When is the right time for standardisation in research processes

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Contribution of StandICT2026 to the common HSBooster-StandICT-Webinar „Standardisation in practice: When is the right time for standardisation in research processes? “

1st of February 2024

Agenda

- Definition of R&D
- Interlinkages between R&D and standardisation
- Impacts of standards on research and innovation

Definitions: What is R&D? (OECD)

"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)

Definitions: What is R&D? (OECD 2015)

- **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.

Definitions: What is R&D? (OECD)

- **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

Definitions: What is R&D? (OECD)

- **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.

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)

Definitions: What isn't R&D (OECD 2002, 2015)

- 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 (OECD 2015)
- Space exploration (expenditures for satellites to perform routine activities) (OECD 2015)

Borderline between R&D, innovation and other business activities (OECD 2015)

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	

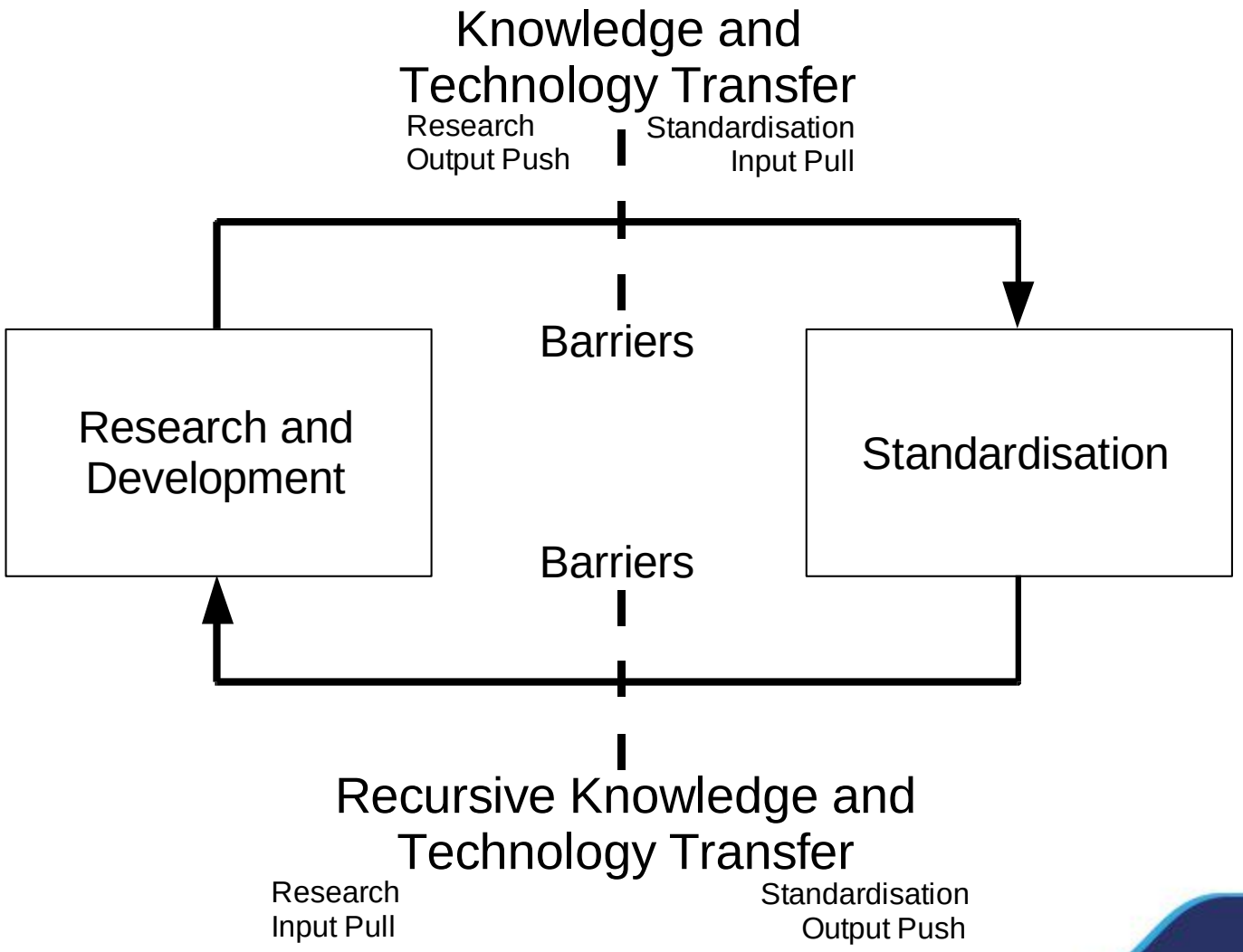
Definitions: What isn't R&D (OECD 2002, 2015)

- 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)

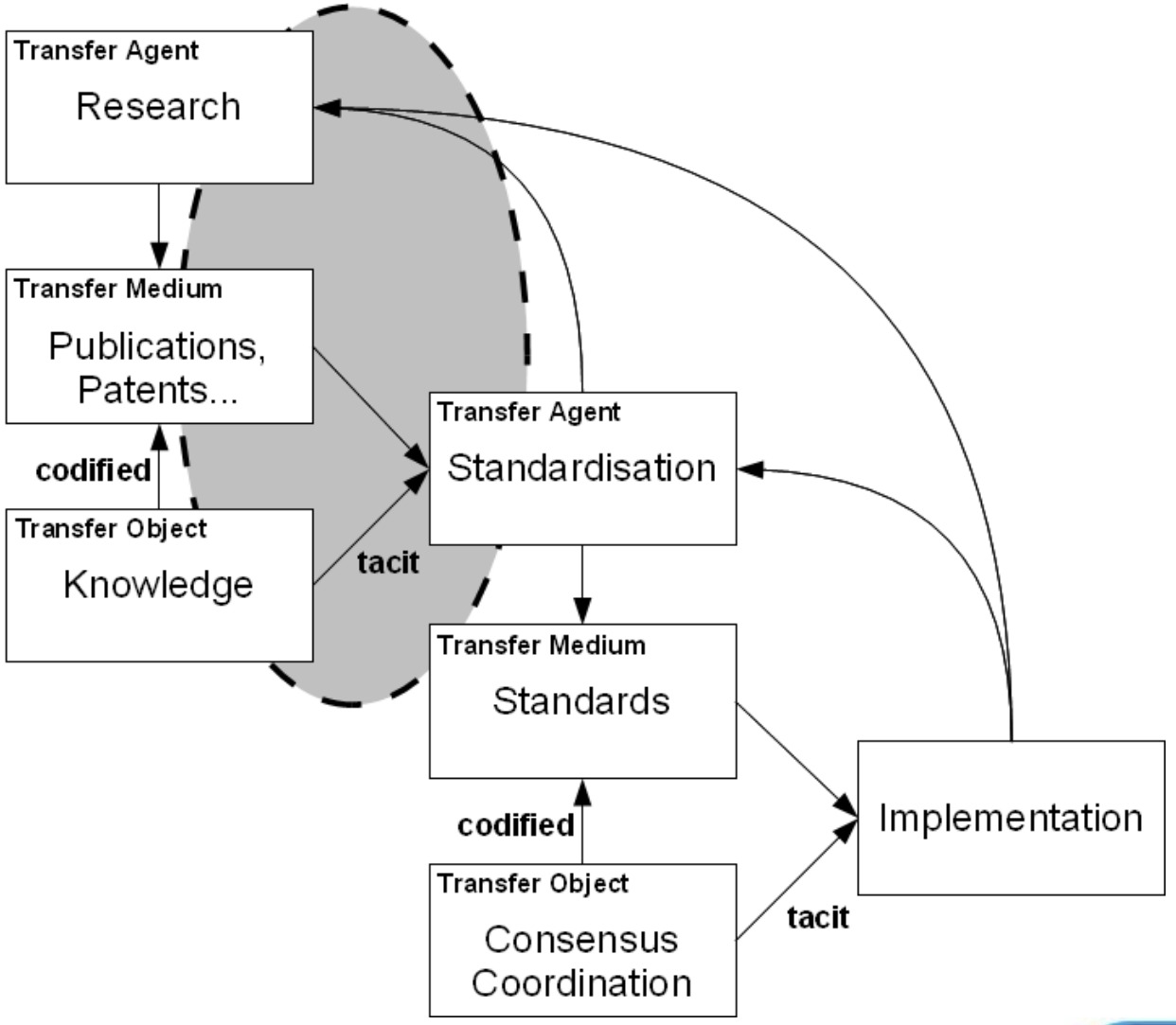
"Public bodies and consumer organisations often operate laboratories that are intended mainly to test products and verify that standards are met. In addition to standard testing and benchmarking activities – which are not R&D – the staff of these laboratories may also spend time devising new or substantially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

A Simple Model of Research and Standardisation



Source: Blind and Gauch 2009

A Cascading Model



Source: Blind and Gauch 2009

Standard categories

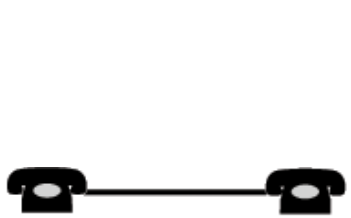
1. Minimum quality/ Safety standards
2. Compatibility and interface standards
3. Variety reduction standards
4. Information and measurement and testing standards

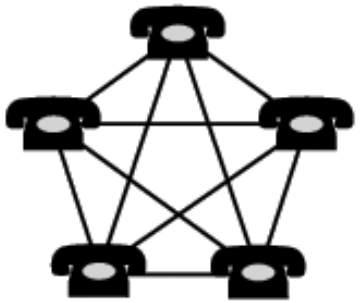
Minimum quality standards

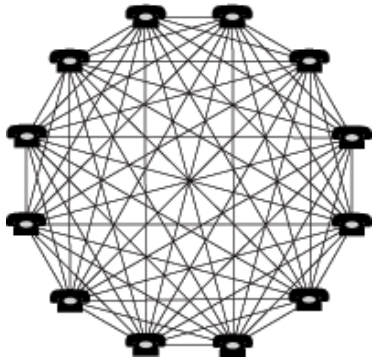
- Specify acceptable performance criteria along dimensions such as functional levels, efficiency, health and safety.
- Reduce **information asymmetries** between buyers and sellers
- Bad quality drives out good quality products if the consumer does not know the quality of the product (Akerlof 1978)
- 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

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

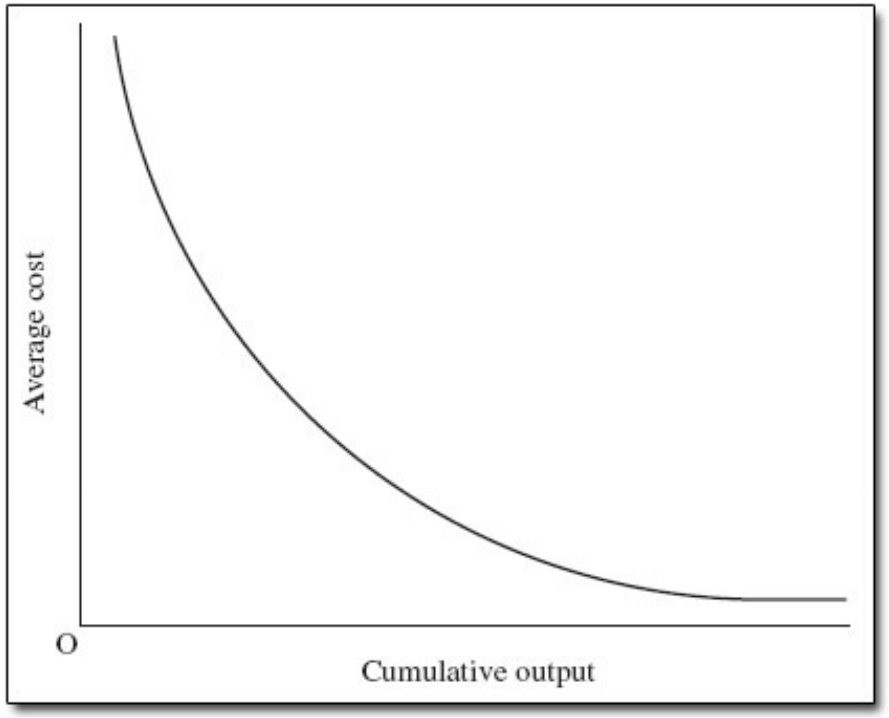






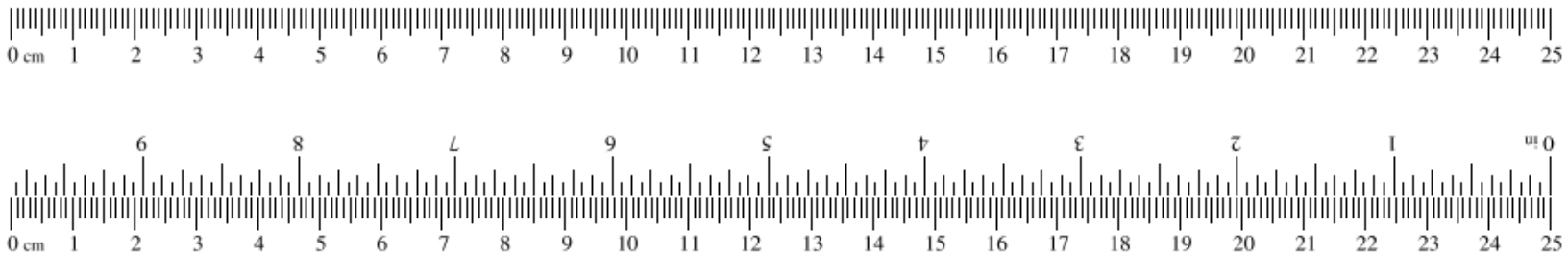
Variety reducing standards

- 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

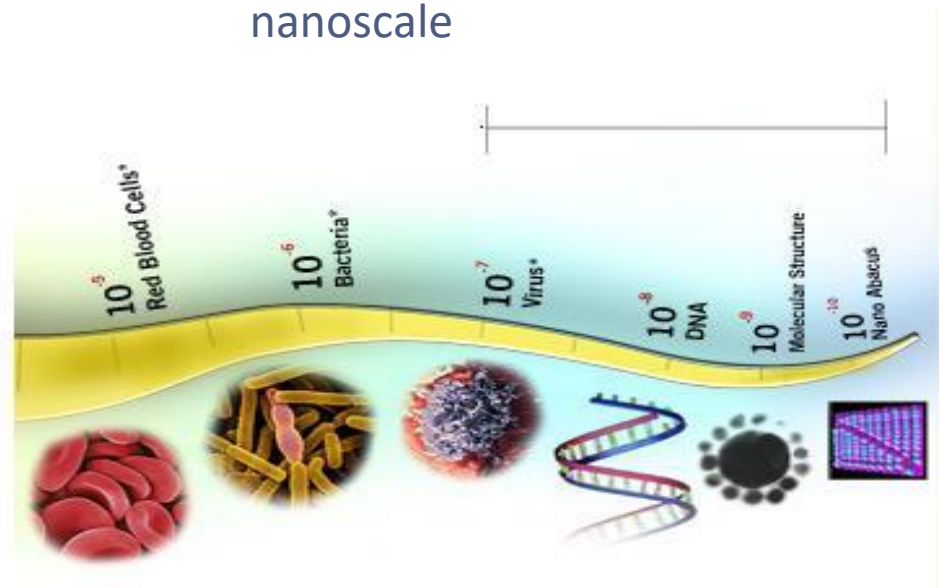
- Facilitate efficient communication and knowledge transfer by describing product attributes and providing technical information.
- Provide standardized scientific / engineering data as well as equipment calibration techniques for efficient R&D.



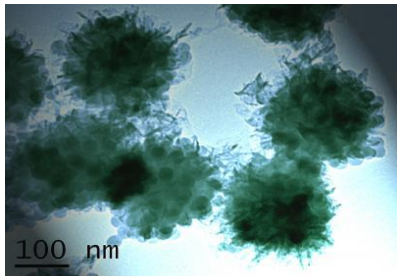
ISO Activities on Terminology in Nanotechnology

100 nm 1 nm

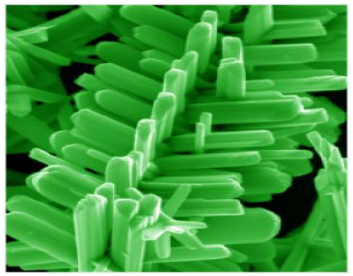
nanoscale



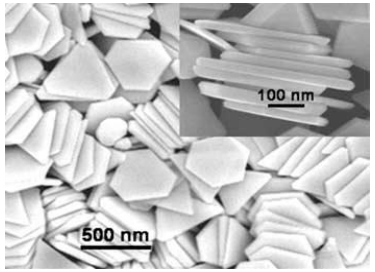
nano-object



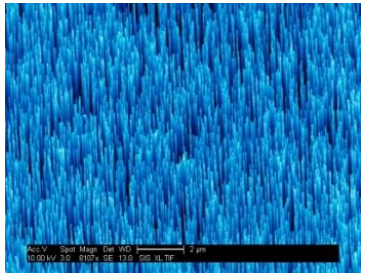
nanoparticles



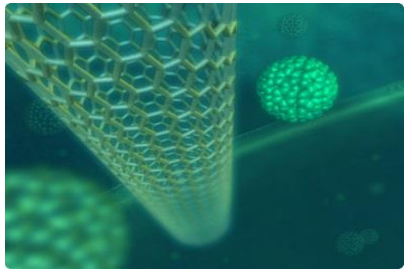
nanoplates



nanocylinder



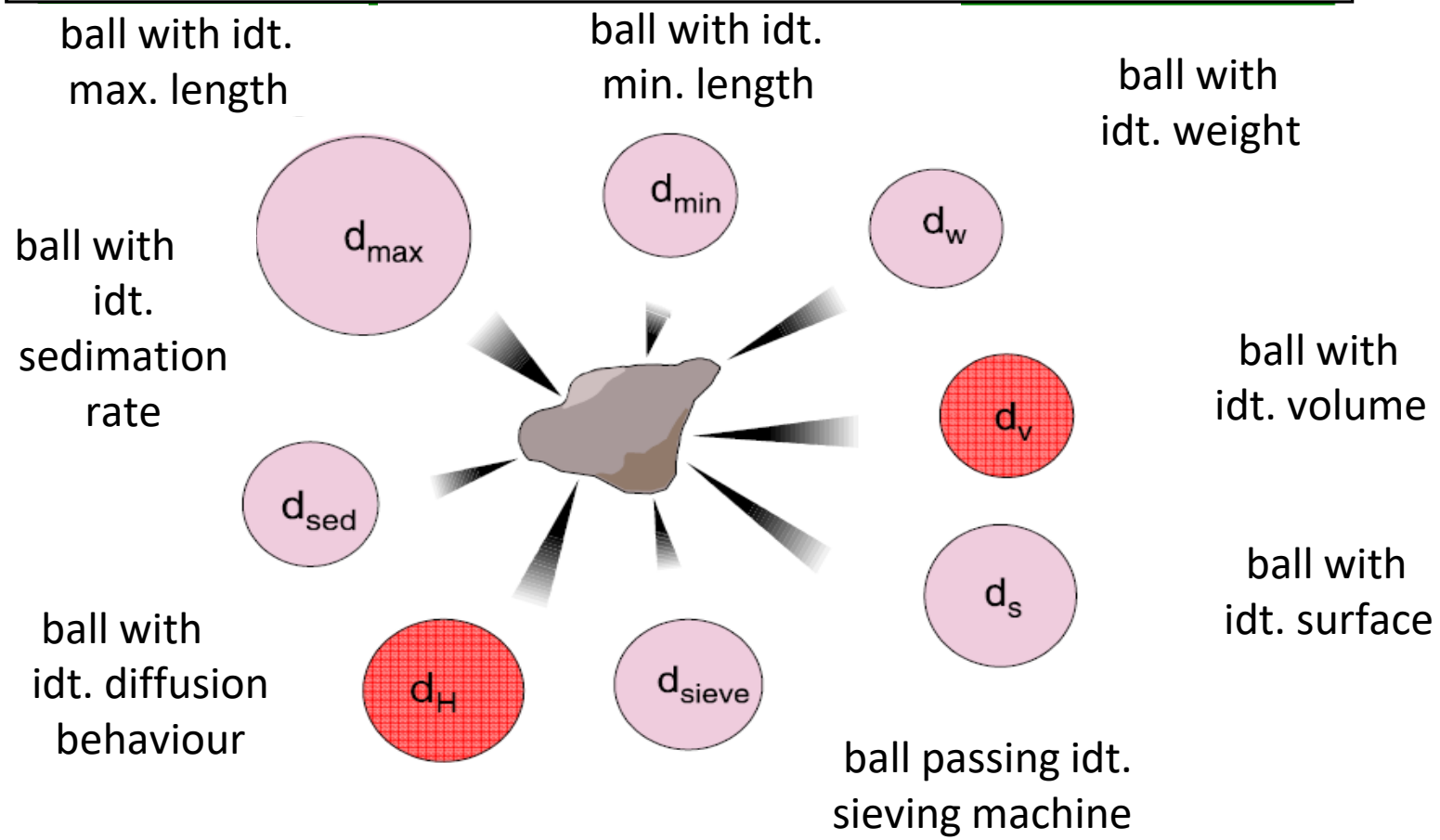
nanotube



Source: Blind 2009

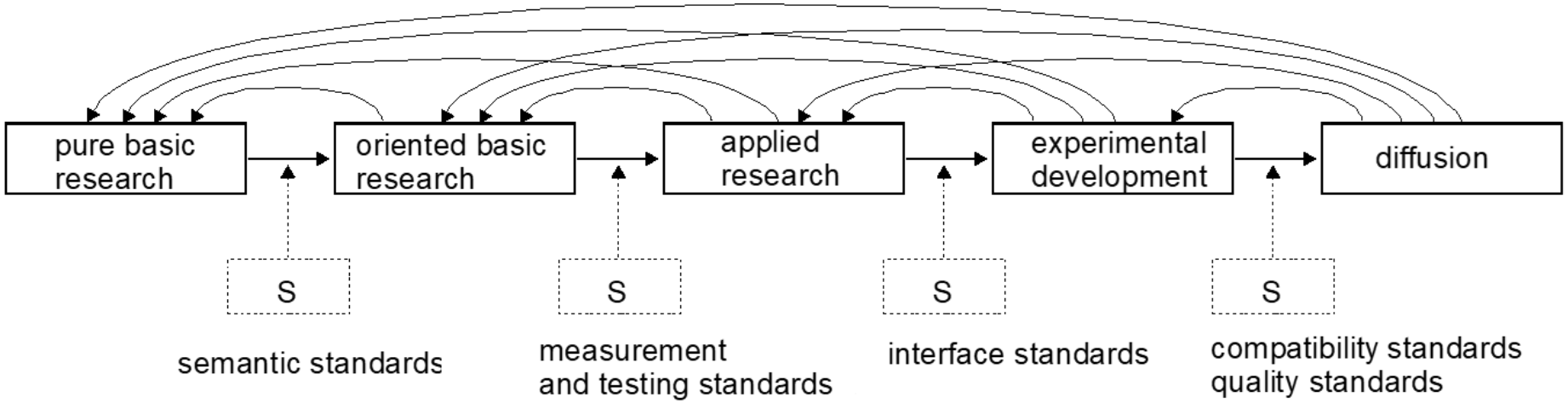
Measurable characteristics

Particle characteristic “Equivalence diameter”



Source: Malvern GmbH

Standards in the research and innovation process



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 and Gauch 2009

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

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)

THANK YOU FOR YOUR ATTENTION.

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