EARTO Webinar Series

Standardisation in research and technology for practitioners

Knut Blind, Fraunhofer ISI

- Background: EDU4Standards

- Pilot EARTO

EDU4Standards.eu - Empowering Standardisation through Education in Europe

OBJECTIVES

Obj.1: Develop and disseminate teaching material about standardisation

Obj.2: Increase the visibility via "Academic Standardisation Days" (ASDs)

Obj.3: Increase the number of HEI & universities offering teaching on standardisation

Obj.4: Increase number of teachers offering courses and students attending courses about standardisation

Obj.5: Set up a Students' Standardisation Association (SSA)

Innovative Teaching Concept of Standardisation (ITCoS)

Web Platform

Student Standardisation Association & Academic Standardisation Days

EDU4Standards.eu
Empowering Standardisation through Education
ecosystem

Community
- Standardisation Student Association created
- 100+ HEIs exposed to standard education
- 100+ teachers with standardisation knowledge
- 500 students educated in pilots
- 1,500+ engaged community members
- EURAS
- External Advisory Group (EAG)

Pilots
a. B.Sc course
b. M.Sc course
c. In-company Training
d. Extra-curricular format
e. Seasonal university school
f. Pan-EU EARTO
g. Distance learning

EU & International Synergies
- > 10 Mutual cooperations with National, European, and Int'l organisations and initiatives
- Continuous engagement and exchanges on all ICT standards topics
- Interaction with Policy makers: (Including: EURAS, MSPs, Sherpa Groups of the High-level Standardisation Forum, STAIR, ISO, IEC, ITU & IEEE etc
- Collaborations with HE Standards projects:

HSbooster.eu   StandICT.eu   STAND4EU

Outreach
- 4 Pilot Workshops
- 10 Webinars
- 5 Academic Standardisation Days
- 2 CEN Workshop Agreement Meetings
- 1 Final event
- 12 newsletters
- 3 Press Releases
- 10 Professional Videos
- Visibility at >15 3rd party events
- PPC Campaign
- Social media channels

Reports & other value-add output
- Whitepapers & Scientific Publications
- Online Teaching Content
- CEN Workshop Agreement
- Pilot evaluation reports
- Sustainability strategy
- Policy Recommendations
- EU Standardisation Roadmap
- All Results published via zenodo

SG 1 HEIs/universities

SG 2 Teachers & standards educators

SG 3 Students & Student Associations

SG 4 Standard Development Organisations

SG 5 Policy Makers

SG 6 Environmental and consumer organisations

SG 7 Research organisations & EU projects

SG 8 Industry & SMEs

SG 9 Citizens and citizen groups

Target groups:

- Beginners "Research & Development and Standardisation" course provides a concise yet in-depth understanding of standardisation as relevant from an Research and Technology (RTO) perspective.

- Intermediate experts "Effectively participating in standardisation bodies" course addresses skills to operate in standards bodies.

- Sophisticated experts "Strategic standardisation for RTOs" high-level course, aimed at senior researchers, offers a tailored format for standardisation topics for management level also related to RTO's business models (e.g. IPRs, SEPs, Open Source)

Webinar series Standardisation in research and technology for practitioners:

- Modul 1: Standardisation Landscape 6.11. 2025

- Modul 2: Types and Impacts of Standards 13.11. 2025

- Modul 3: Research and Standardisation 20.11. 2025

- Modul 4: IPRs and Standardisation 27.11. 2025

- Modul 5: Open Source and Standardisation with Mirko Böhm LF 4.12. 2025

- Modul 6: Geopolitics of Standardisation with Barbara Reiter Uni Graz 11.12. 2025

EDU4
Standards.eu

**Module 2
Types and Impacts
of Standards**

Contents

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
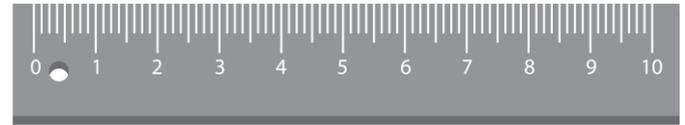
Accompanying scientific articles:

- Blind, K. (2022): Standards and innovation: What does the research say?
  https://www.iso.org/publication/PUB100466.html

○ The learning objectives of this webinar are:

- To know the various **functions of standards**
- To understand **Compatibility/ Interface Standards, Minimum Quality/ Safety Standards, Variety Reduction Standards, and Information/ Measurement Standards**
- To be able to **apply the different types of standards to specific topics**

1 Introduction

- Standards support everyday private and professional life much more than people think

- Society recognized importance of standardised measurements thousands of years ago: e.g. weight, distance or length

- Development of common reference systems agreed within and across societies

- Rapid technological progress → need for new standards, but also update of existing standards grows

- Dynamics especially high in Information and Communications Technologies (ICT)

- Standardisation and standards boost progress and create basis upon which technology, but also science can evolve

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 much harder to make it work)
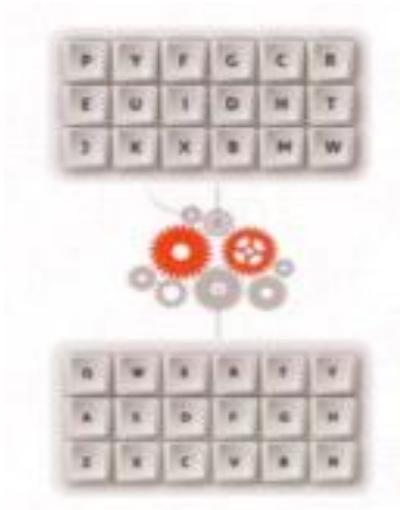
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For instance, what if

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

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

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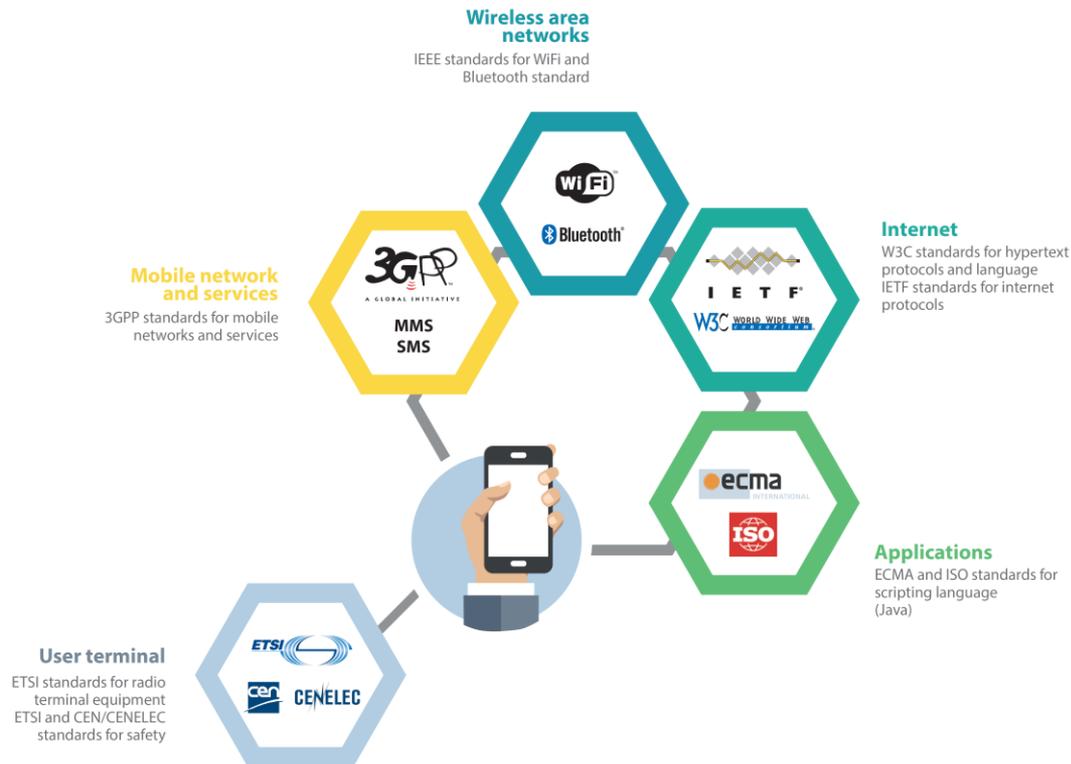
SDO standards are produced by devoted organizations, called Standards Development Organizations (SDOs). SDOs are organizations whose main purpose is to develop standards. They have that put in place formal well-defined procedures to guarantee a fair development process.

De facto standards can become formal standards if they are approved by an SDO. Examples: HTML and PDF becoming ISO standards

Using a Smartphone (some probably deployed standards):

- User equipment, e.g. hardware characteristics and safety/security aspects

- Connectivity between user devices and wireless network, functionality of this network

- Internet access and the protocols to support web browsing

Wireless area networks
IEEE standards for WiFi and Bluetooth standard

Mobile network and services
3GPP standards for mobile networks and services

Internet
W3C standards for hypertext protocols and language
IETF standards for internet protocols

Applications
ECMA and ISO standards for scripting language (Java)

User terminal
ETSI standards for radio terminal equipment
ETSI and CEN/CENELEC standards for safety

Using a Personal Computer
(some probably deployed standards)

Biddle & al. (2010) identified 251 technical interoperability standards (display. graphics, wireless, sound, power, security, processor, etc.,) 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"
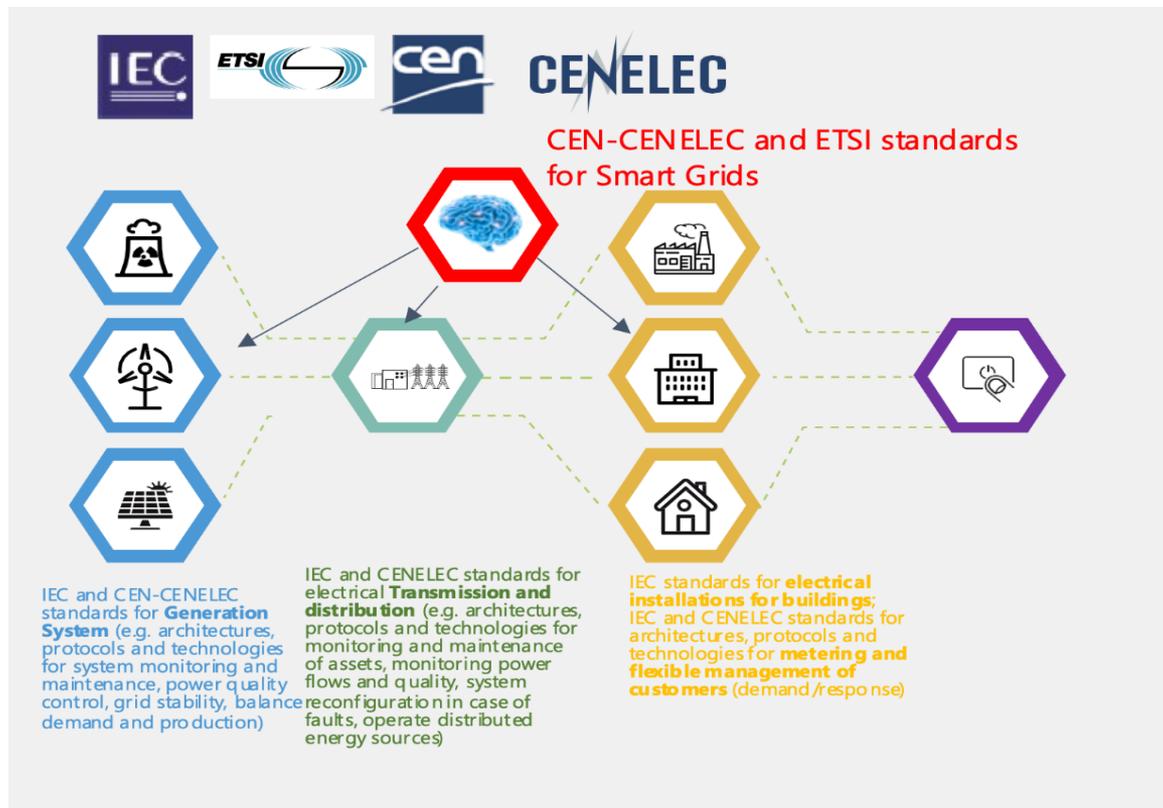
Switching on lights
(some of the standards deployed)

CEN-CENELEC and ETSI standards for Smart Grids

IEC and CEN-CENELEC standards for **Generation System** (e.g. architectures, protocols and technologies for system monitoring and maintenance, power quality control, grid stability, balance demand and production)

IEC and CENELEC standards for electrical **Transmission and distribution** (e.g. architectures, protocols and technologies for monitoring and maintenance of assets, monitoring power flows and quality, system reconfiguration in case of faults, operate distributed energy sources)

IEC standards for **electrical installations for buildings**; IEC and CENELEC standards for architectures, protocols and technologies for **metering and flexible management of customers** (demand/response)

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|	Positive Effects	Negative Effects
Compatibility/ Interface Standards	• Network externalities, like enabling seamless global communication • 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, i.e. supply of bad quality drives out good quality • Creating trust • Reducing transaction costs	• Regulatory capture • Increasing barriers to entry
Variety Reduction Standards	• Economies of scale • Building focus and critical mass	• Reduced choice • Leading to monopoly, barriers to market access
Information/ measurement Standard	• Facilitating trade • Reduced transaction costs • Providing codified knowledge	• Regulatory Capture

Source: based on Blind (2022)

Source: Swann (2000), Pham (2006), Blind (2013, modified)

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○ Compatibility

An essential role of standards is to ensure compatibility.

○ Compatibility includes two sub characteristics (e.g. defined in ISO 25010 Systems and software engineering — Systems and software Quality Requirements and Evaluation SQuaRE):

- **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

○ Developments, particularly in the ICT sector demonstrate the economic importance of compatibility/interface standards

○ Two economic phenomena can influence customers and producers in such markets:
- **Network effects**
- **Switching costs**

○ If both exist, there is a risk that another economic phenomenon occurs:
- **Lock-in effect**

○ Network effects – two forms:

- **Direct:** The value of a good/services increases with the number of people using it
  Examples: Telephone, e-mail, Social Media, …

- **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, cars and charging systems…
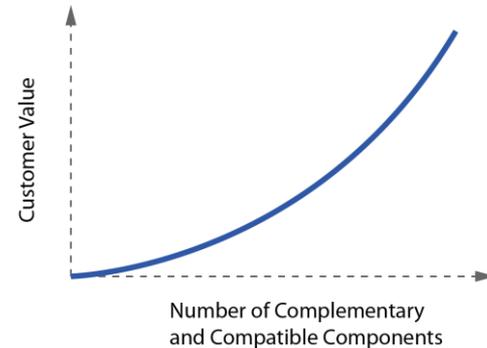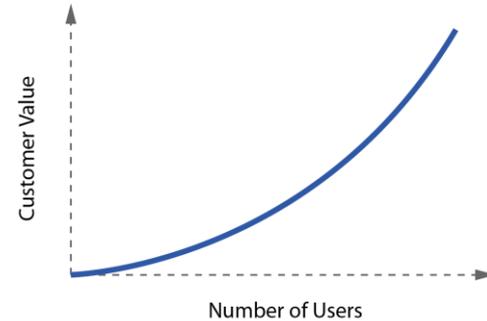
Source: Greenstein and Stango (2008)

○ Switching costs:

Once producers or customers have invested into a particular interface or standard, switching to another one 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 regarding the suitability of alternative products/services

Source: Parr et al. (2005)

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

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

Lock-in: Examples:

Different electrical outlets per countries

- power plugs and sockets connect devices to mains electricity to supply them with electrical power

- electric power was introduced in the 1880s primarily for lighting; in 1885 a two-pin plug and wall socket format was available on the British market, in 1910 the first three-pin earthed plugs appeared. One first national standards for plugs and wall sockets was enacted in 1915 in the UK; followed by various national standards;

- In 1986, the IEC published IEC 60906 intended to become a European, but the effort was put on hold in the mid-1990s
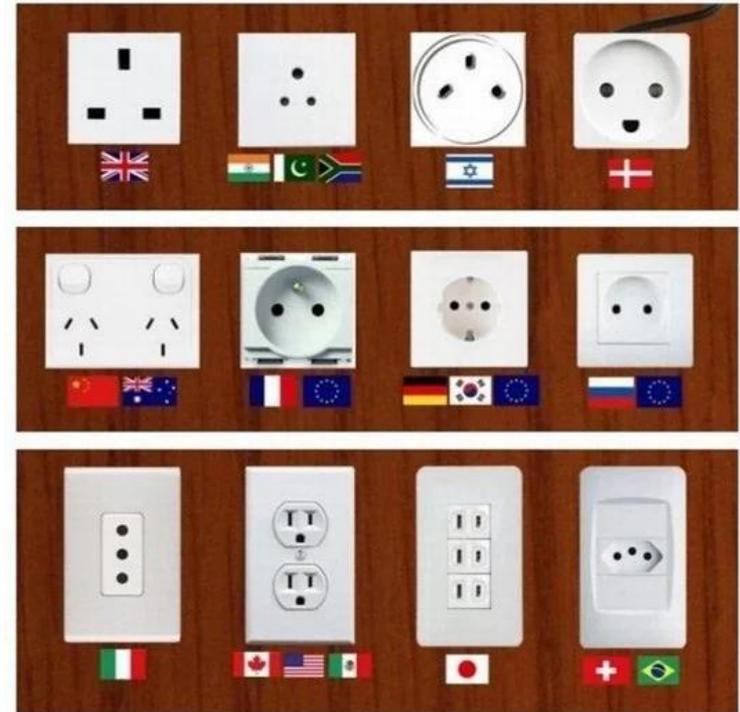
Source: https://www.reddit.com/r/coolguides/comments/enn879/different_electrical_outlets_per_countries/

Lock-in: Examples:

Microsoft (Windows API, file formats etc.)

Regarding the Windows API, Microsoft's 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)

○ Lock-in: 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 Music media player software

- Users could not play purchased music in other software environments

- After the launch of the iPod in 2001 and following 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" DRM has been removed from digital music files since 2009

Source: based on Raustiala and Springman (2012)

- **Open standards** have several positive effects on the market
- Whether or not a standard is considered as open 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 process is expected to meet all World Trade Organization (WTO) principles of standardization, i.e. transparency, openness, impartiality, consensus, efficiency, relevance and consistency.
- With an open standard, the risk of lock-in is reduced, because the standard is accessible and implementable, 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

Funded by
the European Union

- 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 significantly reduced

- These reductions of transaction costs also facilitate division of labour; example from the computer industry:

  - A computer contains components from all over the world

  - Internationally accepted compatibility standards have led to a complete globalisation 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

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Source: based on Blind (2022)

Funded by the European Union

- **Minimum quality standards** identify 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 improve welfare in 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 unnecessarily high level, they can also function as a barrier to entry
- A minimum quality standard can relate, for instance, to CO_2 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: based on Swinnen (2015) and Locksley (1990)

- Customers face a huge variety of different products and find it hard to assess which one 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

FAT FREE

DOUBLE CHOCOLATE

FUDGE COVERED

TWICE THE FAT

CHOOSE YOUR COOKIES

TEENY TINY

CHOCOLAT CREME

REDUCE FAT

TRIPLE CREME

- This problem is due to **information asymmetries.** It arises if 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

- **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 because of a quality 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

Product Developer

My product

Standard

- Minimum quality standards **reduce transaction and search costs** within 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

○ What do minimum quality standards mean for new market entrants?

- General presumption: When a product characteristics are documented in a 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)

○ Example of regulatory capture:

- Difficult to find examples!

- With the release of EN 17092, the European standard for protective motorcycle clothing, some magazines claimed that "the testing standards now used to certify motorcycle riding kit have reduced protection levels by as much as 90%" because of regulatory capture as industry representatives accounted for half the standards committee members including its chair, noting "Few will be aware of the intense opposition [to higher safety standards] from within the industry."

- Obviously, there is a shortage of academic research into regulatory capture in general and regarding motorcyclists' PPE standards in particular.

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Source: based on Blind (2022)

- **Two main functions:**

  1. Support of **economies of scale**, by minimizing the proliferation of differentiated models

  2. Reduction **of transaction costs** for customers, because they do not have to choose between a vast number of slightly different product variations

- **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

- **Disadvantages:**

- In some markets, strong preferences for variations, e.g., fashion industry

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Source: based Blind (2022)

- **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

- Information and measurement standards have a positive effect on the market by **disseminating knowledge**. They support…

  - …building up competencies

  - …spreading essential production knowledge, thus levelling the playing field for incumbents and entrants

  - …reducing information asymmetries

  - …reducing barriers to market entry

- These standards lower transaction costs between companies and contractors, e.g., employees, suppliers and customers, by providing a common language and therefore…

  - …ease the writing of job descriptions, contracts etc.

  - …achieve a feasible division of labour

- 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.)

- Numerous and different types of standards are implemented in complex products and technological systems

- Different functions of standards, e.g., Compatibility/Interface Standards; Minimum Quality/Safety; Variety Reduction; Information/Measurement

- Majority of standards combine different functions

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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