EDU4Standards.eu

EARTO Webinar Series

Standardisation in research and technology for practitioners

Knut Blind, Fraunhofer ISI

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Content

- Background: EDU4Standards
- Pilot EARTO

EDU4Standards's structure at a glance

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)

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)

Innovative Teaching Concept of Standardisation (ITCoS)

Web Platform

Student Standardisation Association & Academic Standardisation Days

EDU4Standards.eu
Empowering Standardisation through Education
ecosystem

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

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Contents

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 standardization 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)

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Contents

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

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Module 3
Research and Standardisation

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Content

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

Accompanying scientific articles:

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

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Research and standardisation

- The learning objectives of this webinar are:
  - **Define research** and its **interface to standardisation**
  - Getting insights into the **interdependencies between research and standardisation**
  - Understand how **research and standardisation** can **benefit** each other
  - Understand how **research** insights can be integrated **into standardisation**
  - Know examples of **standards**, which can **support research**

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Definitions: What is R&D?

“Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge.”

(Frascati Manual 2015, OECD, p. 44)

General: “The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty, i.e. when the solution to a problem is not readily apparent to someone familiar with the basic stock of common knowledge and techniques for the area concerned.” (OECD)

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Definitions: What is R&D?

- **Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.
- **Pure basic research** is carried out for the advancement of knowledge, without seeking economic or social benefits or making an active effort to apply the results to practical problems or to transfer the results to sectors responsible for their application.
- **Oriented basic research** is carried out with the expectation that it will produce a broad base of knowledge likely to form the basis of the solution to recognized or expected current or future problems or possibilities.

Source: Frascati Manual 2015, OECD

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Definitions: What is R&D?

- **Applied research is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.**
- Find possible uses for basic research
  - New methods to achieve specific(!) objectives
  - In business practice: A new research project based on findings of (internal) basic research programmes
  - Results need not be universally applicable

Source: Frascati Manual 2015, OECD

Definitions: What is R&D?

- **Experimental development** is systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to
  - producing new products or
  - processes
  - or to improving existing products or processes.

Source: Frascati Manual 2015, OECD

The five criteria for identifying R&D

- To be aimed at new findings (novel)
- To be based on original, not obvious, concepts and hypotheses (creative)
- To be uncertain about the final outcome (uncertain)
- To be planned and budgeted (systematic)
- To lead to results that could be possibly reproduced (transferable and/or reproducible)

Source: Frascati Manual 2015, OECD

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Definitions: What isn’t R&D

- Education and training
- Scientific and technical information services (e.g. Scientific conferences, Library services, Patent services, Dissemination of results)
- Administration (e.g. Purely R&D-financing activities)
- Specific “industrial activities” (e.g. implementation of new or improved products or services a.k.a. innovation)
- Big data projects for dissemination of data
- Space exploration (expenditures for satellites to perform routine activities)

Source: Frascati Manual 2015, OECD

Borderline between R&D, innovation and other business activities

Item	Treatment	Remarks
Prototypes	Include in R&D	As long as the primary objective is to make further improvements.
Pilot plant	Include in R&D	As long as the primary purpose is R&D.
Industrial design	Split	Include design required during R&D. Exclude design for production process.
Industrial engineering and tooling up	Split	Include "feedback" R&D and tooling up industrial engineering in innovation processes. Exclude for production processes.
Trial production	Split	Include if production implies full-scale testing and subsequent further design and engineering. Exclude all other associated activities.
Pre-production development	Exclude	
After-sales service and trouble-shooting	Exclude	Except "feedback" R&D (to be included).
Patent and licence work	Exclude	All administrative and legal work needed to apply for patents and licences (delivering documentation as an outcome of R&D projects is R&D). However, patent work connected directly with R&D projects is R&D.
Routine tests	Exclude	Even if undertaken by R&D personnel.
Data collection	Exclude	Except when an integral part of R&D.
Routine compliance with public inspection control, enforcement of standards, regulations	Exclude	

Source: Frascati Manual 2015, OECD

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Definitions: What isn't R&D

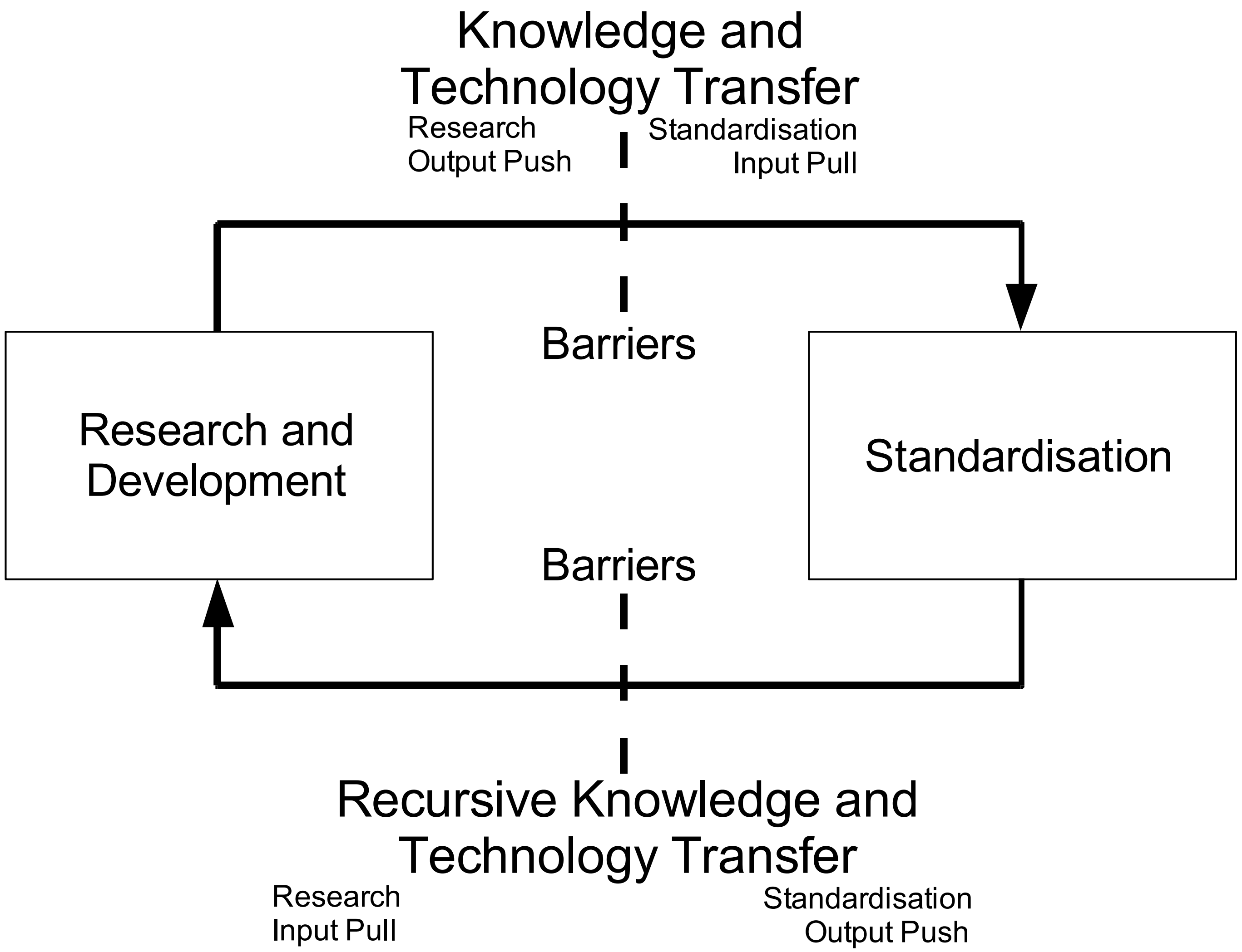
- Testing and standardization

"This concerns the maintenance of national standards, the calibration of secondary standards and routine testing and analysis of materials, components, products, processes, soils, atmosphere, etc." (OECD 2002)

"Public bodies and consumer organisations often operate laboratories that are intended mainly to test products and verify that standards are met. In addition to standard testing and benchmarking activities – which are not R&D – the staff of these laboratories may also spend time devising new or substantially improved testing methods. Such activities should be included in R&D." (OECD 2015)

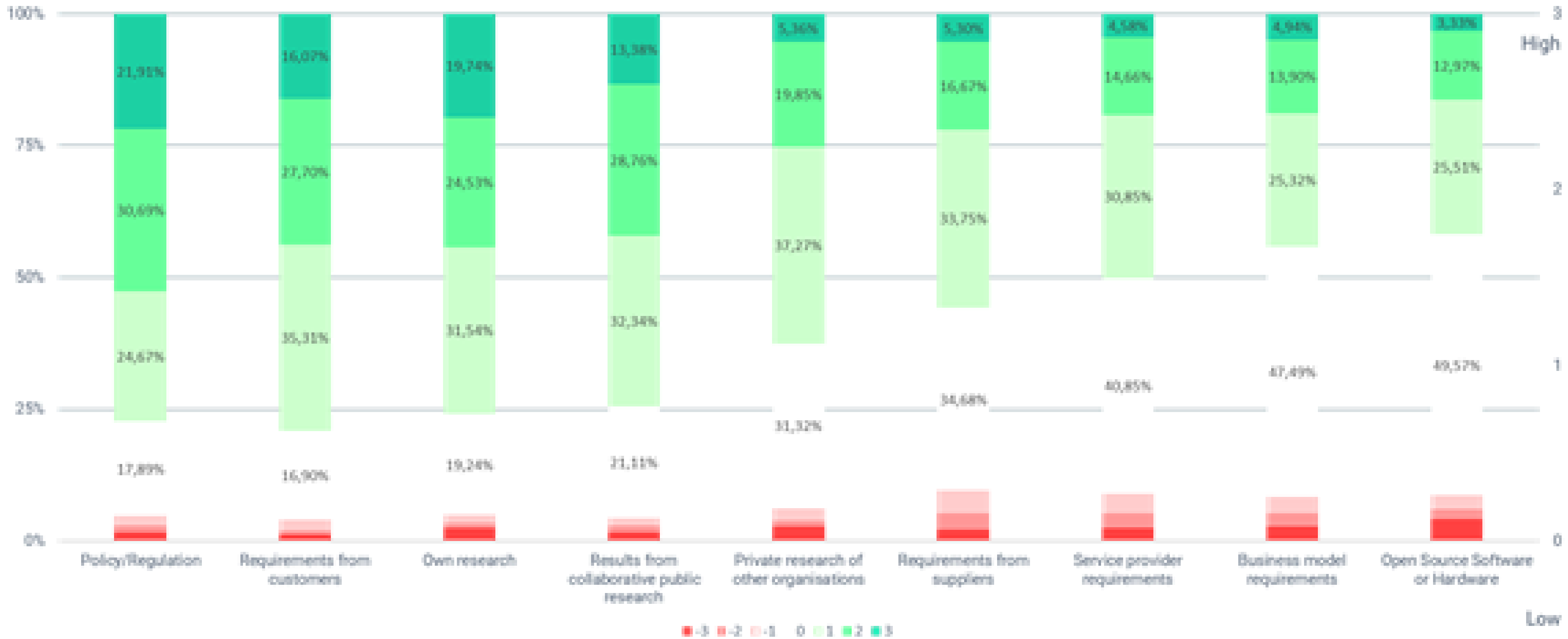
Source: Frascati Manual 2015, OECD

A Simple Model of Research and Standardisation



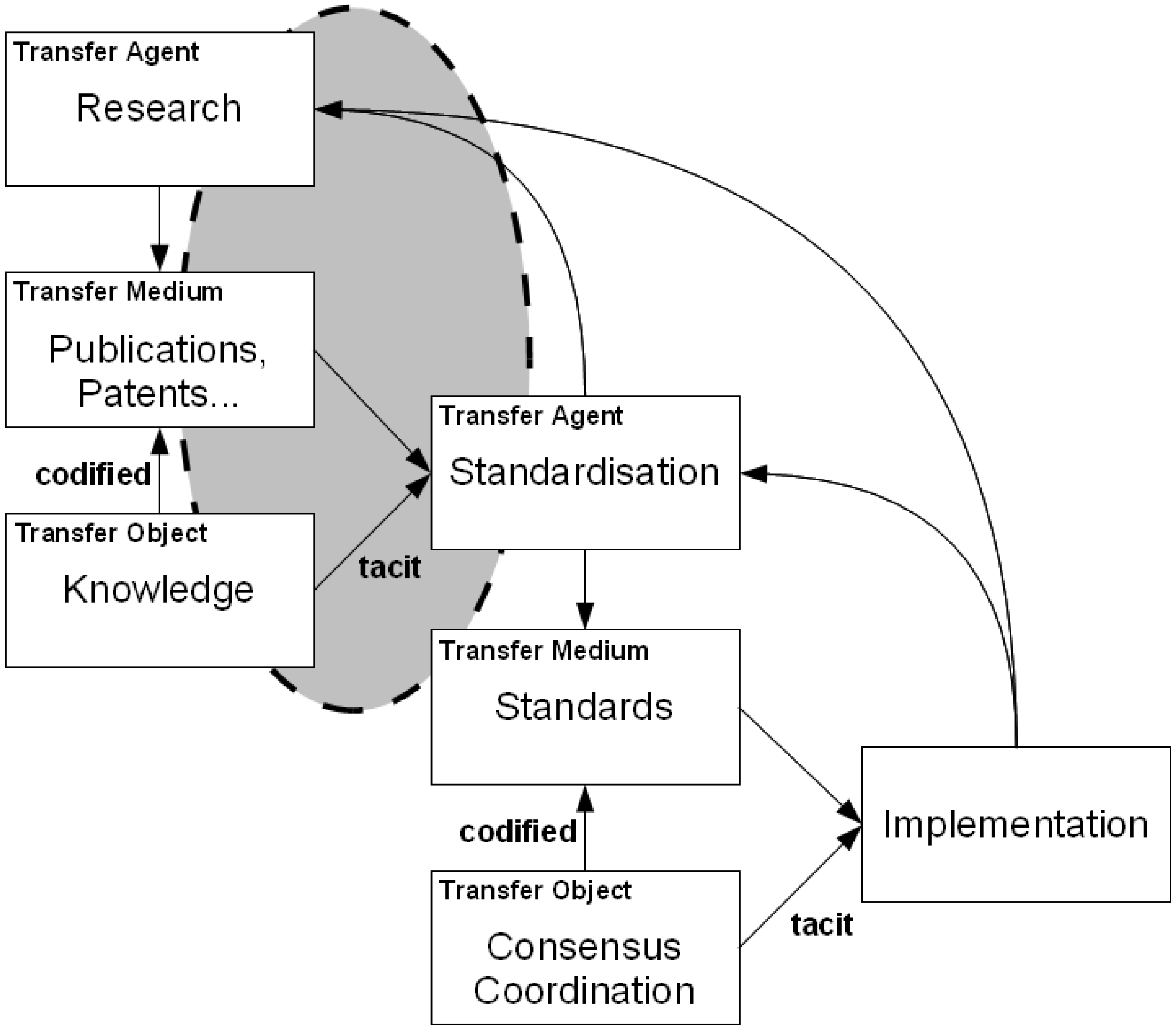
Source: Blind and Gauch 2009

Relevance of input sources for standard development



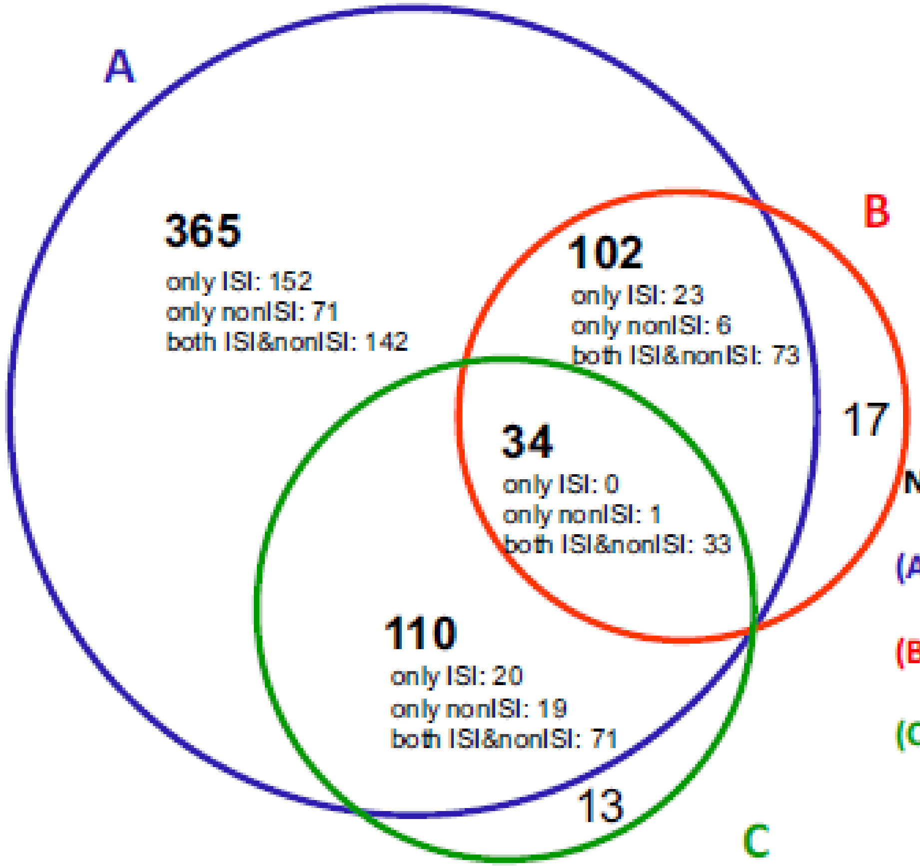
Source: Blind and Kromer 2025

A Cascading Model



Source: Blind and Gauch 2009

Publication, Patenting and Standardisation Activities of Researchers at BAM



Number of BAM researchers involved in:

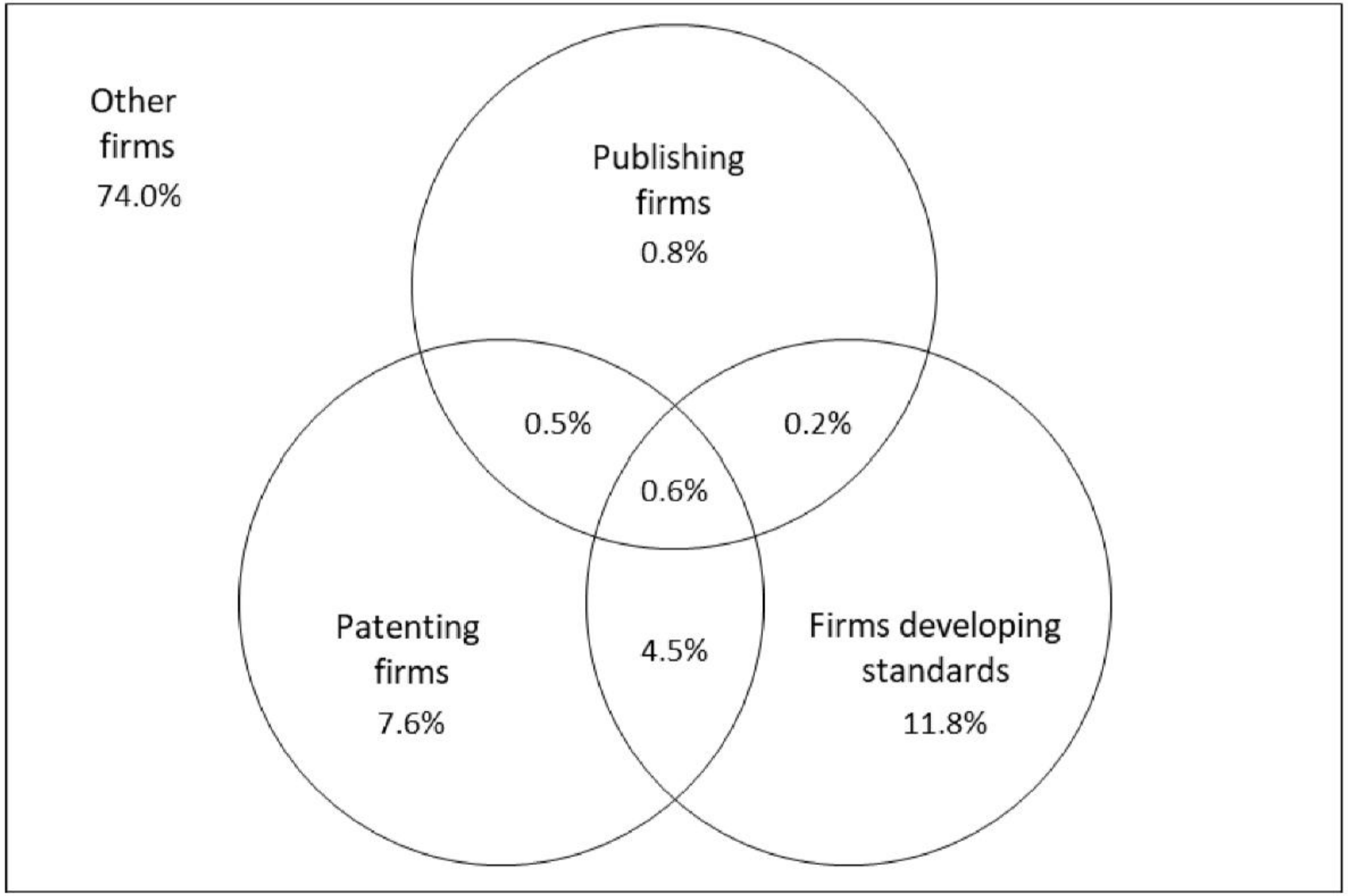
(A) Publications: 611 researchers in total

(B) Patents: 153 researchers in total

(C) Standardisation: 157 researchers in total

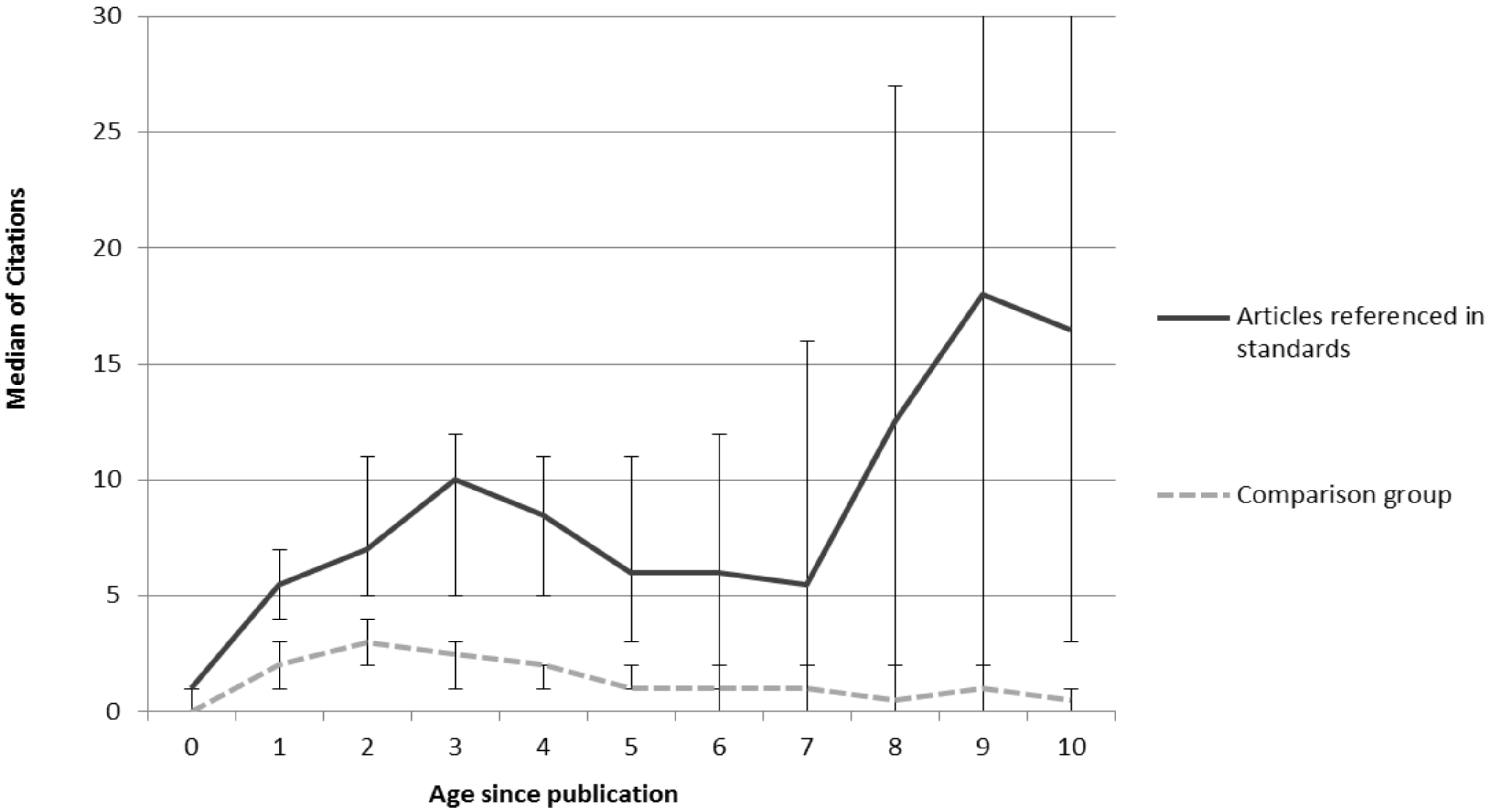
BAM: Bundesanstalt für Materialforschung und -prüfung (BAM)
Source: Zi and Blind 2015

Publication, Patenting and Standardisation Activities of Innovative Firms in Germany



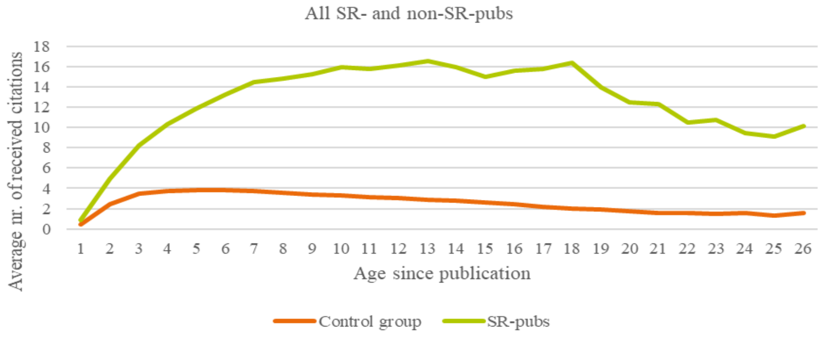
Source: Blind, Krieger & Pellens, 2023

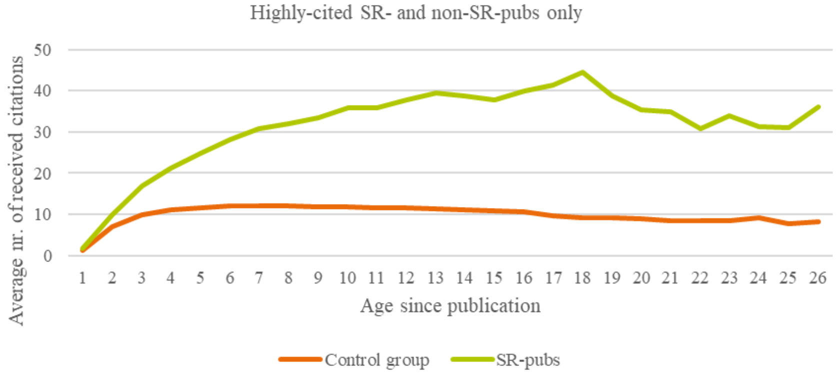
Publications referenced in standards:
Empirical Evidence from Biotechnology

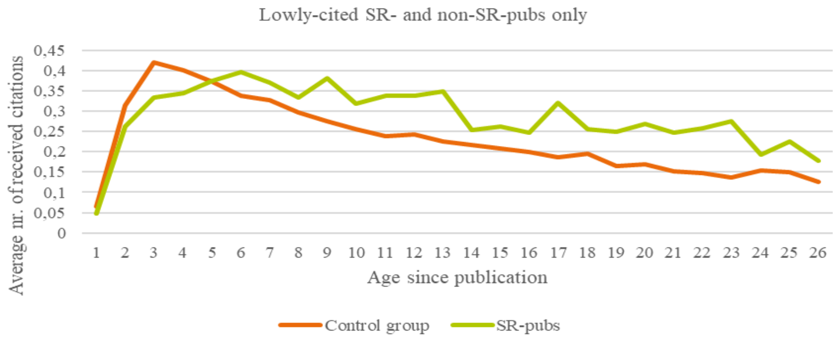


Source: Raven and Blind 2014

Publications referenced in standards:
Empirical Evidence from ISO Standards







Source: Neuhäusler and Blind 2026

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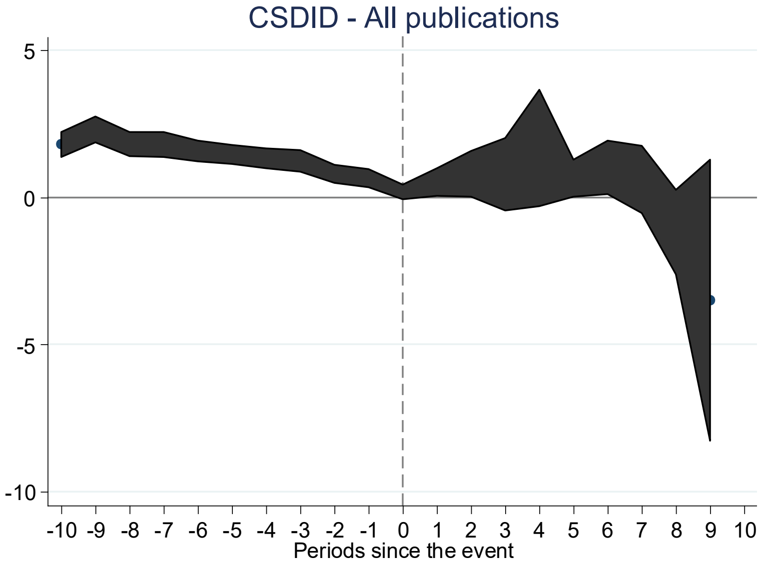
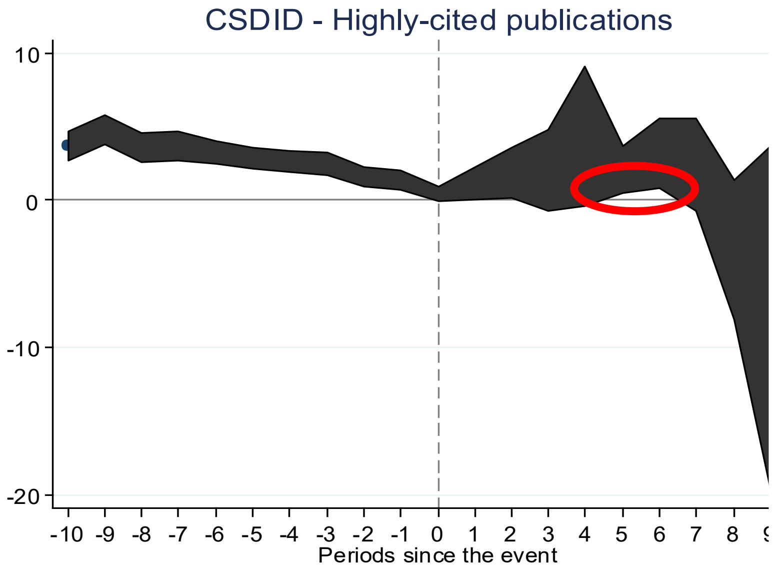
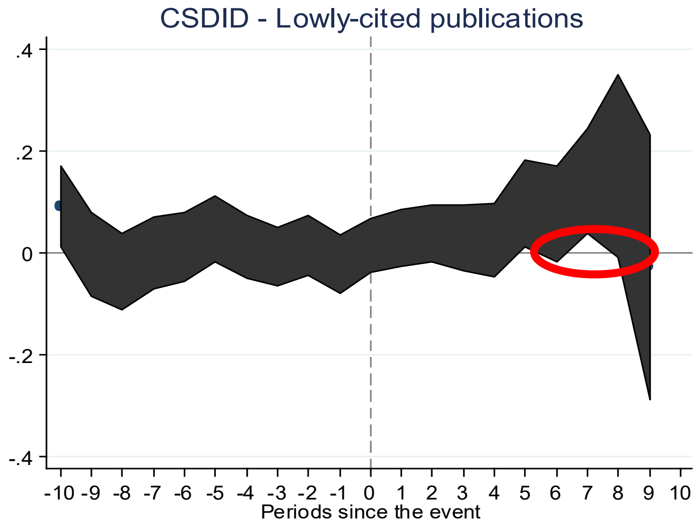
Publications referenced in standards:
Empirical Evidence from ISO Standards applying DiD

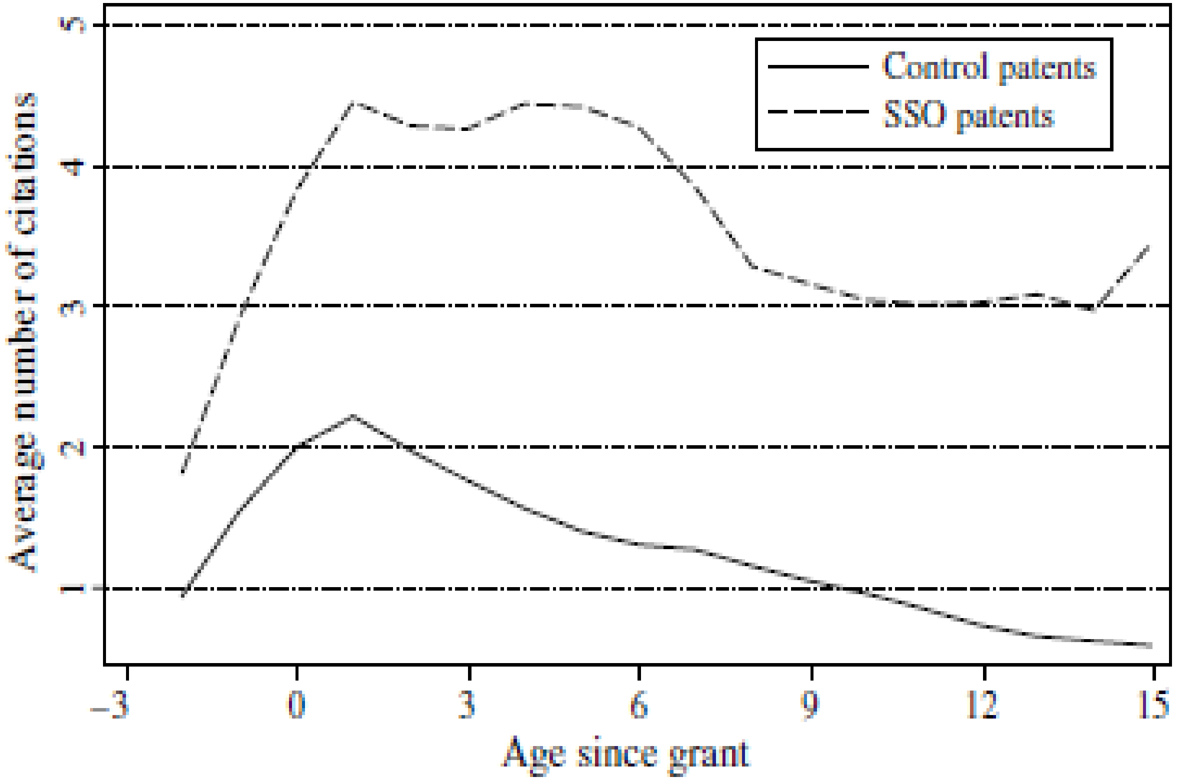




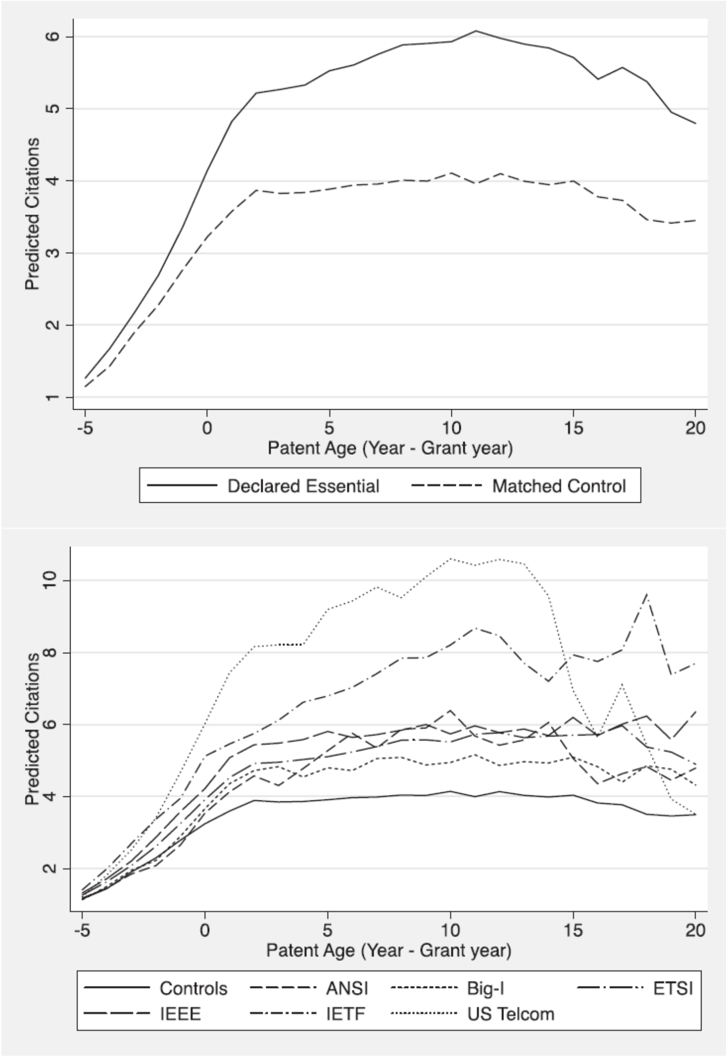


Source: Neuhäusler and Blind 2026

Patents claimed essential for standards: Empirical Evidence from ICT



Source: Rysman and Simcoe 2008



Source: Bekkers et al. 2023

Comparison between SR publications and SEPs

	Standard-Relevant Publications	Standard-Essential Patents
Process	No formalized process	Mainly formalized declarations (e.g. ETSI Homepage)
Input	Mostly published publications	Mostly applied but not granted patents
Timing	Inclusion up until publication of standards	Inclusion during the standardization process, but official declaration before and after the publication of the standards
Type of Research	Both basic and applied research	Applied research
Areas	All scientific and technological areas with a focus on health, safety, and environmental standards	Strong focus on ICT standards
Actors	Mainly research institutes and universities Companies and governmental agencies	Mainly companies and some research institutes
Demographics	Researchers later in their careers	Older than average inventor
Motives	Intrinsic interests, reputation, and influence on public policies	Commercial interests, incl. reputation, signaling, and freedom to operate
Barriers	Cost of participation and lack of recognition by the scientific community	Cost of participation
Impacts	Higher cited papers are referenced in standards Higher subsequent citations due to being referenced in standards No information about commercial impacts	Higher cited patents are declared to be essential to standards Higher subsequent citations due to the essentiality declaration Positive commercial impacts

Source: Neuhäusler and Blind 2026

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Standard categories

1. Minimum quality/ Safety standards
2. Compatibility and interface standards
3. Variety reduction standards
4. Information and measurement and testing standards

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Minimum quality standards

- Specify acceptable performance criteria along dimensions such as functional levels, efficiency, health and safety.
- Reduce **information asymmetries** between buyers and sellers
- Bad quality drives out good quality products if the consumer does not know the quality of the product (Akerlof 1978)
- With Quality/Safety standards the buyer can confidently distinguish high quality from low quality before purchase, and then the high quality seller can sustain a price for his superior product
- E.g. car safety standards/biological produced food

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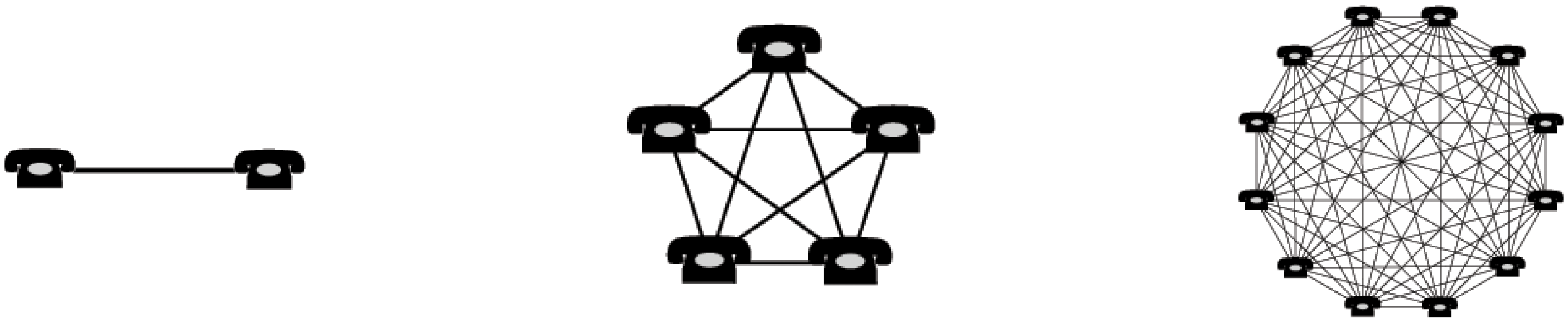
Compatibility / Interface standards

- Specify properties required by a technology in order to be physically/functionally compatible with other product, process, or system.
- Reduces switching costs
- Enable compatibility between products (telephone, internet, …)
- Expand market opportunities through “Network Effects”
- Network effects: The value of a service or products increases with the number users



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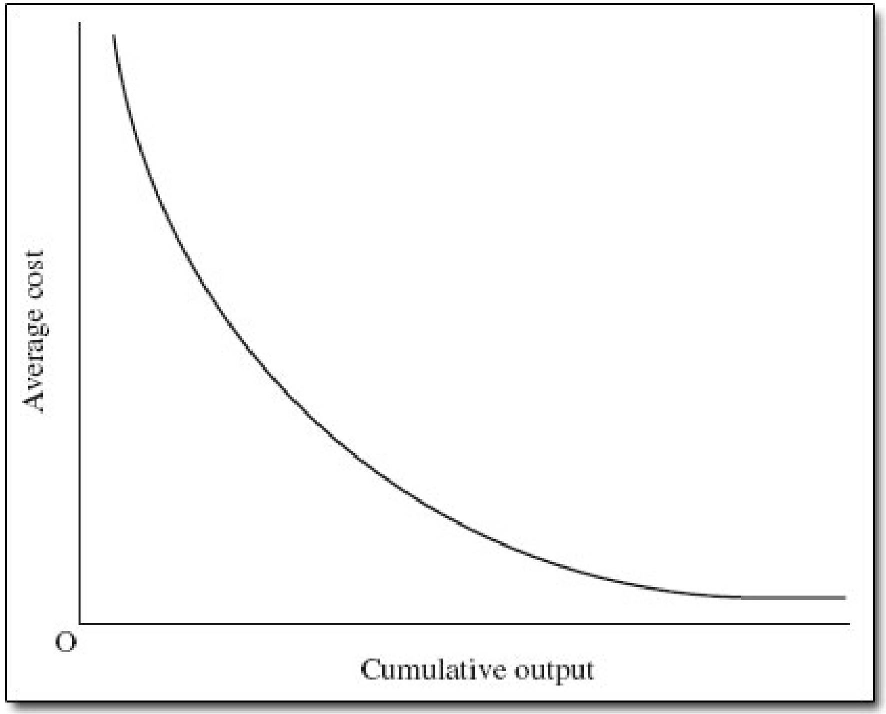
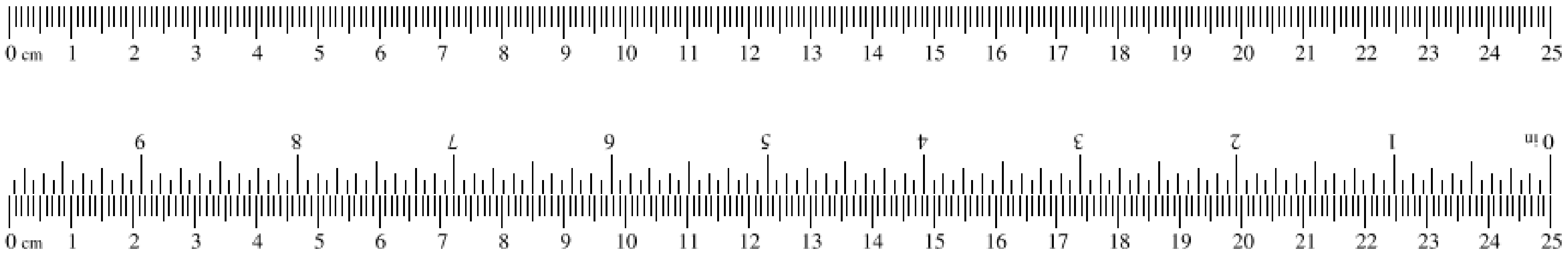
Variety reducing standards

- Limit a certain range or number of characteristics such as size or quality levels, for economies of scale as well as users’ confidence
- Production with “economies of scale”
- Allows mass-manufacturing
- Makes products and services cheaper
- E.g. clothing size (S, M, L, XL)

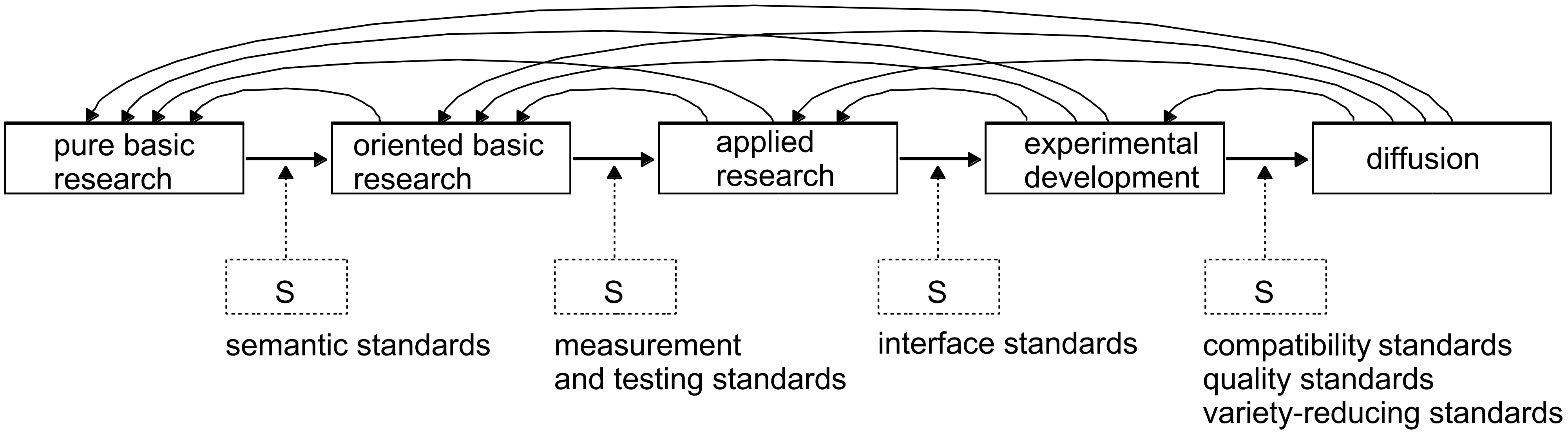


Information and measurement standards

- Facilitate efficient communication and knowledge transfer by describing product attributes and providing technical information.
- Provide standardized scientific / engineering data as well as equipment calibration techniques for efficient R&D.



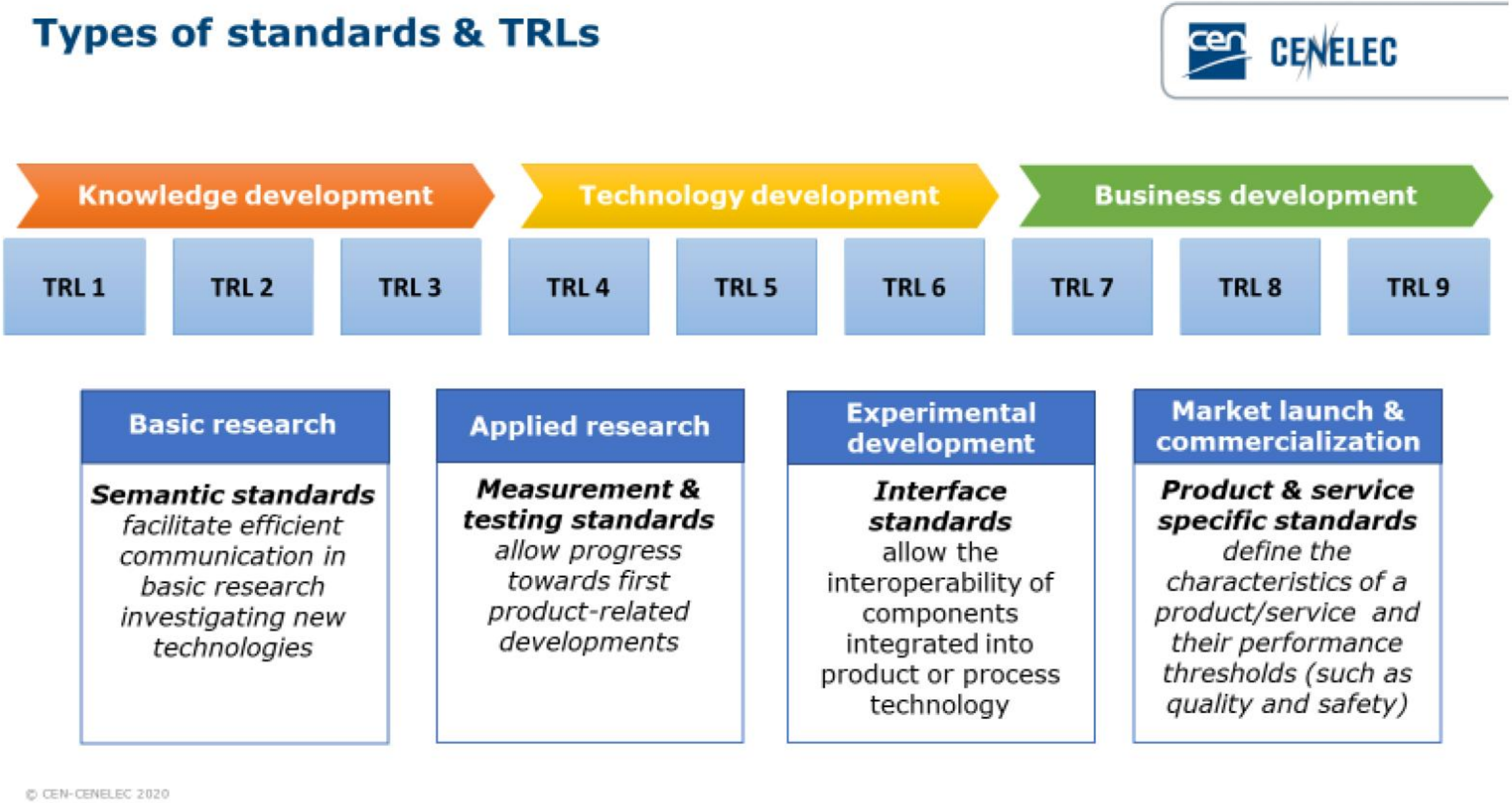
Types of R&D vs. Types of Standards



Function of Standards	Reduction of information cost Reduction of transaction cost		Interoperability between components Savings in adaption cost	Increased quality Reduced health, safety, privacy risks Building critical mass Economies of scale Creation of network externalities Interoperability between products

Source: Blind an Gauch 2009

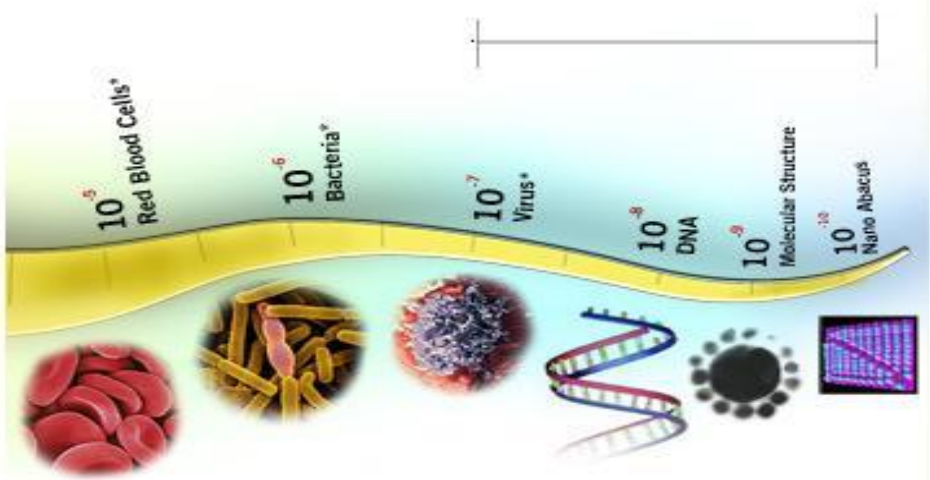
Types of Standards & TRLs



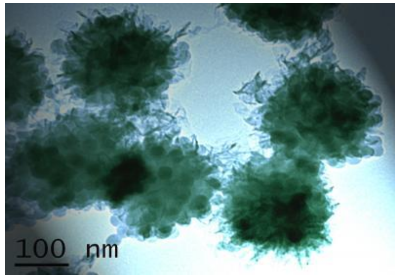
ISO Activities on Terminology in Nanotechnology

100 nm 1 nm

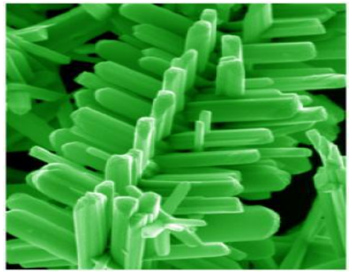
nanoscale



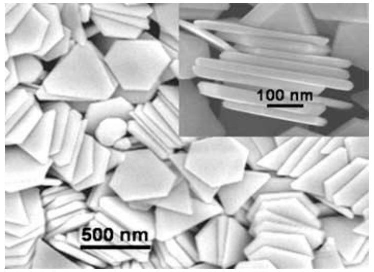
nano-object



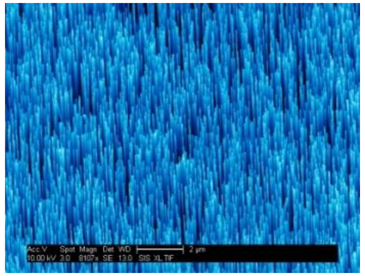
nanoparticles



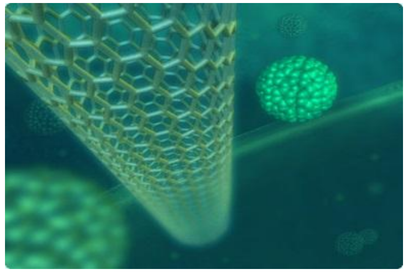
nanoplates



nanocylinder



nanotube



Source: Blind 2009

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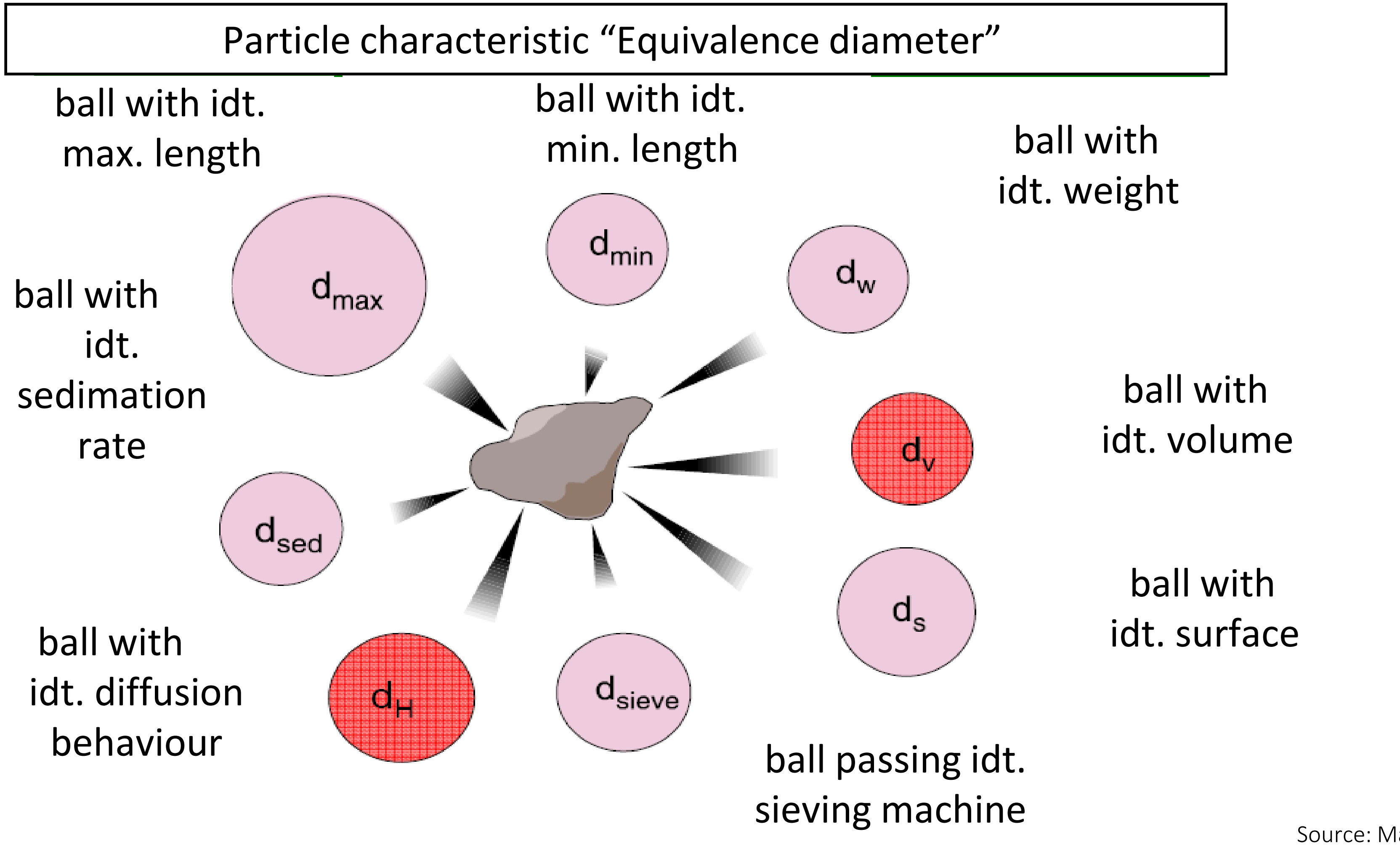
Measurable characteristics of nanoparticles



Source: Malvern GmbH

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Framework and Identification of Standardisation Needs in Quantum Technology

- Horizontal layer and cross cutting of QT components, sub-systems, platforms

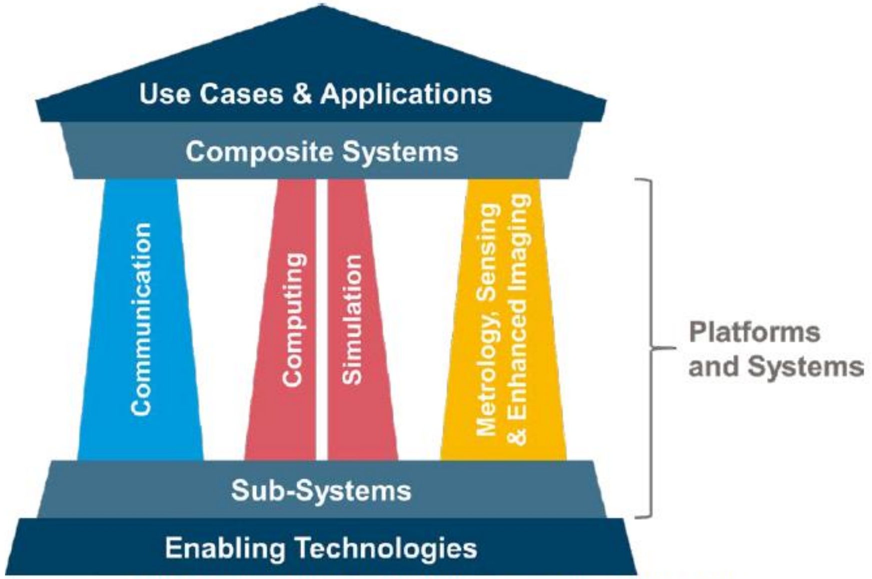
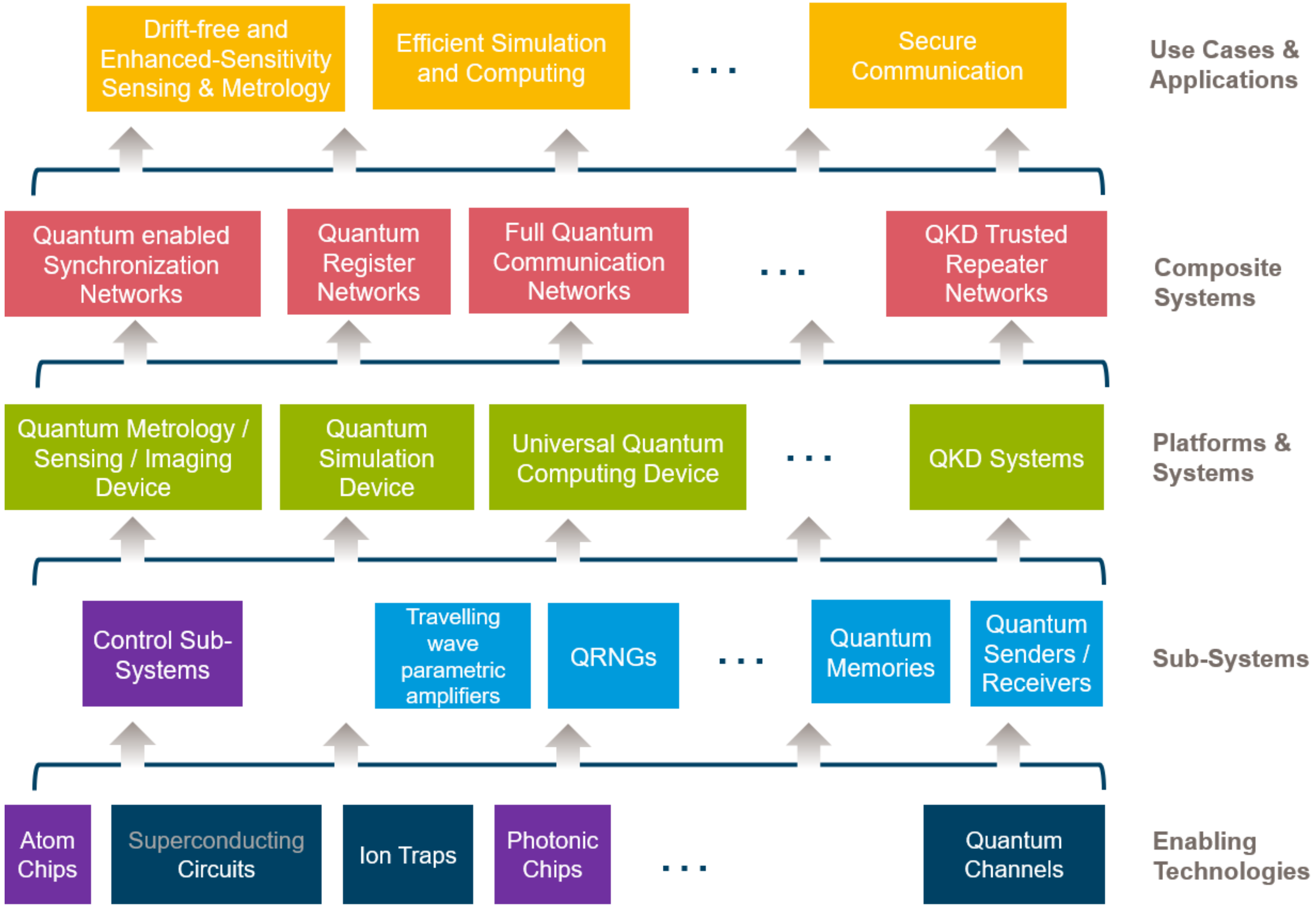


Figure 1: Quantum technology "temple" structure (Source: [57])



Source: CEN-CENELEC FGQT Standardisation Roadmap for Quantum Technologies. Document N020, latest version via https://www.cencenelec.eu/areas-of-work/cen-cenelec-topics/quantum-technologies/.

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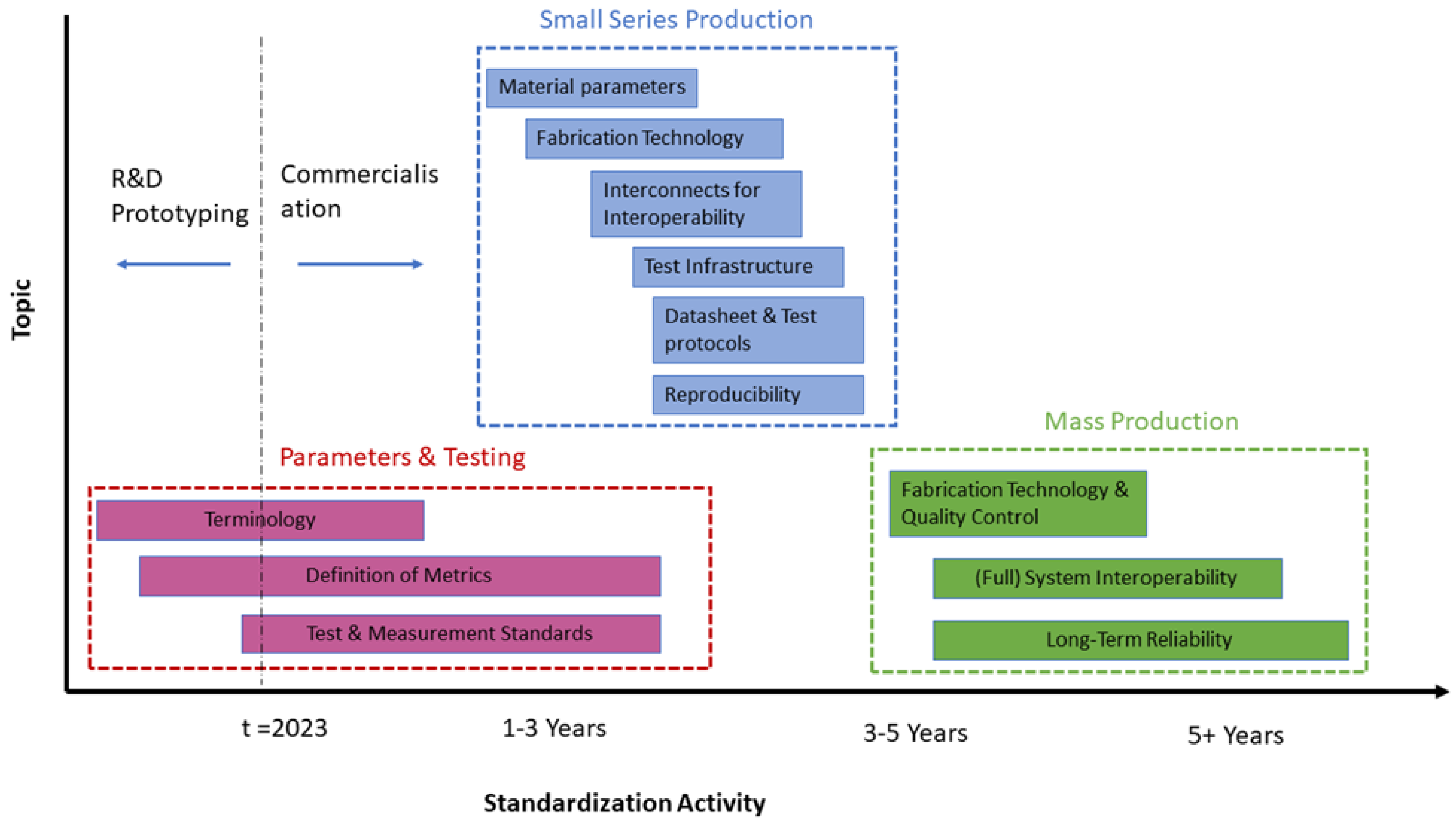
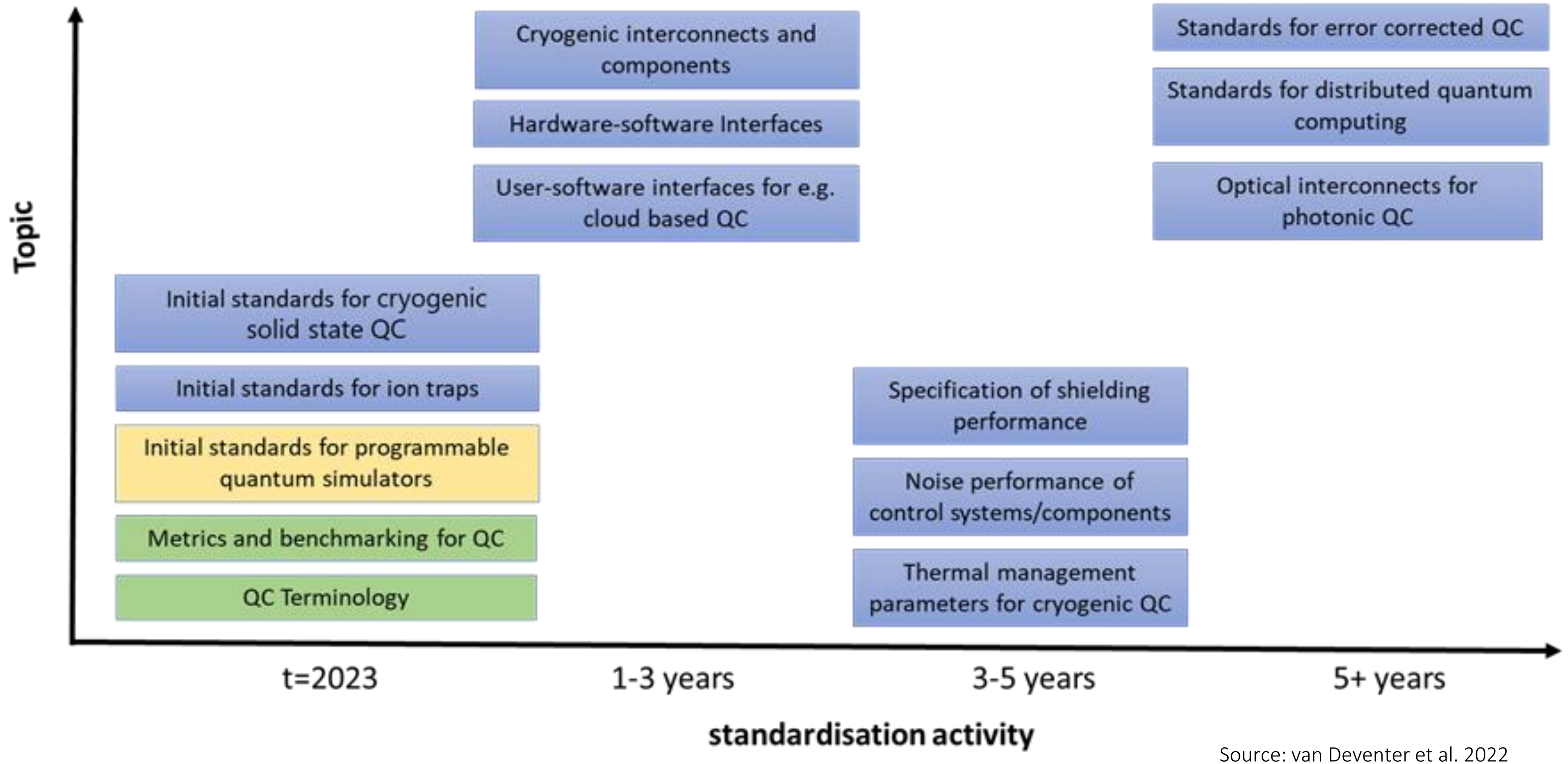
Timeline for Standardisation of Quantum Technology



Source: van Deventer et al. 2022

Timeline for Standardisation of Quantum Computing



Source: van Deventer et al. 2022

Roadmap of JTC 22

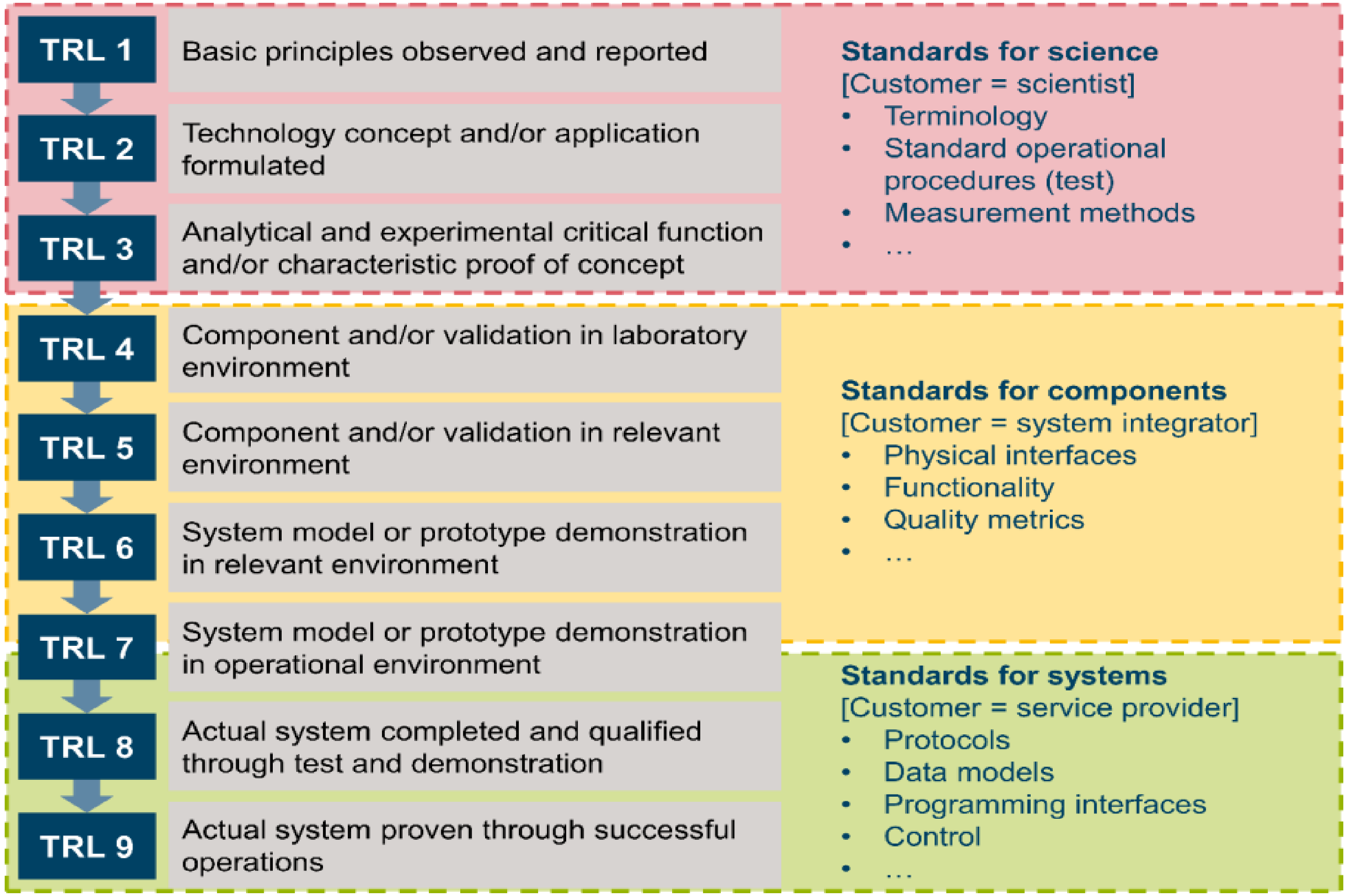


Figure 4 Technology readiness levels (TRL) and their relationship to standards and principal users

Source: van Deventer et al. 2022

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Summary and Implications

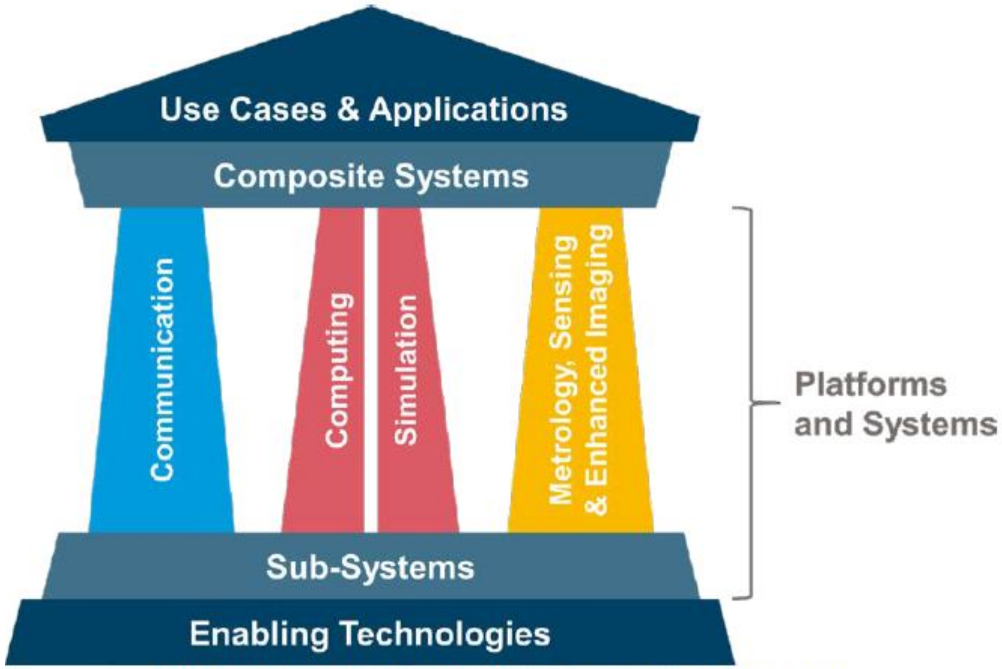

Figure 1: Quantum technology "temple" structure (Source: [57])

Source: CEN-CENELEC FGQT Standardisation Roadmap for Quantum Technologies. Document N020, latest version via https://www.cencenelec.eu/areas-of-work/cen-cenelec-topics/quantum-technologies/.

- Roadmap: Standards How and When and by Whom?
- European voice in international/worldwide organizations
- Pave the way for technical commitees and specific standardization work: **Creation of CEN-CLC JTC 22 'Quantum Technologies'**
- First important standardisation activity: Terminology, metrics, parameters to characterized the quality of components
- **Provide overview and guidance: coherent framework for QT standardisation**
- Help to connect and "streamline" current standardisation efforts

Source: van Deventer et al. 2022

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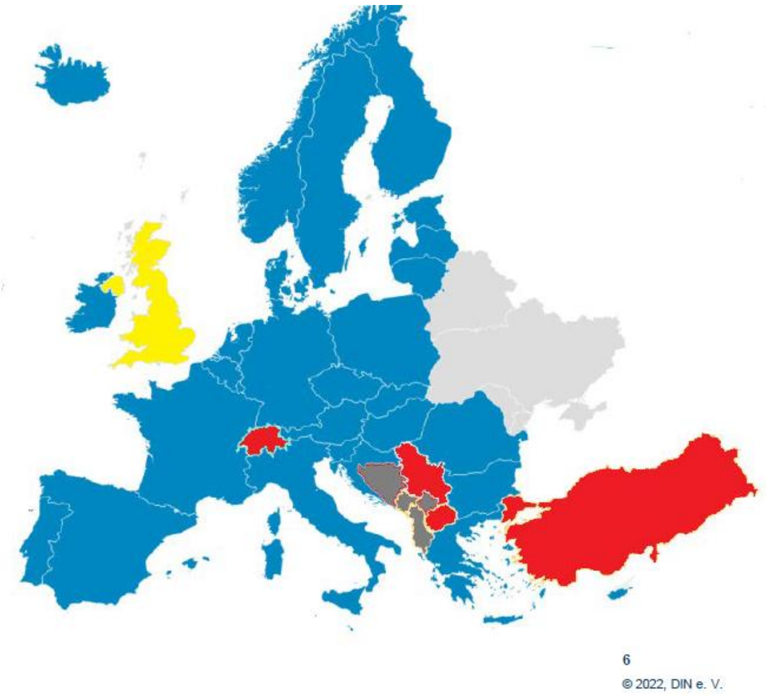
CEN-CENELEC JTC22

- Joint Technical Committee JTC22, proposed May 2022 by DIN (DE)
- Supported by FGQT: European QT roadmap since 2019
- Accepted by CEN/CENELEC BTs in October 2022
- National mirror committees being established 2022-2023
- Berlin kick-off meeting on 9-10 March 2023

Members of CEN:

- blue: European Economic Area, EEA
- red: European Free Trade Association, EFTA
  & candidates for EU membership
- yellow: association agreement with EU



→ **big market, high economic potential!**

Source: van Deventer et al. 2022

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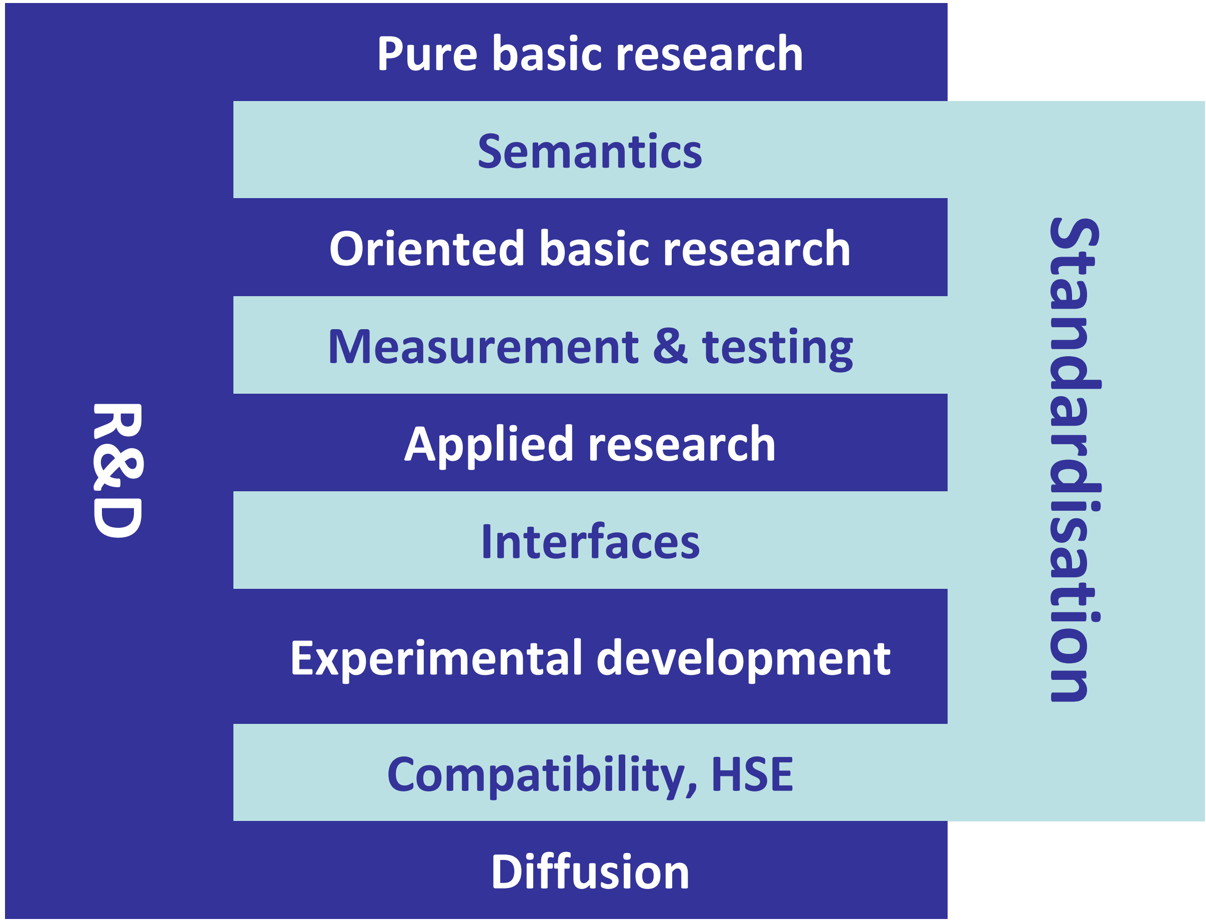
Standards in the research and innovation process



Source: Blind 2009

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Economic effects of standards

General functions of standards	Positive impacts on research and innovation	Negative impacts on research and innovation
Information	Provide codified knowledge relevant for innovation Coordinate collaborative innovation activities	Generate cost for standards screening Allow unintended knowledge spillovers to competitors by implementation of standards
Variety reduction	Allow exploitation of economies of scale via standards Support critical mass via standards in emerging technologies and industries Create incentives for incremental innovation based on standards	Reduce choice Support market concentration Push premature selection of technologies Limit incentives for radical innovation
Minimum quality	Creating trust in innovative technologies and products at the demand side	Promote market concentration
Compatibility	Increase variety of system products Promote positive network externalities Avoid lock-in into old technologies	Push monopoly power Foster lock-in into old technologies in case of strong network externalities
Insurance	Serve as insurance against failure of radical innovation	Create incentives for incremental instead of radical innovation

Source: Blind 2022

Source: Blind 2022 edited by ISO https://www.iso.org/publication/PUB100466.html

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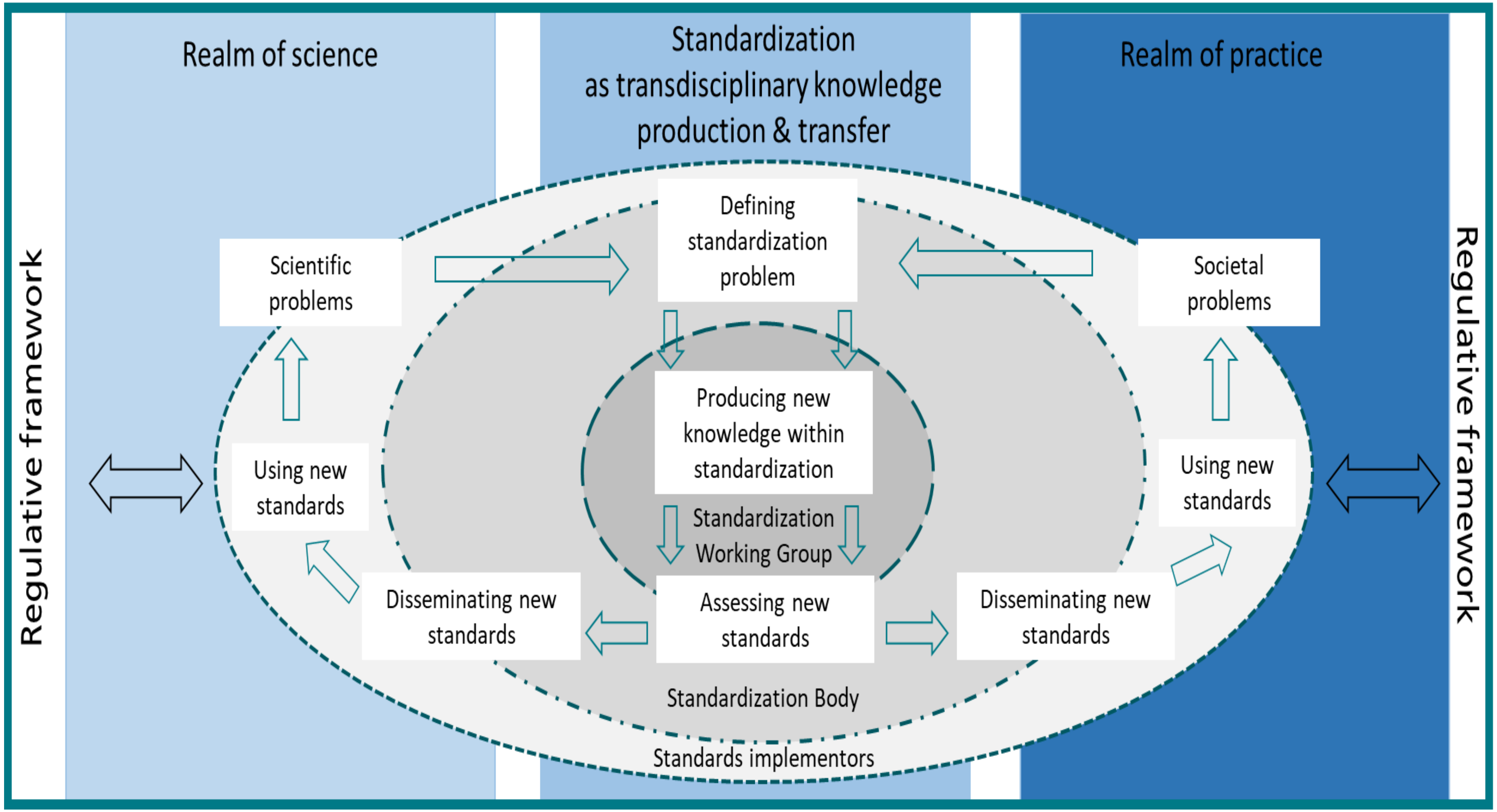
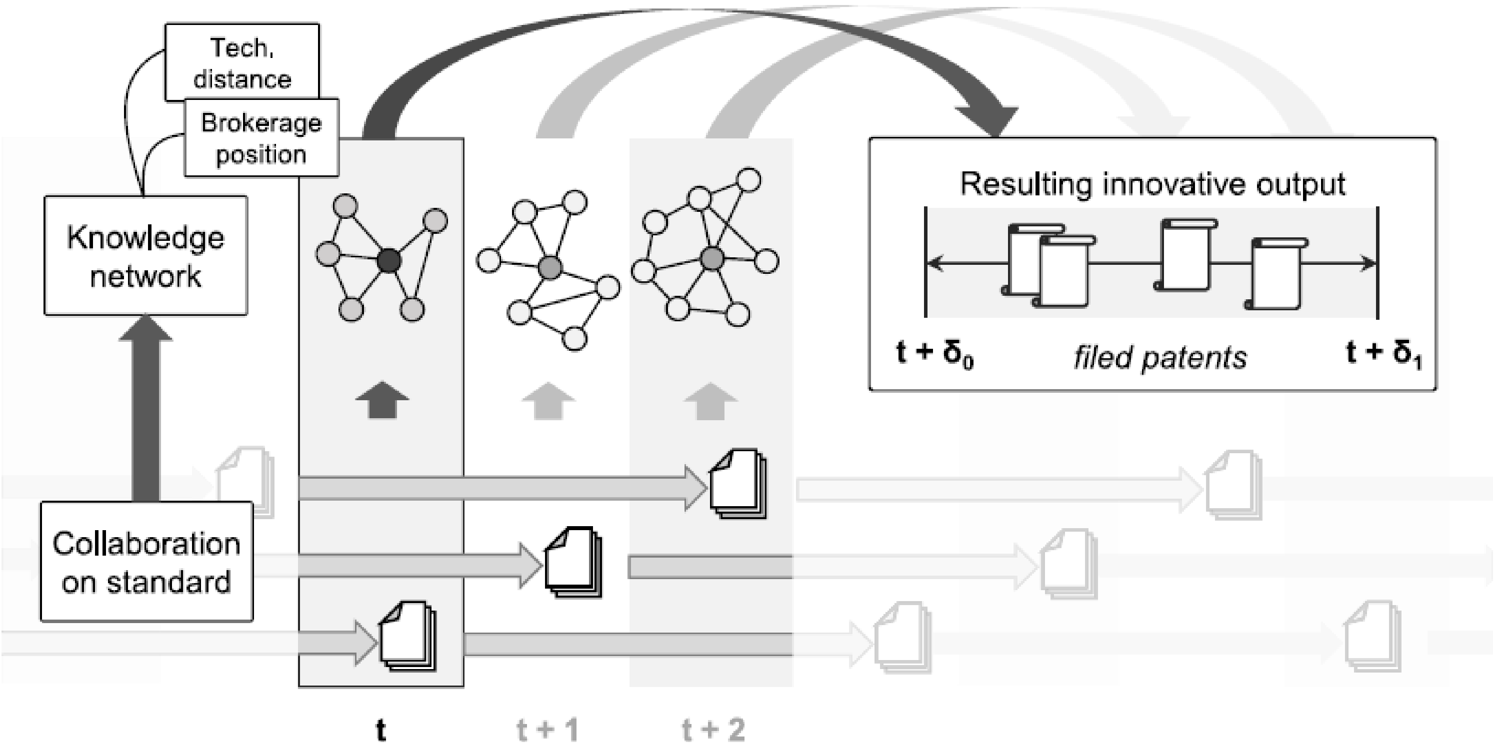
Standardisation in the context of transdisciplinarity



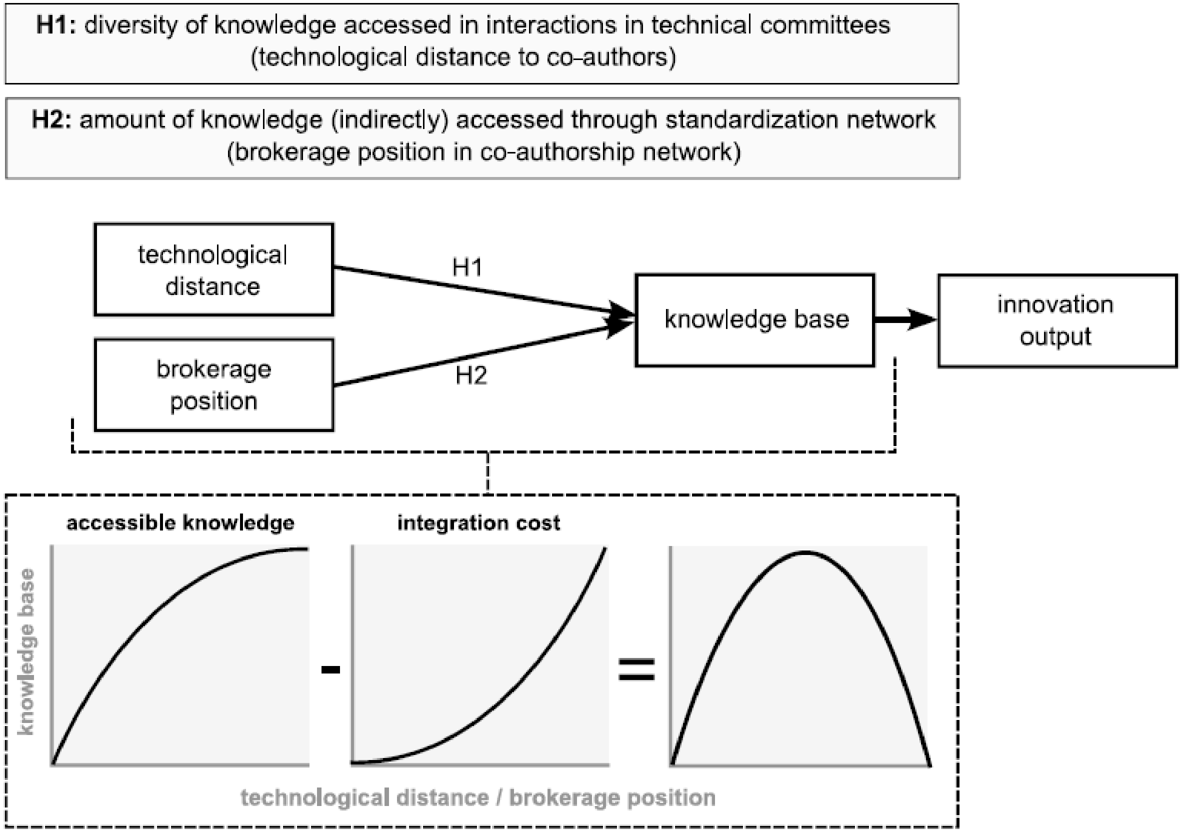
Source: Blind (2024)

Collaborations in standardisation leading to innovation



Source: Heß et al. (2025)

Hypotheses about the influence of technological distance and brokerage on innovation output



Source: Heß et al. (2025)

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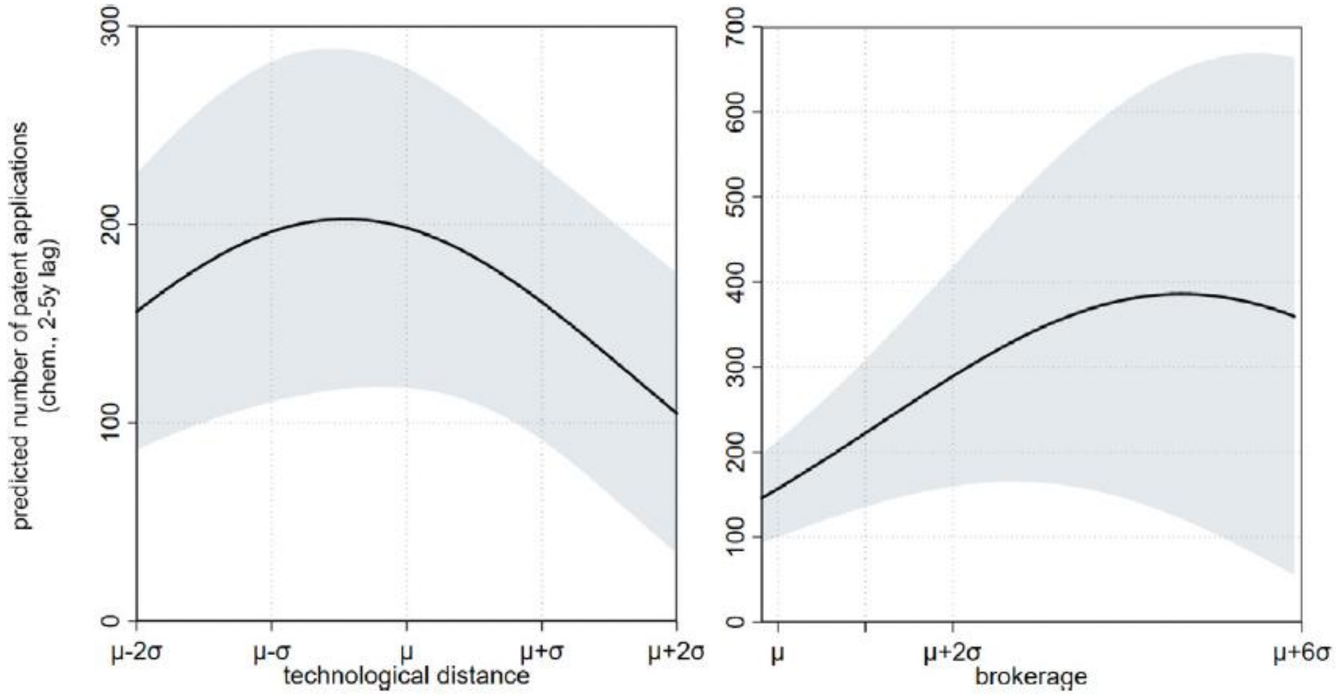
Predicted margins of technological distance and brokerage on innovation (patent applications)



Source: Heß et al. (2025)

Empirical relationship between R&D, patenting, innovation and standardisation

- Link (1983): R&D intensity => positive
- Meuss (2002): R&D and export intensity => nothing
- Blind (2006): R&D and export intensity => Inverse-U
- Blind & Thumm (2004): patent intensity => negative
- Blind & Mangelsdorf (2013): R&D => Inverse-U; patent intensity => negative
- Wakke, Blind, De Vries (2015): R&D and innovation intensity (for services) => Inverse-U
- Blind, Lorenz, Rauber (2021): R&D (insignificant), Patenting activity (+), Market introduction (+)
- Foucart & Li (2021): use of standards increase incremental and reduces radical innovation
- Blind, Krieger, Pellens (2023): innovation intensity incl. R&D positively correlated with involvement in standardisation

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Are standards obstacles in the innovation process?

- In the presence of network effects, standards may be a necessary condition for innovation (Tassey, 1992, 2000)
- Standards are not a major obstacle to innovation activities (Swann,2000)
- Standards can have a positive effect as a marketing tool (Mione & Steinmueller, 1994)
- Standards can prepare the market for products and services based on new technologies or technological platforms (Swann & Watts, 2000)
- Open standards are desirable to enable a competitive process of innovation-led growth (e.g. Krechmer, 1998)
- Standards are catalysts to innovations (Blind, 2009)
- Formal standards lead to higher innovation efficiency in markets with high uncertainty avoidance but to lower innovation efficiency in market with low uncertainty avoidance (Blind et al. 2017)
- Technology standards can be used by firms as an “insurance” hedging against the risky process of developing new products (Foucart & Li 2021)

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Summary

- Research is an important input into standardisation
- Standard-relevant publications and standard-essential patents are codified inputs for standards
- Standards are a form of codified (through the document) and tacit form of knowledge transfer (in the meetings) pushing dissemination of research and hence may enable follow-up innovation
- Within the standardisation process, knowledge production and innovation takes place. Therefore, it can also be considered as type of transdisciplinary research
- In general, we observe on the individual and company a positive correlation between research, patenting and innovation intensity on the on hand and standardisation activities on the other hand.
- However, causality is difficult to prove. And there might be tensions between standards and radical innovation and intellectual property rights, particularly patents

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THANK YOU FOR YOUR ATTENTION.

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