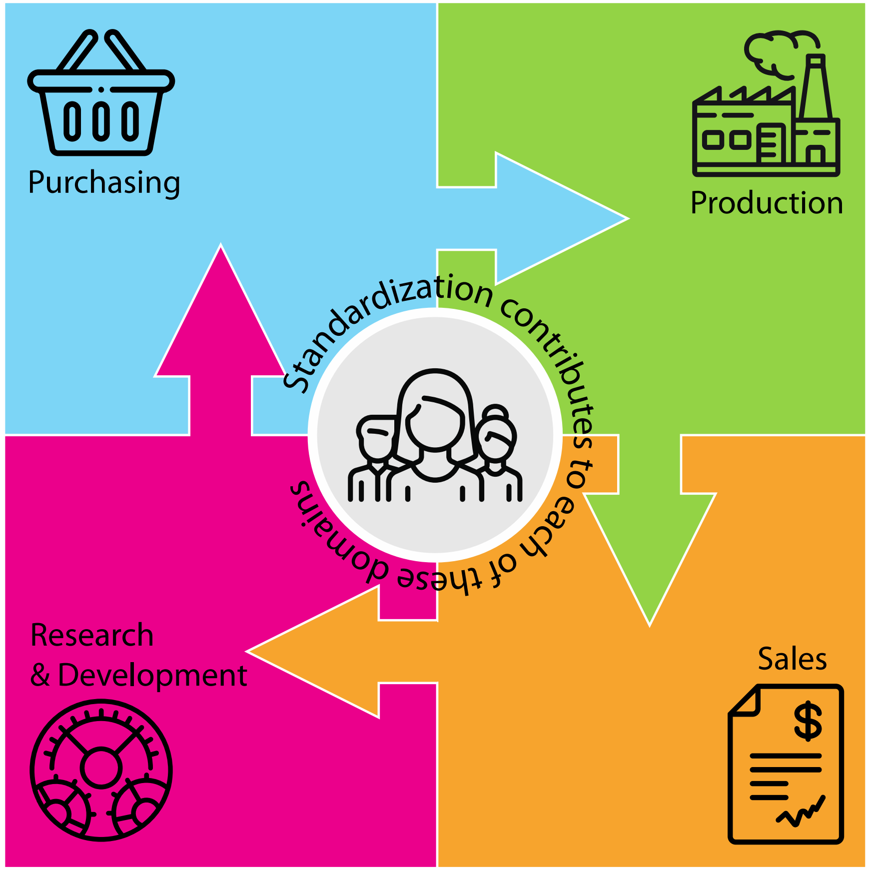


Source: Abdelkafi and Makhotin (2014)

Absorption of innovation

- Absorption of innovation
  - Standardization supports the ability of companies to transfer and apply novel and useful external knowledge. The participation in standards setting process is crucial for the achievement of this innovation potential

> *“Not only the development of standards was important, but also we were able to identify new application areas for our products. That’s what was interesting in those discussions.” (Security)*



Source: Abdelkafi and Makhotin (2014)

List of abbreviations: Chapter 5

- B2B: Business-to-Business
- DAB: Digital Audio Broadcast
- DIN: German Institute for Standardization
- Fraunhofer IIS: Fraunhofer Institute for Integrated Circuits
- GSM: Groupe Spécial Mobile—Global System for Mobile communications
- IEEE: Institute or Electrical and Electronics Engineers
- ISDN: Integrated Services Digital Network
- ISO: International Standardization Organization
- ITU: International Telecommunication Union
- MPEG: Moving Picture Expert Group
- MP3: MPEG-1 Audio Layer III
- NPO: Non-Profit-Organization
- NTF: New-To-the-Firm
- NTM: New-To-the-Market
- NTW: New-To-the-World
- OECD: Organisation for Economic Co-operation and Development
- R&D: Research and Development
- SDO: Standards Development Organization
- SIG: (Bluetooth) Special Interest Group
- SSL: Secure Sockets Layer
- TLC: Technology Life Cycle
- TLS: Transport Layer Security
- TRIZ: A Theory of inventive Problem Solving
- UMTS: Universal Mobile Telecommunications System

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6 A Strategic Perspective on Standardization

Contents

6 A strategic perspective on standardization

6.1 Introduction

- This chapter looks at participation in standardization from the point of view of an organization interested in getting involved in standardization.
- It looks at different strategies for participation, at the choice of which standards organization to join, and at more technical aspects of standardization, including implementation.
- Addressed is also the operation of standardization efforts and SDOs, including voting, and the impact of external influences.
- The organization’s internal communication aspects are discussed.
- Finally, guidance on how to select standards is discussed.

6.2 Different strategies of participation
Organizational strategies

- Organizations can be classified according to which role they play in the standardization ecosystem, using here a classification according to Corporate Strategic Standardization Management (SSM).

Leader	Contributor	Follower	Spectator
-Participation in standards-setting activity is business critical	-Active participation in standardization process -Less interested in influencing strategic direction of an SSO	-Full membership privileges wanted -Not interested in influencing strategic direction	-Main motivation: intelligence gathering -No active contribution to creation of a standard

- The role that standardization plays for the organization is a function of how important standardization and/or presence in standardization is for the overall, primarily business strategy.

Source: Jakobs (2014) Table I. Linking organizational strategies and approaches to standardization

6.2 Different strategies of participation
Organizational strategies

- An organization may have a differentiated approach and may participate in different domains with different objectives:
    - the protection of its business interest,
    - early warning for technological and market developments,
    - promotion of IPR and internal as well as proprietary standards,
    - avoiding duplication between countries or continents, etc.

- This means different roles may be taken, leader in one domain, spectator in another, etc. This may lead to issues of perception: e.g. an organization might be expected to be also a leader in other domains.

6.2 Different strategies of participation
Organizational strategies

- The business strategy is supported by a set of technology strategies.
- The standardization strategy of an organization is therefore driven by both the business strategy itself and by the derived technology strategies.
- To understand the standardization strategy of an organization, it is at least useful to know and understand also its supporting technology strategies.

6.2 Different strategies of participation
Technical focus

- Where and how to participate will be a function of the technical needs and priorities of an organization.
- Priority will certainly go to standardization topics related to the core activities of the organization.
- However, market and development of these core activities may depend on infrastructure (telecom and non-telecom) and of related activities such as privacy and security requirements.
- Therefore, the organization may decide to be present as well in domains of activity related to, but outside its core activities.

6.2 Different strategies of participation
Technical focus

- A simplified, non exhaustive overview of the ICT standardization ecosystem

ORGANIZATION	TYPICAL TECHNICAL FOCUS OF ICT ACTIVITY
ITU	Interoperable telecom specifications incl. architecture, services protocols, addressing/numbering plans.
ISO	ICT, architecture, services and protocols, incl. application protocols
IEC	Electrotechnical standards, incl. connectors and electrical safety, EMC and tests.
JTC1	ICT, architecture, services and protocols, incl. application protocols
ETSI	ICT, interoperable telecom specifications, incl. architecture, services and protocols and tests
CEN	ICT, architecture, services and protocols, incl. application protocols.
CENELEC	Electrotechnical standards, incl. connectors and electrical safety, EMC and tests.
CEN/CENELEC	ICT architecture (OSI model) services and protocols, incl. application protocols.
IEEE	A wide range of technical and electrotechnical domains, incl. LAN and MAN specifications, addressing rules (IP, URL), AI, IoT, automotive, robotics, home automation, etc.
IETF	All Internet related specifications, incl. protocols, generic applications, addressing rules (IP, URL).
ECMA International	Media specifications, ICT specifications fed into ETSI, ISO/IEC, IEEE, etc.
3GPP	Develop technical specifications for the 3rd generation of mobile, cellular telecommunications, UMTS, LTE and 5G
OneM2M	Global community that develops IoT standards to enable interoperable, secure, and simple-to-deploy services for the IoT ecosystem.

6.2 Different strategies of participation
Localizations and relations between SDOs

- In deciding in which SDOs to participate, the interrelations between the SDOs, and the status of an SDO with respect to public authorities, may play an important role.
- The geographical location,
  - in which continent, and where meetings take place also plays a role in the decision.
  - may create complications, as it may not coincide with the organization’s geographic organization.
- standards organizations typically are Non-Governmental Organizations (NGO), association without profit objectives
- Exception is the ITU, now a United Nations organization.

6.2 Different strategies of participation
Localizations and relations between SDOs

- A simplified classification of SDOs by geographical scope and technical domain

Organization	type	headquarters	recognition	domain of activity	members	Standards 'feeding'
ITU	UN	Geneva (CH)	UN	Telecom + RF spectrum	National delegations	> JTC1
ISO	NGO	Geneva (CH)	Multi-national	ICT	National delegations	> ITU
IEC	NGO	Geneva (CH)	Multi-national	electrotechnical	National delegations	(> ITU)
JTC 1	NGO	Geneva (CH)	Multi-national	joint comm. ISO + IEC	National delegations	> ITU
ETSI	NGO	Sophia Ant (FR)	Multi-nat. / EU	Telecom	Organizations	> ITU
CEN	NGO	Brussels (BE)	Multi-nat. / EU	ICT	National delegations	> ISO
CENELEC	NGO	Brussels (BE)	Multi-nat. / EU	electrotechnical	National delegations	> IEC
CEN/CENELEC	NGO	Brussels (BE)	Multi-nat. / EU	joint comm. CEN + CLC	National delegations	> ISO + IEC
IEEE	NGO	New York (US)	de-facto	ICT + electrotechnical	Individuals	> ISO
IETF	NGO	Fremont (US)	de-facto	ICT ('internet')	Individuals	(> ITU + ISO)
Ecma international	NGO	Geneva (CH)	de-facto	ICT	Organizations	> ISO

6.2 Different strategies of participation
Technology strategies

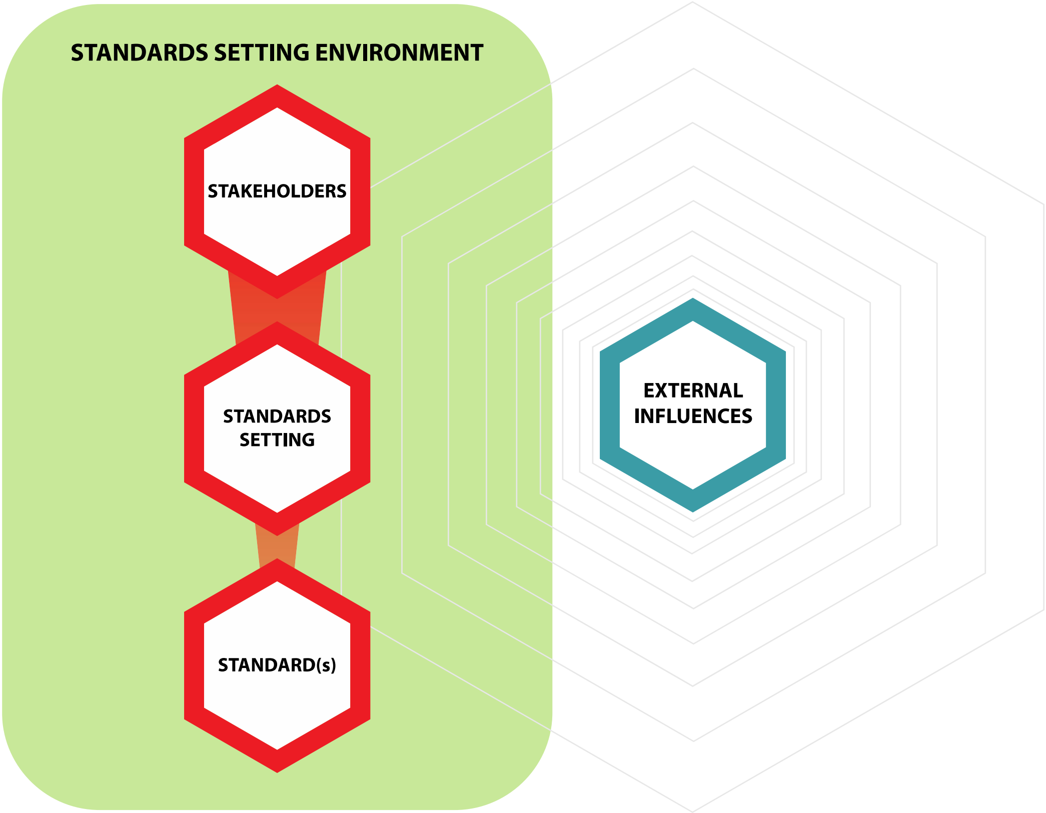
- Apart from showing presence, there are also technology related considerations for participation:
  - The “radar” function: a view on technologies and applications that may become important in the future.
  - The activity of others, as indication of R&D activity, location, priority and importance of developments.
  - It may be used for activities towards the formation of consortia, interest groups, fora, etc.
  - It may help promote ideas and solutions, including IPR.
  - It may incite dialogue with public authorities, giving a preview on public support, measures and concerns.

6.2 Different strategies of participation
Technology strategies

- Organizations may decide to be active also in standardization activities that are not corresponding to their core activities.
- It then is then likely that these organizations do not have the same level of competences in these domains, and therefore may have more limited possibilities to contribute.
- An organization leading in a domain may take an active role in new developments, or it may take a defensive role. It might not look favourably at standardization activities which might result in competition for standards in which it has invested.

6.3 Modalities and external influences
Impacts on the standardization process

- Factors and boundary conditions that have an impact on the standardization process:



Source: Jakobs (2014) Fig.1. A very simple view of what influences a standard

6.3 Modalities and external influences
Managing the relationship of standardization and market

- There is a strong interrelation between standardization, technical development and market development
- Managing the relationship with technical development
  - is challenging, needs to take into consideration as far as possible market trends, developments and market forces,
  - requires deep insight and assessment of technology developments, industrial applicability and maturity.
- Assessing the relation with market trends and developments is difficult, uncertainties include ‘unknown unknowns’, including unexpected competition developing between different technologies.

6.3 Modalities and external influences
Managing cooperation

- Standardization is a competitive domain, but requires cooperation to arrive at results:
  - active cooperation (may go together with conflicts)
  - passive cooperation
- Passive cooperation may be a pragmatic and ‘honourable’ approach, it does not, however, give an indication of commitment for adoption of the results, and does not prevent standards proliferation (‘you have your standard, I have my standard’).

6.3 Modalities and external influences
Managing synchronization

- Standardization may be considered leading, in sync or following developments, including:
  - Technological developments and technology trends
  - Market and value chain ordering
  - Market push and pull
  - Societal trends and developments
  - Legal and regulatory environment

- **Leading**, i.e. early standardization, not all issues understood
- **In sync**, i.e. ‘just in time’ needs agility of the process
- **Following** developments, i.e. ‘late’ standardization.

6.3 Modalities and external influences
Managing synchronization

- An analysis on these principles can be made by taking GSM as an example. GSM consists of a rather complex system of a range of functions. This evaluation is based on what one knows now, roughly 30 years after the development (ex post).
  - Leading, and therefore rather anticipatory: data services and roaming (limited data rates, limited roaming expected.
  - In sync, and therefore enabling: the cellular organization, including hand-over etc.
  - Following, in the sense of adopting elements of dominant design and existing standards, the 64kbit/s channels (coding techniques had advanced allowing e.g. 8 Kbit/s channel structure.

6.3 Modalities and external influences
Voting and voting rules

- Different organizations have different voting rules; possibilities include:
  - weighted voting, based on category, size, etc.; example: ETSI, CEN/CENELEC
  - Individual expert vote, based on regular attendance; examples: IEEE802, IETF

- In ETSI, the issue of a possible imbalance between the total votes of different categories of members has been raised. Large organizations represented by delegations from different countries accumulate significant amounts of weighted, revenue-linked voting rights. However, the strong use of consensus in ETSI's technical work avoids voting in the vast majority of work.

6.3 Modalities and external influences
Voting and voting rules

- Also the interest of an SDO as an organization may play a role in standardization:
  - The organization, i.e. its secretariat and governance entities, likely have a role in relations with members, other SDOs and with public authorities
  - The organization's interest may be reason to accept or reject proposals for new standardization
  - The organization's interest might play a role in the voting.

- Public authorities address their communications mainly to an SDO as an organization; e.g. the EC, as a customer and as a sponsor, addresses its communications first of all to the ETSI and CEN/CENELEC secretariats.

6.3 Modalities and external influences
‘Backdoor policy’

- The “backdoor policy” means that a group of stakeholders decide to switch to another SDO when a first choice SDO is not favourable to undertake or accept a new standardization activity. This brings with it opportunities and issues:
  - It circumvents blockage of new or different approaches
  - It carries with it the risk of duplication of effort and standards proliferation

- Ecma International has played a role as alternative standards route, e.g. standards for ‘private telecom’ such as X.25 and ISDN found an alternative to restrictive public SDOs.

6.3 Modalities and external influences
Standards portfolio management / Technology development

- Ideally standardization takes place ‘just in time’ or better ‘in sync’, i.e. when technological development and market requirements have necessarily arrived at a complementary and supportive level of expected maturity.
- This is not always achieved, resulting in growing ‘stress’ between the evolving technological state of the art and/or market requirements, and the developed standard.
- It may be considered normal, however, that during the lifetime of a standard such ‘stress’ develops between a standard and technological advances and/or changing market requirements, resulting in standards needing updates and amendments, losing importance or being withdrawn.

6.3 Modalities and external influences
Managing phases of standardization

- As an example, in most Western European countries there is still work ongoing on completing the coverage of the territory with 2G/GSM .
- Operators may be working in parallel on the deployment of 2G, 3G, 4G and soon 5G infrastructure and services.
- Mobile phones need still to support 2G, as it has still the widest coverage.
- Similarly, standardization in 3GPP needs to consider maintenance of 2G and 3G, bug fixes in 4G and requirements for 5G.

6.3 Modalities and external influences
Managing phases of standardization

- Standardization needs to care about the following external aspects of management:
  - Standards need to comply with legal, regulatory and other requirements concerning materials, safety, safe practices, security, etc.
  - Standards need to coexist with existing or parallel developing systems. The concept of coexistence is relatively new and increasingly important, in particular of importance for access to frequency spectrum.
  - Although this may be achieved only partially, standards need to achieve interoperability between different implementations of equipment and services.

6.3 Modalities and external influences
Other activities

- SDOs may be initiated by industry and industry groupings, with other, related activities. They may also be enablers of platforms for related activities, and may take on other roles for the benefit of their members.
- An initiative in ETSI to address concerns of the European Commission regarding the timing and modalities of the introduction of Radio Equipment Directive (RED) is an example of what could be considered a natural consequence of the presence of the stakeholders, and therefore as a natural extension of ETSI's role.

6.4 Communication in standardization activities
Communication inside the organization

- The requirements for senior standardization experts include the right mix of
  - Leadership
  - Technical and/or market vision
  - Technical competence
  - Communicative skills and
  - Negotiation skills

- Meeting all these requirements requires highly skilled and communicative persons with full support from top management. This requires the organization to recruit or train senior standardization experts and give them the means to communicate with all levels of the organization.

6.4 Communication in standardization activities
Communication inside the organization

- Often only a part of these conditions is met, standardization experts may lack some of the critical support needed to fully implement their mission.
- Reason is that structural access to top level persons in a large part of the organization, while being a 'non-resident', requires privileges given to e.g. Vice-Presidents and up.
- An alternative would be for the individual expert, or the standards entity, obtaining wide recognition; however, this leads to incomplete and informal exchange of information.
- The best solution is to have in top management a 'standardization champion'.

6.5 Choosing your standard(s)
The standardization process from an implementation viewpoint

- The ultimate goal of standardization is the implementation of the resulting standards in products and services, for the benefit of users and industry as a whole.
- Excellent examples of successful standardization are the sets of standards for mobile networks 2G, 3G, 4G (with 5G under development). These sets of standards have achieved a wide acceptance in the global markets. Technically, these standards excel in achieving interoperability, as is demonstrated by the almost flawless international roaming capabilities.

6.5 Choosing your standard(s)
What to take in consideration

- Selecting Standards and/or Specifications for my application.
- Since the need for compliance to numerous standards and specifications is increasing, and the perception of the distinction between committee standards and de-facto standards is diminishing, this section gives some practical considerations and steps to select the most suitable set of standards and specifications to adhere to when implementing a given application.
- In some cases, choosing the standards you will need to adhere to may be rather simple. E.g., when the intention is to bring to the market products supporting access to 2G, 3G, 4G networks, the choice is obvious. There is a complete suite of standards and tests available.

6.5 Choosing your standard(s)
What to take in consideration

- Less clear, when e.g. products are aimed at the “smart anything everywhere” market, with a choice between different wireless networks (including ‘LPWANs’ such as LoRa, WAN, Sigfox, Ingenu, in addition to 2G, 3G, 4G or 5G).
- Interest in standards in a specific case may range from
  - compatibility and/or interoperability in procurement,
  - purchasing sub-systems implementing certain standards,
  - developing ‘in-house’ products that need to comply with standards and interoperate with other implementations.
- The issue “development of products that comply with standards” is particularly challenging.

6.5 Choosing your standard(s)
What to take in consideration

- Important criteria that should help organizations in the standards evaluation task:
  - Completeness: is this standard / set of standards all that is needed, or the tip of the iceberg: what other standards are needed to support or complement this standard(s)?
  - Stability: is this standard new, still developing; is it mature, widely adopted and tested; is it aging, may need brought up to date (legacy components, coexistence and interoperability with more recent systems)'; is there an installed base, what is the influence (stability, inertia)?
  - Maintenance: is maintenance of the standards ensured; are there other mechanisms to learn about issues, workarounds, and de-facto reference implementations?

6.5 Choosing your standard(s)
What to take in consideration

- Interoperability and conformance: are good conformance tests and test facilities available; required level of interoperability; what is the scope of the interoperability: some functions, a subset, all functions; is interoperability required with the standard or a dominant implementation; are good interoperability tests and test facilities available; what level of interoperability is on requires the market?
- If implementation of the standard(s) is targeted, then interoperability is of key importance. Interoperability is often achieved only partially. Conformance is a prerequisite for, but not a sufficient condition for interoperability. The complementary ‘plugtest’ testing is very useful addition, but does not guarantee either.

6.5 Choosing your standard(s)
Supporting standard ‘X’, and now?

- The next step in the evaluation process would be to attribute a weight to these parameters, that may range from less important to a condition sine qua non.

- After making a choice, you implement a specific set of standards and specifications. This choice, but equally the results of the detailed evaluation that led to his choice, may influence your position: you are now a stakeholder with an interest in a specific standard ‘X’.

- For example, your interest may now be increased involvement, supporting, improving or completing the selected standard(s) and specifications, adding or improving interoperability tests and testing, etc.

6.5 Choosing your standard(s)

If one cannot find a suitable set of standards / specifications?

- If, after your internal evaluation, you cannot come up with a suitable set of standards or specifications, it is recommended that you consult with your partners (suppliers, customers, competitors). If the subject appears suitable for an existing SDO, then bring your request to the most suitable SDO.
- If the subject appears less suitable for an existing SDO, then consider bringing it to a suitable industry forum.
- If the subject does not appear to fit anywhere, then consider setting up your own forum, together with partners. An industry specification could later gain the status of a "public available specification". It could also become a committee standard, if the interest spreads more widely.

6.6 Summary

- In this chapter, participation in standardization is dealt with from the point of view of an interested organization.
- It examined how to choose a standards organization, SDO, to participate in, as a function of activities and location.
- It also addressed the operation of standardization efforts and organizations, including voting systems and rights, and external influences. Important external influences are market trends and developments, and technological development.
- As presented, participation in standardization requires internal and external communication within an organization.
- Finally, the chapter discussed some considerations that help evaluate and choose standards for a certain application.

List of abbreviations: Chapter 6

- SDO: Standards Development Organization
- SSM: (Corporate) Strategic Standardization Management
- ISO: International Organization for Standardization
- IEC: International Electrotechnical Commission
- JTC 1: Joint Technical Committee 1 (an ISO/IEC joint technical committee)

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7 IPR and standardization

Contents

Chapter 7: IPR and standardisation

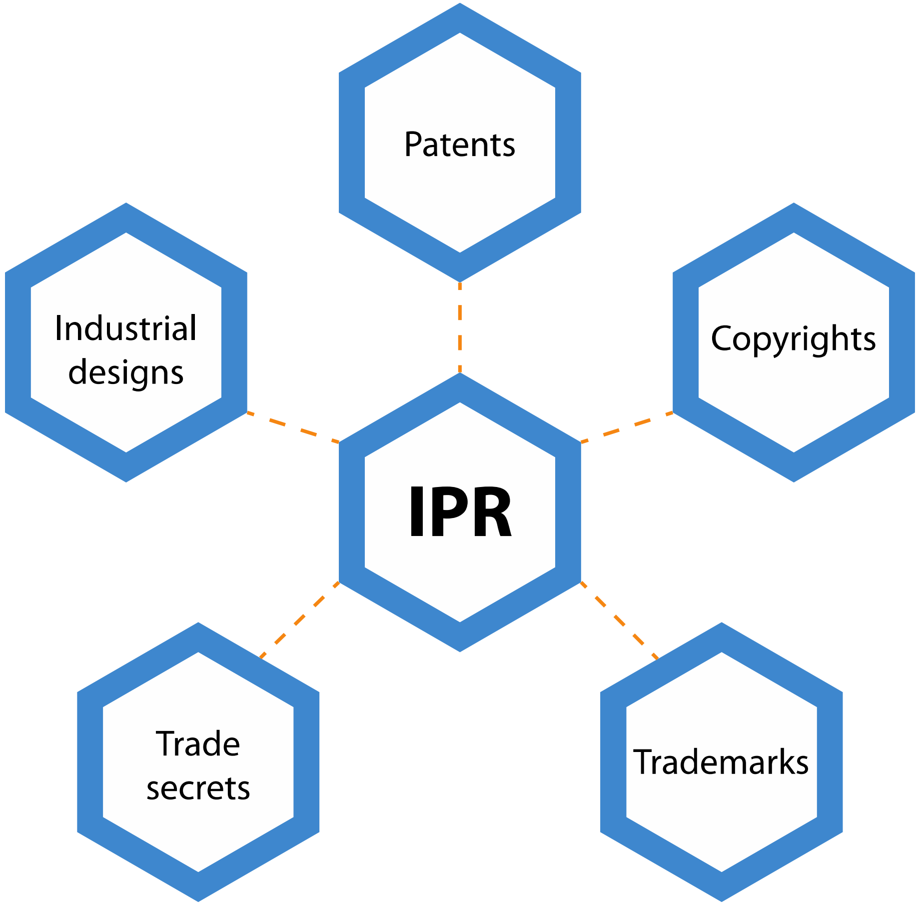
7.1 Introduction

- In standardization, various participants bring innovative ideas
  - Yet, innovative ideas may be subject to intellectual property rights (IPRs)
    - Many standardization participants are indeed very active in applying for IPRs
  - This may limit the usage of these ideas (e.g. implementation in devices)
  - For this reason, it is important to have a good understanding of the interplay between IPRs and standards

Note: This contribution is intended to be a laymen's personal introduction into the topic of IPRs and standards. It is by no means intended to provide legal guidance or to provide an interpretation of the IPR policies of ETSI or any other standard body. When dealing with standards and IPR, any party should consider the appropriate law and the applicable IPR policies of standards bodies and consult legal counsel where appropriate.

7.2 IPRs and its different forms

- Laws for the protection of intellectual property exist in virtually any country around the world
- Countries have laws to protect intellectual property for several reasons:
  - They give expression to the moral and economic rights of creators
  - they can promote creativity and the dissemination and application of its results, and encourage fair trading contributing to economic and social development
- Just as creations by humans can take many different forms, there are different types of intellectual property rights that protect these creations



7.2 IPRs and its different forms

- The most common types of IPRs are:

Type of IPR	Description	Examples
Patent	Protects solutions to a specific technological problem, that is, an invention	A way to encode information on a radio carrier
Copyright	Protects creative expressions	Texts, books, music, movies, works, of art, but also software code
Industrial design	Protects the visual design of “utilitarian” objects, including their shape, configuration or composition of pattern or colour	A specific type of chair, or a car design
Trademark	Protects words, signs or symbols that represents a company or products	The word “Nike”, the "Just do it" tagline and the wing-like symbol
Trade secret	A piece of information (invention, formula, etc.) not known to the public, used for economic benefit by a holder that makes efforts to maintain its secrecy	The Coca-Cola formula, and Google's search algorithm

Note: a trade secret is not a ‘right’ like the other items in this list and may be better described as ‘IP’ than as ‘IPR’

7.2 IPRs and its different forms

- But what does it mean to own an IPR?
  - An IPR provides its owner with the right to exclude others from making use of the creation
  - It may do several things with this right:
    - Keep the creation to itself
    - Allow others to use the creation, for instance for monetary compensation (by offering a license)
  - The rights conferred by IPRs are temporary (e.g. patents last 20 years, and copyrights at least 50 years after the death of the author)

- While an IPR allows the holder to exclude others, it does not offer the **right** to use the creation: it is well possible that using a patented invention also requires the use of inventions that were already patented by other organizations or individuals
  - In such a case, a license from these others is needed

7.3 Ways in which IPRs can be relevant to standards and standardization

- IPRs can be relevant to standards and standardisation in different ways:
  - 1. Standards are text documents, and the question of copyright arises
  - 2. Standards are often known by a name and associated with certain logos (or symbols or emblems, think of GSM, Wi-Fi, Bluetooth and CD)
    - Often, the SDO will be copyright owner of the name
    - But not always: the well-known ‘GSM’ logo is owned by the GSM Association (GSMA), and the trademark ‘Wi-Fi’, is owned by the Wi-Fi Alliance
  - 3. The implementation of a standard into a product or service may require the use of certain intellectual property rights
    - May require patented inventions
    - May require mandatory software code

further focus of this chapter

7.4 The tension between patents and standards

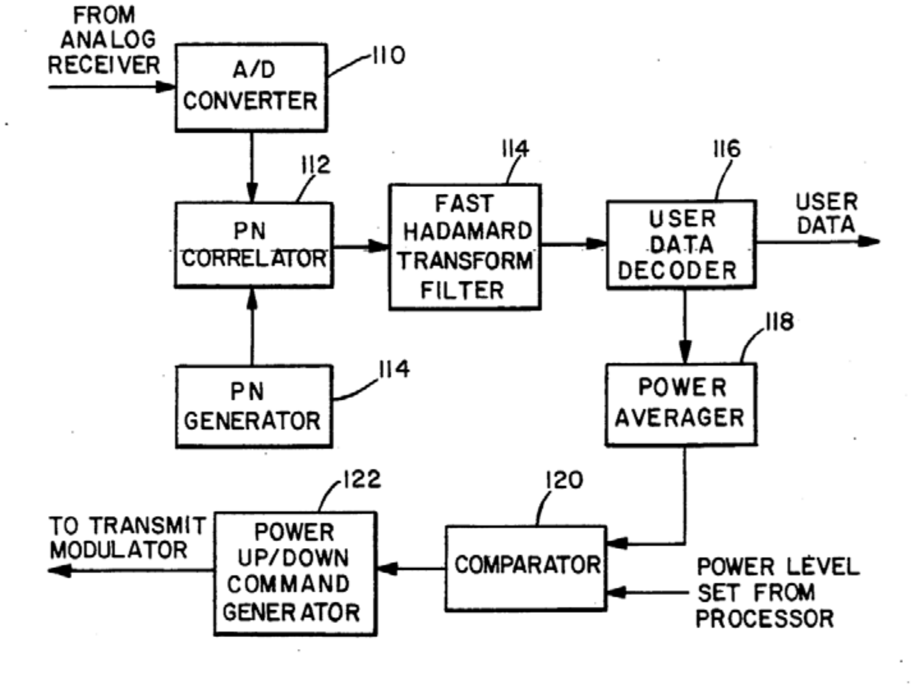
- The patent system and the standardisation system are both institutionalized to serve the public benefit
- Yet, they have an uneasy relationship, which creates tension and calls out for thoughtful considerations and policy
  - Underlying reason: patents aim to promote innovation by granting temporary rights to exclude others from using technological innovations, whereas standards aim to promote innovation by an endeavour to make technical solutions available to all interested parties without any undue barriers
- This tension specifically pronounced for so-called Standard Essential Patents (SEPs)

7.4 The tension between patents and standards

- Basic concept of a SEP: **without the use of the technology protected by that patent, it is impossible to make a product that satisfies the standard**
  - That means that, without having obtained a permission (a license) to use the patented technology (or being the owner of that patent itself), an implementor cannot make or sell a product that complies with the standard
  - Whereas in ‘normal’ circumstances, an implementer can choose not to implement a certain feature in a product if it cannot obtain the necessary licenses, or ‘invent around’ to create a similar feature using a technology different from the one that is patented in the case of a SEP both approaches are, by definition, not possible, since implementing the standard requires the use of the SEP
  - This creates a particularly strong position for the patent owner
  - If a standard is covered by many SEPs, then each implementer must obtain licenses for each of these SEPs – insofar relevant for the product in question

7.4 The tension between patents and standards

Patent that may well be a SEP:



Patent that is not a SEP:

(but may nevertheless be valuable!)

7.4 The tension between patents and standards

- Q: How many SEPs are there?   A: Nobody knows
  - Many SDO policies require participants to disclose information on patents that are potentially essential. A recent study for the European Commission showed that per February 2019, parties declared around 260,000 patents as potentially essential for ETSI standards, which can be grouped into slightly over 25,000 patent families
    - Patent families group patents on the same invention but applied for in different countries
  - Yet, a potential SEP is not a factual SEP
    - At the time of such a declaration, the precise content of the final standard is not yet known, and the technology in the declared patent may eventually not be included in the standard at all. Furthermore, by the time of such declaration, the ultimate scope of the patent may not be yet known either – this only becomes known at the moment when that patent is actually granted (or granted at all)
  - In 2017, the European Commission announced it wants to increase transparency in this field, and noted that it is desirable that information on factual essentiality would be available to market players

Note: for references, see the textbook

7.4 The tension between patents and standards

- While patented technology can bring innovative and valuable solutions into a standard, the inclusions of this technology can also raise a number of concerns

NON-AVAILABILITY OF LICENCES	SDOs and their participants, after having finalized and published a standard, find out that one or more owners of essential patents are not willing to license these
EX POST PATENT HOLD-UP	SEP owners, aware of the fact that implementers have no choice other than obtaining a license from them, use the resulting bargaining power to demand a significantly higher licensing fee than they could have obtained in a licensing negotiation where implementers were not yet ‘locked into’ the standard
ROYALTY STACKING	The total amount of royalties for a single product that implements that standard mounts up to such a level that the product is no longer commercially viable
UNDUE DISCRIMINATION	This refers to the situation where a SEP owner treats implementers differently

7.5 IPR policies at SDOs

- SDOs have already been long aware of the difficult relationship between patents and standards
    - For ANSI of the US, this goes back to the 1930s
    - Yet, it took until the 1980s and 1990s before intensive discussion started at almost all large SDOs to adopt IPR policies
    - Each SDO had its own discussion and made its own choice in terms of the policy it adopted, matching its objectives, its specific technical context, and its culture

7.5 IPR policies at SDOs

- SDO IPR policies can be broadly categorized into two main categories:

Policy type	Description	Examples
COMMITMENT-BASED POLICIES	(A) Members have the obligation to inform ('disclose', 'declare') the SDO when they believe they own patents that may be or may become essential to a standard. (B) Owner of disclosed patents are requested to commit to making licenses for these patents available specified conditions, if the patent indeed becomes essential	ISO, IEC, ITU, ETSI and IEEE
PARTICIPATION-BASED POLICIES	As is a condition of membership, all members of the SDO must be willing to license all their essential patents at specified conditions, if the patent indeed becomes essential. Opt-out possibilities may exist	W3C, HDMI Forum

- If a commitment is missing, the SDO will seek to develop a standard not requiring the patent
- Examples of specified conditions:
  - Fair, Reasonable and Non-Discriminatory (FRAND, sometimes referred to just as RAND)
  - "Royalty Free"

7.6 IPR, standards, and the legal system

- How can one be sure that a party respects the commitments it made to an SDO in terms of licensing essential patents, or respected other obligations related to standards and IPR, such as disclosure obligations?

- While SDOs seek to have licensing commitments in place for (potentially) essential patents, they usually do not see it as their role to enforce such commitments

- Instead, if parties themselves fail to successfully conclude licensing agreements, then national courts of law have the authority to resolve such IPR disputes

7.6 IPR, standards, and the legal system

- When parties to turn to the legal system (courts), three bodies of law are relevant here:
  - Patent law
    - is relevant here because it is this body of law that allows a patent holder to prevent others from making, using, selling, or importing the patented invention without permission
  - Private law
    - is relevant because it governs contracts and other relationships between companies and other parties
  - Competition/antitrust law
    - is important because it places restrictions on the conduct of parties (or groups of parties) that have a dominant market position

- There have been quite some court cases on SEPs. Landmark cases include Microsoft vs. Motorola (2013), In re Innovatio (2013), TCL v Ericsson (2017), and Huawei/ZTE (2015)

7.6 IPR, standards, and the legal system

- Wat explains the large number of legal conflicts on SEPs in the last decades?
  - The number of patents essential to standards has increased a lot over the years as well as the number of different owners of these patents
  - Essential patents are traded a lot, including acquisitions by new owners that have a strategy, in which patent assertion (i.e. accusing others of patent infringement) or litigation (i.e. patent court cases) plays a major role
  - Standards are becoming more relevant for a wide variety of markets, which also brings together parties that have very different business cultures, expectations, etc.
  - The relevant markets often have very considerable commercial interest, markets are subject to strong market dynamics
    - For instance, in mobile phone / smartphone market, Nokia, once market leader in mobile phones, later saw its market share diminishing and eventually left that market, while new parties (Blackberry, Samsung, Apple) have entered that market segment and have become very successful

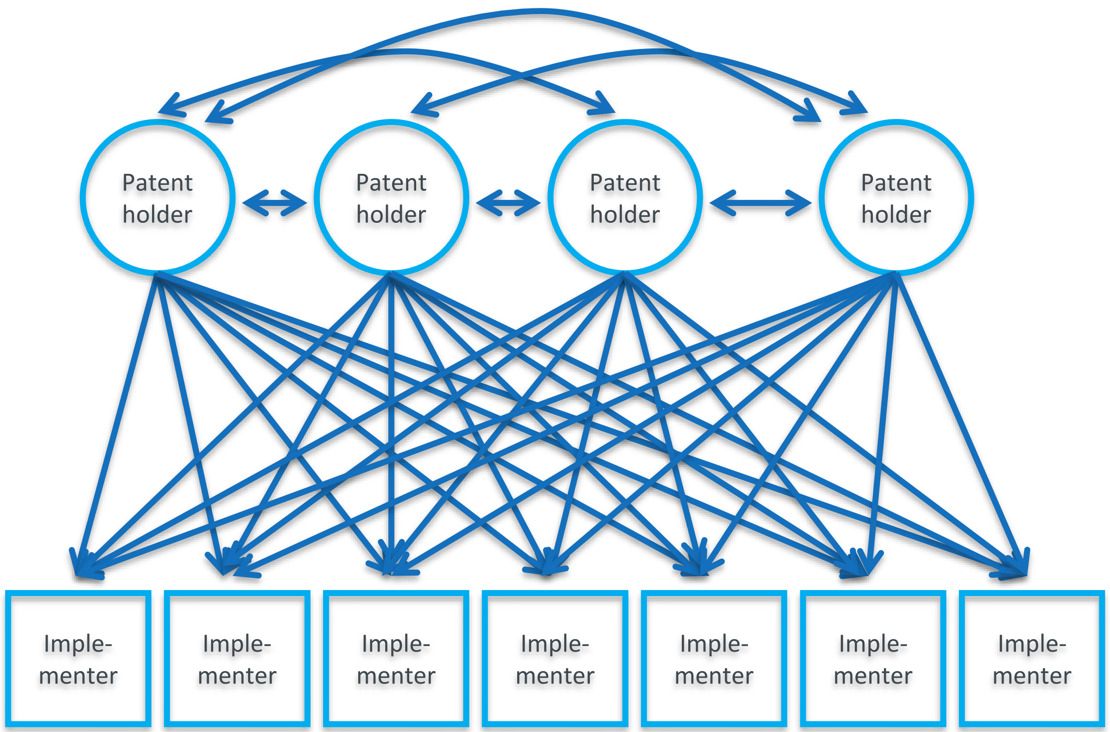
7.7 Patent pools

- For many standards, there are many SEP owners as well as many implementers
- As a consequence, an large amount of bilateral licenses needs to be conducted
- Recognizing such inefficiencies, patent owners started to experiment in the 1980s with joint licensing programs for technical standards, now known as patent pools
  - While not easy to set up, a large, successful pool requires much fewer licensing agreements (see next slide) which reduces transaction costs
- In standards-based pools, the pooled patents are available to licensors participating in the pool, as well as to external licensees. The licensees are offered standard licensing terms, typically with a menu of “patent packages” relevant for specific product categories
- Many pools have a high degree of transparency, and the licensing fees, pooled patents, lists of licensors and list of signed-up licensees can be found on their websites

7.7 Patent pools

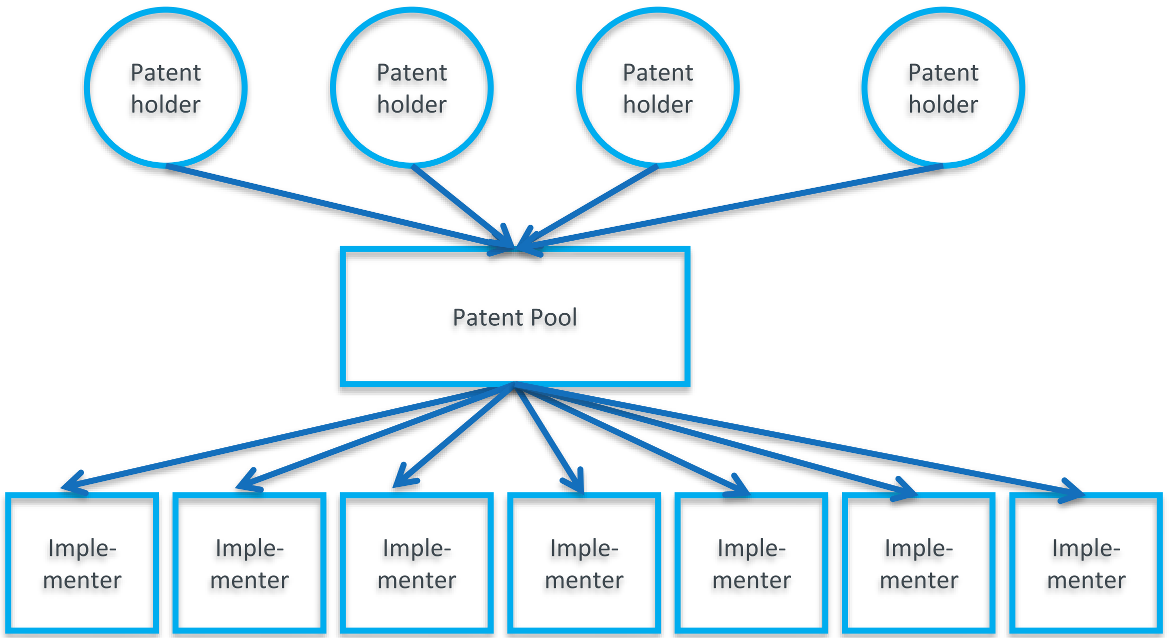
No pool

(34 licensing agreements needed)



Patent pool

(11 licensing agreements needed)



7.7 Patent pools

- Pools bring along significant advantages for both implementers and patent owners:

Advantages for (prospective) licensees	Advantages for participating patent owners
• Provide a one-stop shop for access to patent licenses • Lower transaction costs and (usually) a discounted licensing fee compared to multiple individual licenses • Create a level playing field (fewer competitors that do not pay royalty fees) • Reduce uncertainty, increase transparency	• Helps to promote the overall adoption and success of the technology • Lower transaction costs • May lead to higher profits because of more efficient licensing and royalty collection

7.7 Patent pools

- Patent pools also attracted the attention of authorities; after all, a group of SEP owners can easily have a dominant position. Competition/antitrust stipulates that such a position may not be abused

- At the same time, pools have many pro-competitive elements and generally, competition/antitrust regulators looked favourably at pools
  - Their precise assessment depends on the exact design of the pool under investigation
  - One important condition is that pools only bring together complementary patents, not substitute patents
  - Another important condition is that an implementer must always be allowed to negotiate with an individual patent owner as well for a license, and not be forced to license only via the pool

7.7 Patent pools

- If pools have advantages for both patent owners and licensees, why has the pool model not overtaken bilateral licensing? Possible reasons include:
  - Pools are difficult and expensive to set up
  - There is usually a wide diversity of interests and views across (potential) pool participants, making it hard to find a set of agreements and rules that everybody is willing to endorse
  - Patent owners might be of the opinion that the freedom and flexibility they have when they do bilateral licensing outweighs the advantages of pools
- Whereas pools for mobile telecommunications (2G, 3G and 4G) have failed to materialize or had rather limited success, one might argue that this may change in the future
  - For the Internet of Things (IoT) and Industry 4.0, the implementer landscape is much more diverse, and transaction costs for bilateral licenses may be much higher
  - Avanci, is a new automobile pool that also announced IoT pools, and has many SEP owners involved

7.7 Patent pools

- A selection of current pools and their licensing administrators:

Licensing Administrator	Description and selection of pools	Based in / founded
MPEGLA The Standard for Standards	Pioneered the MPEG2 pool for video coding, served as an example for many others. Current pools include various modern audio and video coding protocols, but also wireless power, EV charging, and video ports (DisplayPort)	US, 1990s
VIA LICENSING	Has active pools in the field of audio and video coding, but also for 3G and 4G mobile telecommunications and other technologies. Owned by Dolby Laboratories	US, 2002
SISVEL	Patent pool covering wireless communications (including Wi-Fi, 2G, 3G and 4G mobile telecommunications, audio and video coding, and (DVB) television broadcast	Italy, 1990s
one-blue	Focusing Blu-ray, the successor of the DVD	2011, Europe
AVANCI	Initially focusing on licensing mobile telecommunications SEPs for connected cars and has announced activities aimed at the IoT	2016, US /Europe

7.8 Public interest and activities by regulators

- The relation between patents and standards has a clear public interest dimension
  - It may hinder the development or adoption of standards, create undue barriers for market entry, create ('unnecessary') friction, etc.
- All around the globe, policy makers and regulators have recognized have actively been involved in this policy area

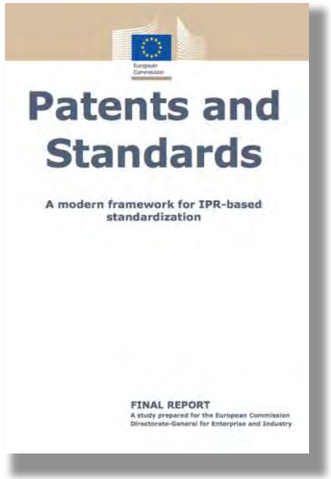
7.8 Public interest and activities by regulators

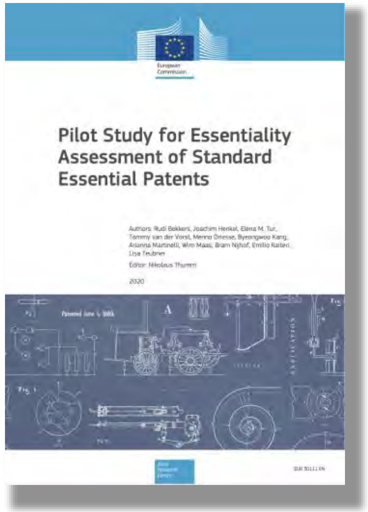
- Broad overview of main public interest topics over time:

Period	Main public interest topics
1990s	Market access (esp. possible exclusion of market parties by nonavailability of licenses)
2000s	Concerns regarding possible abuse in terms of excessive licensing fees Concerns over sale of SEPs where the successor did not deem itself bound to FRAND commitments
2010s	Increasing interest for geopolitical dimension
2020s	Especially in the light of the broad use of standards by the Internet of Things, vertical industries, Industry 4.0, increasing interest in transparency on SEP ownership and factual essentiality, possible frictions in the market, and the relation between (FRAND-based) standards and open source

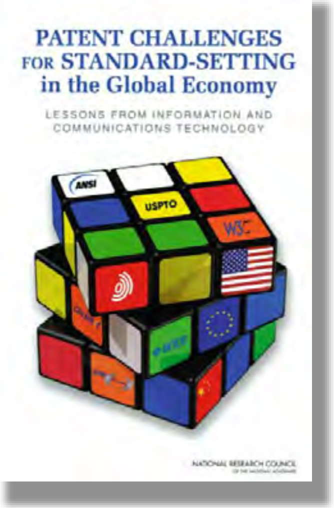
7.8 Public interest and activities by regulators

- Policy activities can be categorized into:
  - Government-commissioned studies
  - Public consultations
  - Policy documents
  - Competition law / antitrust enforcement





- Examples of important EU policy documents include:
  - Horizontal Guidelines (2011)
  - Setting out the EU approach to Standard Essential Patents (2017)
  - The European Commission 2020 IP Action Plan (2020)



List of abbreviations: Chapter 7

- ANSI: American National Standards Institute
- ASA: American Standards Association
- CD: Compact Disc
- CJEU: Court of Justice of the European Union
- DVD: Digital Versatile Disc
- EPO: European Patent Office
- ETSI: European Telecommunications Standards Institute
- EV: Electric Vehicle
- FRAND: Fair, Reasonable and Non-Discriminatory
- GSM: Global System for Mobile communications
- GSMA: GSM Association
- HDMI: High-Definition Multimedia Interface
- IEC: International Electrotechnical Commission
- IEEE: Institute of Electrical and Electronics Engineers
- IETF: Internet Engineering Task Force
- IoT: Internet of Things
- IP: Intellectual Property
- IPR: Intellectual Property Right
- ISO: International Organization for Standardization
- ITU: International Telecommunication Union
- MPEG: Moving Picture Experts Group
- RAND: Reasonable and Non-Discriminatory
- RF: Royalty Free
- SDO: Standards Development Organisation
- SEP: Standard Essential Patent
- UMTS: Universal Mobile Telecommunications System
- W-CDMA: Wideband Code Division Multiple Access
- W3C: World Wide Web Consortium

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8 An Economic Perspective on Standardization and Public Procurement

Contents

8 An economic perspective on standardization

8 An Economic Perspective on Standardization

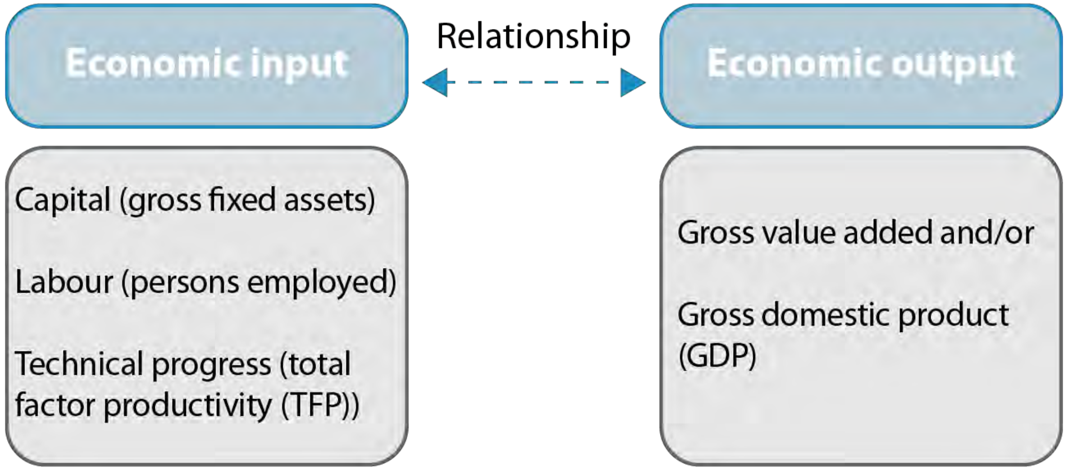
- The learning objectives of this section are:
  - Understanding that standards and standardization are an important basis for a functioning economic system.
  - Getting valuable insights into the far-reaching impacts of standardization on the economy, and how different stakeholders can benefit from these impacts.
  - Understanding and being able to explain the impact of standardization on public procurement.
  - Being able to recall the most important policy and legal frameworks in area of public procurement and linking the benefits of standardization to different stakeholders such as citizens and businesses.

8.1 Economic contribution of standards
Contribution of standards to the GDP

- Several studies calculated the contribution of standards to economic growth:
  - Great Britain (DTI, 2005)
  - Germany (Blind et al., 2011)
  - France (Miotti, 2009)
  - Canada (Haimowitz and Warren, 2007)
  - …
- They are based on regression analysis:
  A statistical process for estimating the relationships among variables

8.1 Economic contribution of standards
Important variables (Blind et al., 2011)

- The Cobb-Douglas production function encompasses the entire business sector:



- A national economy is also affected by external political factors (e.g., oil crises, “new economy” bubble burst) which have to be taken into account

Source: Blind et al. (2011)

8.1 Economic contribution of standards
The TFP (Total Factor Productivity)

- A country's technical progress increases with the number of companies that incorporate the technological knowledge. Economic growth depends on:
  - Generation of knowledge/inventions
  - Wide dissemination among as many companies as possible
- The Total Factor Productivity (TFP) comprises three factors:
  - Technological knowledge generated **in a country** (number of patents)
  - Technological knowledge imported **from abroad** (number of technological licence payments abroad)
  - The **diffusion** of this technological knowledge (number of standards)

8.1 Economic contribution of standards

The role of standards

- SDO standards are developed in consensus with the participation of all market participants (best case scenario)
- As opposed to codified knowledge in patents, SDO standards are accessible to all
- The **benefits of standardization** for economic growth lie in the **dissemination of technological knowledge**
  - In the Cobb-Douglas production function, economic output increases in capital and labor, but the rate of growth diminishes over time.
  - This effect of diminishing marginal returns is counteracted by technical progress.
  - Even if capital and labour stay the same, we can still witness an economic growth due to the production of knowledge (patents) and **diffusion of knowledge (standards)**

8.1 Economic contribution of standards
The example of Germany (Blind et al., 2011)

- Increasing contribution of standards to the GDP throughout the 1970s
- 1986 – 1990 adjustments of the standard collection
- After German reunification the values stabilize at 0,7 to 0,8%

CONTRIBUTION TO GROWTH OF VARIOUS PRODUCTION FACTORS, IN %

	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1992*-1996	1997-2001	2002-2006
Capital	2.30%	1.70%	1.60%	1.10%	0.90%	0.90%	0.90%	0.50%	0.30%
Labour	0.70%	0.10%	-0.50%	0.60%	-0.40%	1.20%	-0.70%	0.60%	-0.30%
Patents	0.50%	0.50%	-0.60%	0.60%	1.00%	0.00%	-0.70%	-0.60%	-0.60%
Licences	0.90%	0.80%	0.90%	0.30%	0.50%	2.00%	1.70%	0.10%	0.50%
Standards	0.40%	0.60%	1.80%	1.20%	0.70%	-0.02%	0.70%	0.80%	0.70%
Special factors	0.01%	0.01%	-0.70%	-0.20%	-1.30%	0.01%	0.01%	-1.10%	1.10%

*** There is no reliable data for 1991 due to German reunification.**

Source: Blind et al. (2011)

8.1 Economic contribution of standards
Contribution of standards to the GDP

- What does 0,7 – 0,8% of the GDP mean in monetary value?

16.77 billion Euros a year*

*from 2002-2006 in Germany

- Results from other countries:

Country	Publisher	Time frame	Growth rate of GDP	Contribution of standards to GDP
France	AFNOR (2009)	1950 – 2007	5.4 %	0.8 %
United Kingdom	DTI (2005)	1948 – 2002	2.5 %	0.3 %
Canada	Standards Council of Canada (2007)	1981 – 2004	2.7 %	0.2 %
Australia	Standards Australia (2006)	1962 – 2003	3.6%	0.8%

Note: The table covers different periods as no consistent data was available.

Source: Blind et al. (2011)

8.1 Economic contribution of standards
Costs of standardization/standards from company's perspective

- Financing standardization activities:
  - Usually participants (e.g., companies, academics) have to finance standardization activities themselves:
    - Membership fees (e.g. ETSI 6000€/year for SMEs)
    - Travel costs
    - Working hours of representatives
  - Offset of short-term costs versus long-term pay-off
- Costs can also work as barriers to trade (e.g., if set at an unreasonable level)
- SMEs appear to have individually very limited resources to invest in standardization (Ernst & Young, 2015)
- Within the 3rd Generation Partnership Project (3GPP), SMEs and start-ups have a low participation level in standardization (15% of overall participation), but their contributions are as likely to be accepted as those of non-SMEs (Gupta, 2017)

8.2 Economic effects of standardization

Effects of standardization

	Positive Effects	Negative Effects
Compatibility/ Interface Standards	• Network externalities • Avoiding lock-in in old technologies • Increased variety of system products • Efficiency in supply chains	• Anti-competition, leading to monopoly • Lock-in in old technologies in case of strong network externalities
Minimum Quality/ Safety Standards	• Avoiding adverse selection • Creating trust • Reducing transaction costs	• Regulatory capture • Increasing entry barriers
Variety Reduction Standards	• Economies of scale • Building focus and critical mass	• Reduced choice • Leading to monopoly, market access barriers
Information/ measurement Standard	• Facilitating trade • Reduced transaction costs • Providing codified knowledge	• Regulatory Capture

Table: Effects of standards (Source: Swann (2000), Pham (2006), Blind (2013), modified)

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Table: Effects of standards (Source: Swann (2000), Pham (2006), Blind (2013), modified)

8.2 Economic effects of standardization
Compatibility/ Interface Standards

- Compatibility
  An Essential role of standards is to ensure compatibility.
- Compatibility includes two sub characteristics (ISO 25010):
  - **Coexistence**: An IT service/product sharing a common environment and resources with other independent services/products without adverse side effects
  - **Interoperability**: Ability of those components to work constructively with one another

8.2 Economic effects of standardization
Compatibility/ Interface Standards

- Developments in the ICT sector demonstrate the economic importance of compatibility/ interface standards
- Two economic phenomena can influence customers and producers in such markets:
  - Switching costs
  - Network effects
- If both exist, there is a risk that another economic phenomenon occurs:
  - Lock-in effect

8.2 Economic effects of standardization
Compatibility/ Interface Standards

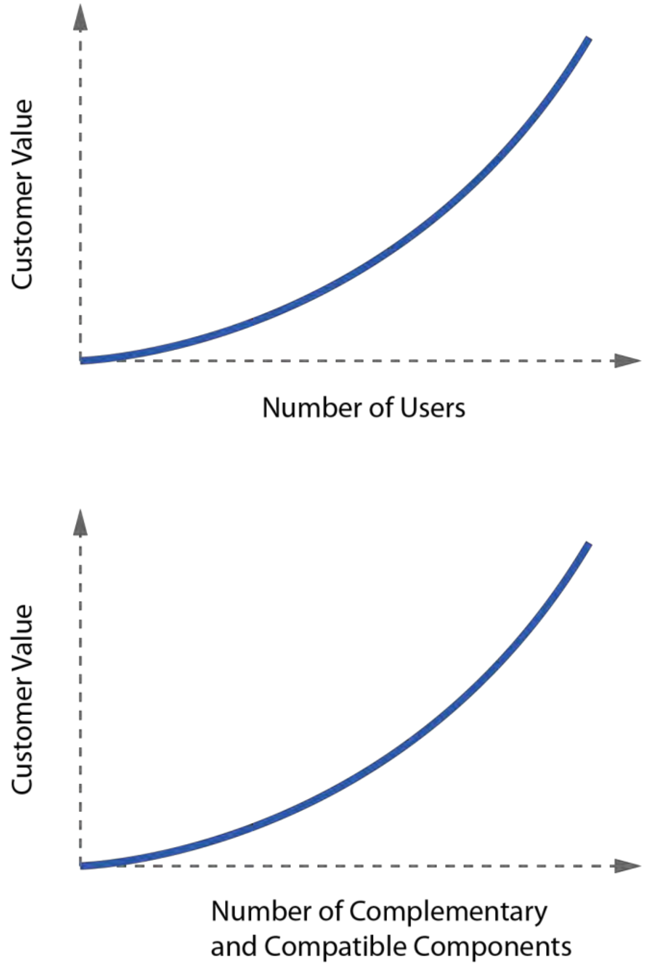
- Switching costs:
  Once producers or customers have invested into a particular interface or standard, switching to another will become increasingly expensive

- Examples:
  - **Acquisition costs:** When new equipment has to be bought or adapted
  - **Training costs:** Associated with learning to use a new product
  - **Testing costs:** If there is uncertainty as to the suitability of alternative products/services

Source: Parr et al.(2005)

8.2 Economic effects of standardization
Compatibility/ Interface Standards

- Network effects – two forms:
  - **Direct:** The value of a good/services changes because the number of people using it changes
    Examples: Telephone, Fax, Facebook, Twitter, …
  - **Indirect:** The value of a good/service does not depend directly on the number of users but rather on the availability of complementary and compatible components
    Examples: Video game consoles, computer hardware and software, …



Source: Greenstein and Stango (2008)

8.2 Economic effects of standardization
Compatibility/ Interface Standards

- Lock-in: Markets can get locked into inferior products/services/technologies because producers and customers will only switch to a better design when:
  - All others do so too
  - They can afford the switching costs
- If one of the two conditions is not satisfied lock-in occurs
- When a standard is not developed according to the principles of formal standardization and is owned by one single organization, lock-in is more likely to happen, because one party has full control over the standard.
- **For the market lock-ins mean:**
  - Barriers to market entry
  - Monopolies

Source: Parr et al.(2005), de Vries et al. (2008)

8.2 Economic effects of standardization
Compatibility/ Interface Standards

- **Examples:**
  Microsoft (Windows API, file formats etc.)

In terms of the Windows API the Microsoft general manager for C++ development Aaron Contorer stated in an internal Microsoft memo for Bill Gates:

"The Windows API […] is so deeply embedded in the source code of many Windows apps that there is a huge switching cost to using a different operating system instead" (European Commission 2004, pp. 126–127).

- **Windows exclusive franchise**: Windows grants other suppliers the right to use the Windows API (application programming interface) to produce systems according to its specifications
- The strategic role of API is to maintain network effects and block competition
- Use of proprietary file formats in Microsoft's application software drives the lock-in effect.

Source: Deek and Am McHugh (2007)

8.2 Economic effects of standardization

Compatibility/ Interface Standards

- **Examples:**

  Apple Inc. (iPod)

  - Digital music files with DRM (digital rights management) are purchased from Apple's iTunes store in proprietary AAC format only compatible with Apple's iTunes media player software
  - Users could not play purchased music in other software environments
  - After the launch of the iPod in 2001 and a licence deal with major music labels, Apple controlled almost 75% of US market for paid downloads
  - DRM conditions and incompatibility with other music players caused conflicts with consumer rights
  - After several suits for "unlawful bundling", since 2009 DRM is removed from digital music files

Source: Raustiala and Springman (2012)

8.2 Economic effects of standardization
Compatibility/ Interface Standards

- **Open standards** have several positive effects on the market
- Referring to a standard as open or not depends on the openness of the standardization process
  - In an open standardization process, any entity, be it an organization or individual, can participate in the creation of the standard.
  - The output of an open standardization process is an open standard.
  - As formal standardization is expected to meet all the principles of open standardization, the standards created through that process are, by definition, open standards.
- With an open standard, the risk of lock-in is reduced, because the standard is freely available, leading to lower barriers to entry and lower switching costs for consumers.

> *"[…] it is better to have a share of a large market than a monopoly of a tiny one." Swann (2000), p.5*

8.2 Economic effects of standardization
Compatibility/ Interface Standards

- Compatibility standards help to reduce transaction costs: If buyers know that a particular piece of software is compatible with a particular operating system, the burden to verify that the software will run as expected is reduced
- These reductions of transaction costs also facilitate division of labour; example of the computer industry:
  - A computer contains components from all over the world
  - Internationally accepted compatibility standards have led to a complete globalization of the industry
  - Producers specialize in a small part of the value chain to achieve economies of scale and sell their products around the world

8.2 Economic effects of standardization
Effects of standardization

	Positive Effects	Negative Effects
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Table: Effects of standards (Source: Swann (2000), Pham (2006), Blind (2013), modified)

8.2 Economic effects of standardization
Minimum Quality/ Safety Standards

- **Minimum quality standards** refer to minimum acceptable requirements for the reliability, durability, and safety of products and services, as well as to other fields such as working conditions.
  - They can be welfare improving for an economy (also in the areas of health and environment)
  - They help reduce the risk felt by the buyers and increase trust between traders
  - If set at an unnecessary high level, they can also function as a barrier to entry
- A minimum quality standard can relate, for instance, to fuel-economy or carbon dioxide emissions generated through car usage. When adopted by regulation, such standards are compulsory by law, making it necessary for car producers to respect the minimum quality standard.

Source: Swinnen (2015) and Locksley (1990)

8.2 Economic effects of standardization

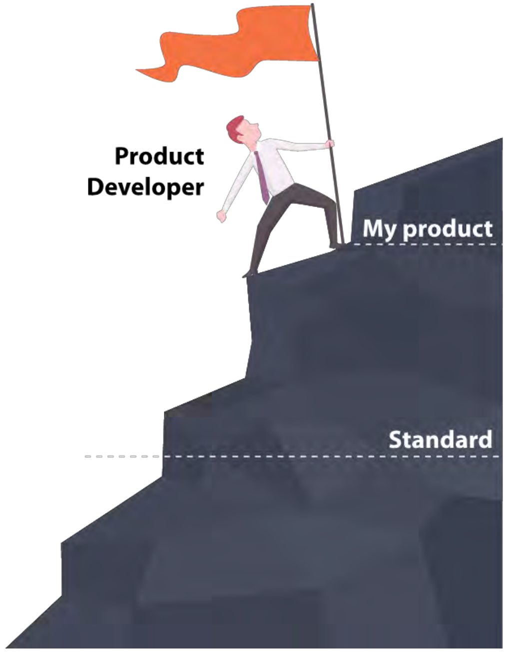
Minimum Quality/ Safety Standards

- Customers face a huge variety of different products and find it hard to assess which is suited for their purpose
- If buyers cannot distinguish between different product variants, it is hard for the quality seller to sustain a price premium (if costs exceed those of low-quality sellers)
- Gresham's law: "bad drives out the good"
- Worst case: The market will break down and lead to market failure

8.2 Economic effects of standardization

Minimum Quality/ Safety Standards

- This problem due to **information asymmetries** arises when one party (e.g., seller) has more or better information than the other (here the buyer), making it hard for the buyer to make an informed decision
- Leland (1979) showed **minimum quality standards can help to overcome information asymmetries,** as they function as a reference and define the minimum requirements a product should fulfil
- Some companies even trade on their reputation and can sustain a price premium well above the minimum threshold of a standard
- Ex post restitution (e.g., a guarantee) can also work as a substitute for a certified minimum quality standard



8.2 Economic effects of standardization
Minimum Quality/ Safety Standards

- Minimum quality standards **reduce transaction and search costs** caused by economic exchange
- If a product is defined in a way that reduces buyer uncertainty:
  1. The buyer’s risk is reduced
  2. Less need for the buyer to spend money and time on evaluating different products before a purchase
- Product certification can function as a shortcut for buyers as it proofs the compliance to a standard

Source: Pham (2006); Swann (2000); Swann (2010)

8.2 Economic effects of standardization
Minimum Quality/ Safety Standards

- What do minimum quality standards mean for new market entrants?
  - General presumption: When a product characteristics are documented in an open standard, the playing field between incumbent and entrant gets levelled
  - In the absence of the standard, incumbents have an information advantage over entrants
  - **BUT**: Quality standards can be set at an unnecessarily high level to deter entrants from entry
  - Even if those standards impose a cost burden on incumbents, this strategy can be very effective when the cost burden on entrants is greater still (raising rival's costs or increasing entry barriers)

  - The concept of "**regulatory capture**" can be considered as a variant of the "raising rival's costs" concept
  - **Basic idea**: Some producers may **lobby to persuade the regulator** to define regulations in their interest rather than in the interest of the buyer/customer (original intention of standards)

8.2 Economic effects of standardization

Effects of standardization

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Table: Effects of standards (Source: Swann (2000), Pham (2006), Blind (2013), modified)

8.2 Economic effects of standardization
Variety Reduction Standards

- Two main functions:
  1. Support of **scale economies**, by minimizing the proliferation of minimally differentiated models
  2. Reduction of **transaction costs** for customers, because they do not have to choose between a vast number of products
- Many advantages:
  - **Prevention of market fragmentation** and support of a **joint vision**
  - For suppliers less fragmentation also means reduced risk
  - Variety reduction standards can also reduce barriers to entry
    - Variety proliferation is sometimes used by incumbents to limit competition from small scale entrants who cannot provide the same degree of variety
    - Some incumbents try to restrict entry by companies with an idiosyncratic product specification

8.2 Economic effects of standardization
Variety Reduction Standards

- Do variety reduction standards need to be defined publicly?
  - **Not necessarily**: Economies of scale (best-known function of this type of standard) can also be obtained with an idiosyncratic model range
  - **But**: A store selling cloth in idiosyncratic sizes will not perform well

8.2 Economic effects of standardization
Effects of standardization

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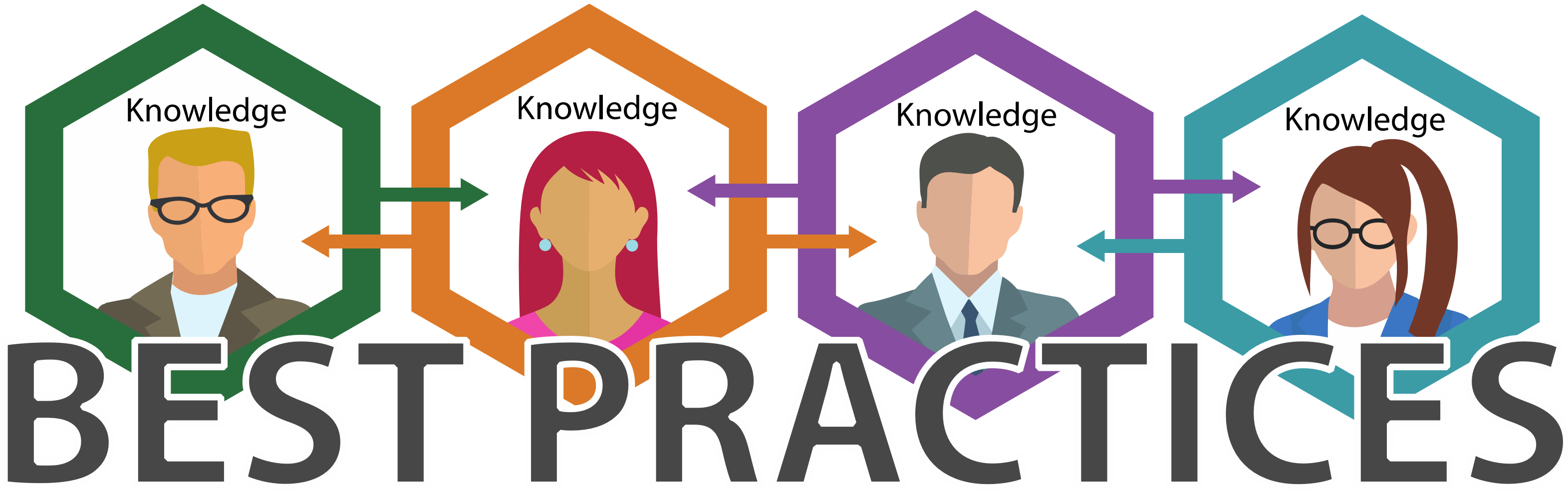
Table: Effects of standards (Source: Swann (2000), Pham (2006), Blind (2013), modified)

8.2 Economic effects of standardization
Information/ measurement Standard

- **Information and measurement standards**: Standards that contain codified knowledge and product descriptions
- These standards an be seen as **important instruments of technology transfer** as they…
  - …contain the work and experience of generations
  - …act as instruments in the dissemination of best practices



8.2 Economic effects of standardization
Information/ measurement Standard

- Information and measurement standards have a positive effect on the market by **disseminating the knowledge**. They support…
  - …building up competencies
  - …spreading essential production knowledge, thus levelling of the playing field between incumbents and entrants
  - …reducing information asymmetries
  - …reducing barriers to market entry
- These standards lower transaction costs between companies and sub-contractors by providing a common language and therefore…
  - …ease the writing of job descriptions, contracts etc.
  - …achieve a feasible division of labour

8.2 Economic effects of standardization

Example: Digital image compression

- During 1990s: rapid diffusion of image and video processing applications and advancement of multimedia technologies

  → Increased importance of compression methods

- International SDOs developed several standards describing different compression methods, e.g. JPEG (“Joint Photographic Experts Group”)

  → Offered new solutions for saving storage place and reducing transmission rate requirements to industry

- Many software products are based on these compression methods, e.g. sharing of digital images, remote sensing, archiving, image search

Source picture: Schelkens (2015)

Source: ANSI (n.d.)

8.2 Economic effects of standardization
Major demand-side effects for innovation

- Summary

Different Types of Standards and their Major Demand-side Effects for Innovation				
	Generation of Network Effects	**Generation of Economies of Scale**	**Reduction of Information Asymmetries**	**Reducing Uncertainty and Risk**
Compatibility/ Interoperability	X			
Minimum Quality/ Safety				X
Variety Reduction		X		
Information			X	

Source table: Blind (2013), p.15

8.3 Public procurement and standardization
The use of public procurement and standardization

- Public procurement
  - Process by which public authorities (e.g., government departments or local authorities) purchase work, goods or services from companies
  - Examples: the Building of a state school Purchasing furniture for a public prosecutor’s office, Contracting cleaning services for a public university
- The public sector can use standards in the context of public procurement (e.g. in tender specifications) to benefit from these demand-focused functions of standardization
- This way governments can diffuse innovations to the private sector: Companies and other organization applying for public tenders have to comply with specific standards
- in 2017, the estimate of total general government expenditures on works, goods, and services was 2049.8 billion euros. This is about **13.3%** of European GDP

8.3 Public procurement and standardization
Positive effects of innovation for public procurement

- Positive effects:
  - Improve the quality of public services and infrastructures → high customer (e.g. citizen) satisfaction
  - Improvement in public services can lead to intensified competition between regions
  - Innovations may lower costs over the whole life cycle of a technology (lower maintenance, energy or repair costs)

- Negative effects:
  - Due to new features or improved functionalities the purchase price might be higher
  - Innovative technologies bear higher risks for the user, but also e.g. for the environment
  - New technologies can increase maintenance costs due to less experience
  - Specific innovation can only be produced by a small number of companies (or even a single one)

8.3 Public procurement and standardization

Example: Disseminating accessibility standards

- Access to ICT supports people with disabilities to equal access to education and services
- ETSI standard EN 301 549 (intended for use in public procurement) ensures that software products, web applications and digital devices satisfy basic accessibility requirements
- Governments can improve accessibility of ICTs by referencing the standard in public tenders (e.g. ticket vending machines, websites)
- Companies applying for these tenders need to comply with the accessibility criteria laid down in the standard

Source: ETSI (2014); Rice (2015)

8.3 Public procurement and standardization
Standards in public procurement

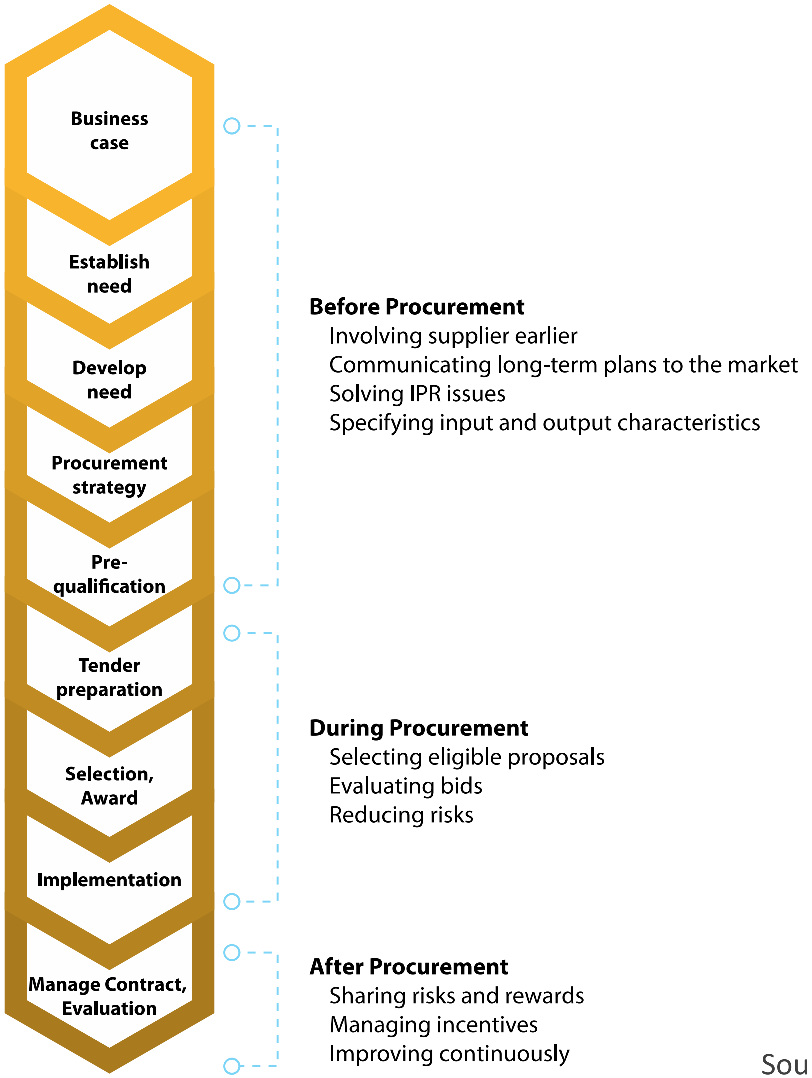
- Standards referenced in public tender mean:

1. Innovative products can reduce production costs: Lowering the price to be paid by public procurers
2. Securing the interoperability of the purchased innovation with already existing infrastructure
3. Pushing the competition, and therefore the innovation pressure among competitors for public tenders
4. Reduction of the risk of lock-in to a specific supplier
5. Direct innovation effects for companies through the implementation of newly released standards
6. Reduced risk related to costs, health, environment and safety
7. Facilitation of positive spill-overs on innovation promoting procurement processes in the private sector

Source: Blind (2013)

8.3 Public procurement and standardization
The procurement process

- Standards come into pay at various stages of the procurement process:



Source: Blind (2013)

8.3 Public procurement and standardization

The procurement process

- Public procurement process and standards
  - Before procurement
    - Analysis of appropriate standards
    - Strategic referencing of standards
  - During procurement
    - Selection of proposals can be based on compliance to required basic standards
    - Possible conflicts can be solved with help of standards
  - After procurement
    - Reduced transaction costs by identifying deviations using standards as references
    - Easier monitoring of technology by taking newly released standards into account

Source: Blind (2013)

List of abbreviations: Chapter 8

- AAC: Advanced Audio Coding
- AFNOR: Association Française de Normalisation
- ANSI: American National Standards Institute
- API: Application Programming Interface
- CEN: European Committee for Standardization
- CENELEC: European Committee for Electrotechnical Standardization
- DRM: Digital Rights Management
- DTI: Department of Trade and Industry (United Kingdom)
- ESS: European Standardization System
- ETSI: European Telecommunications Standards Institute
- EY: Ernst & Young Consulting Company
- GDP: Gross Domestic Product
- IEC: International Electrotechnical Commission
- ISO: International Standardization Organization
- ITU: International Telecommunication Union
- JPEG: Joint Photographic Experts Group
- SDO: Standard Development Organization
- SME: Small and Medium-sized Enterprises
- TFP: Total Factor Productivity
- 3GPP: 3rd Generation Partnership Project

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