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Supporting Europe's effort in Blockchain/DLT Standardisation

Teaching Module 3 (Advanced) The interface between research and standardisation with a focus on blockchain

Funded by the European Union

Contents

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 topic
  - Available at: www.etsi.org/standardization-education

Accompanying review article:

- **Blind, K. (2022): Standards and innovation: What does the research say?**
  - Further references about the topic
  - Available at: https://www.iso.org/publication/PUB100466.html

Interface between 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 in blockchain standardisation
  - Know standards, which can support blockchain-related research

1. 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)

1. 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.

1. Defintions: 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

1. 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.

1. 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)

1. 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)

1. 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	

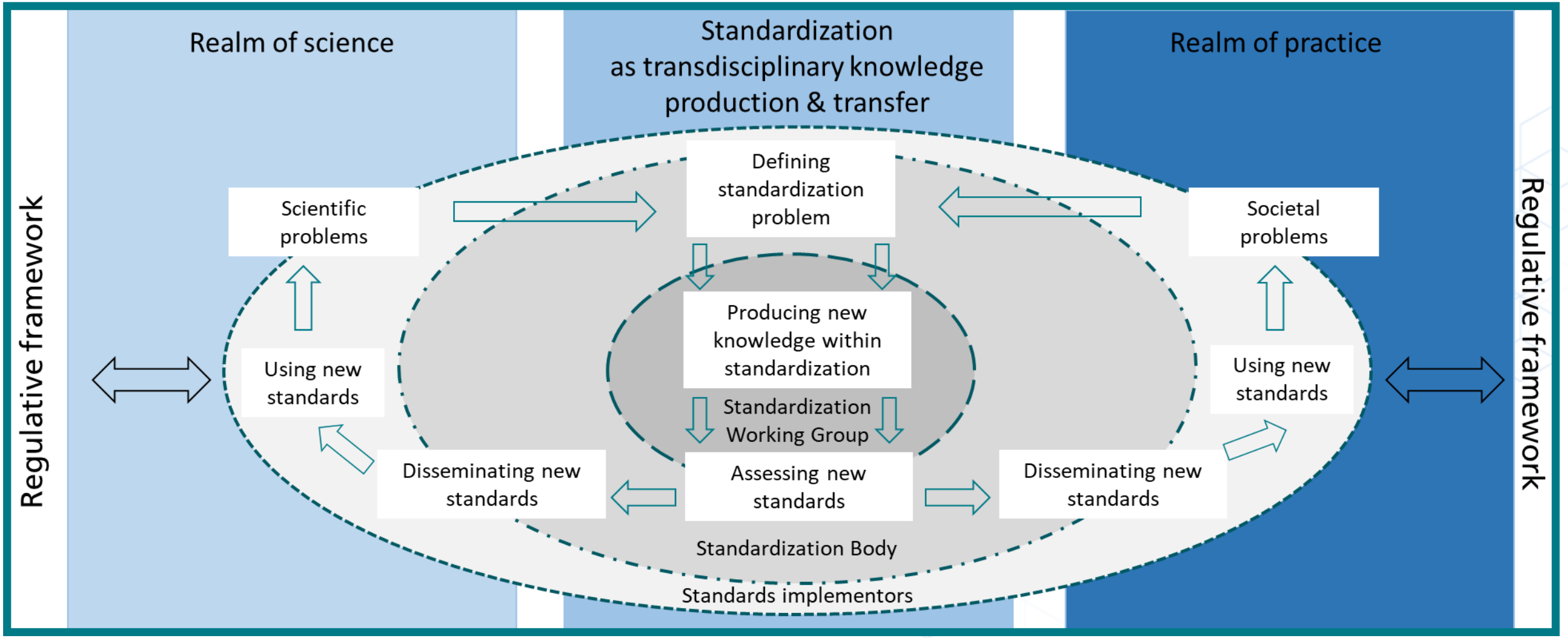
1. Definitions: What isn‘t R&D (OECD 2002, 2015)

- 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)

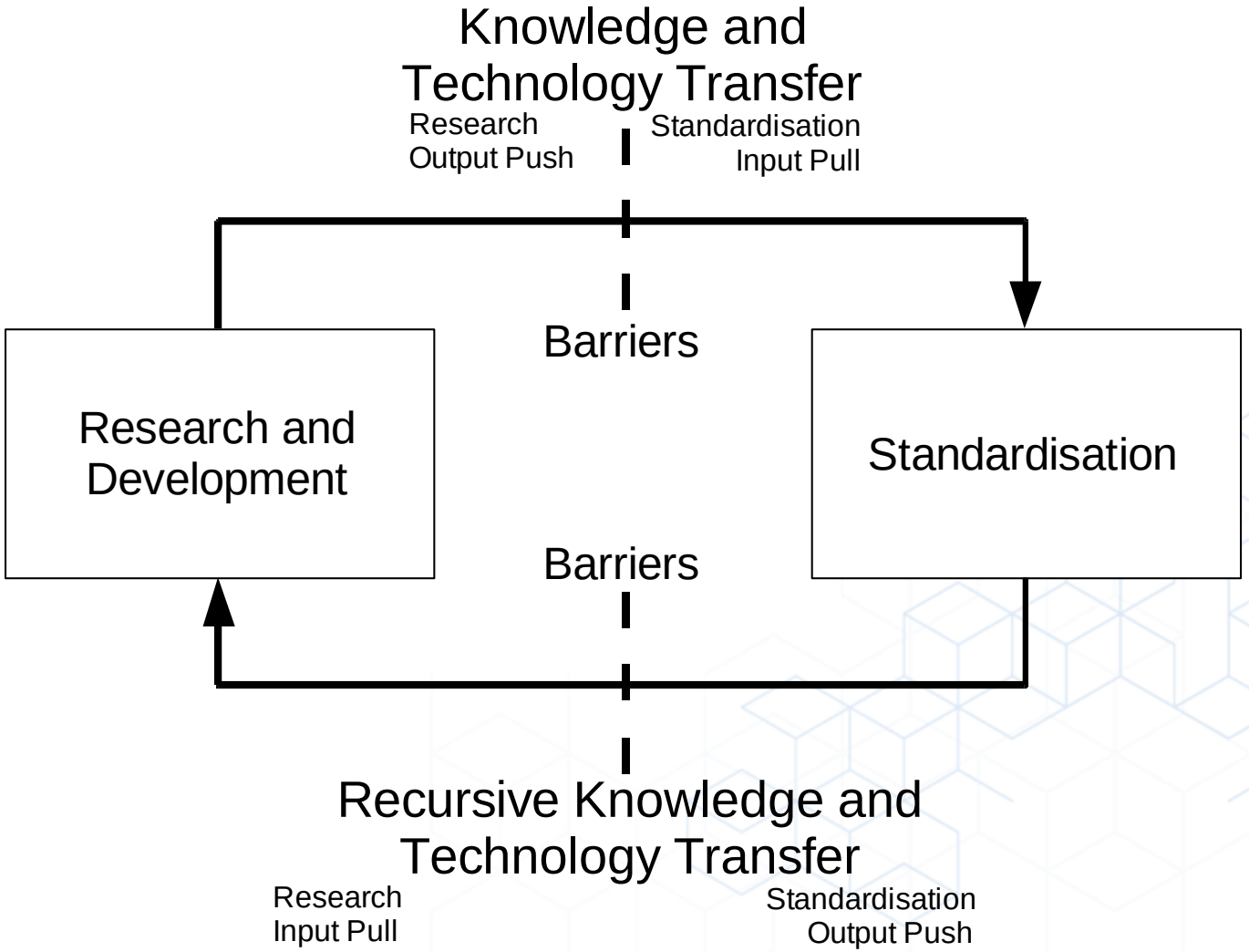
“Public bodies and consumer organisations often operate laboratories that are intended mainly to test products and verify that standards are met. In addition to standard testing and benchmarking activities – which are not R&D – the staff of these laboratories may also spend time devising new or substantially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

2. Interlinkages between R&D and standardisation: Standardisation as transdisciplinary knowledge production & transfer



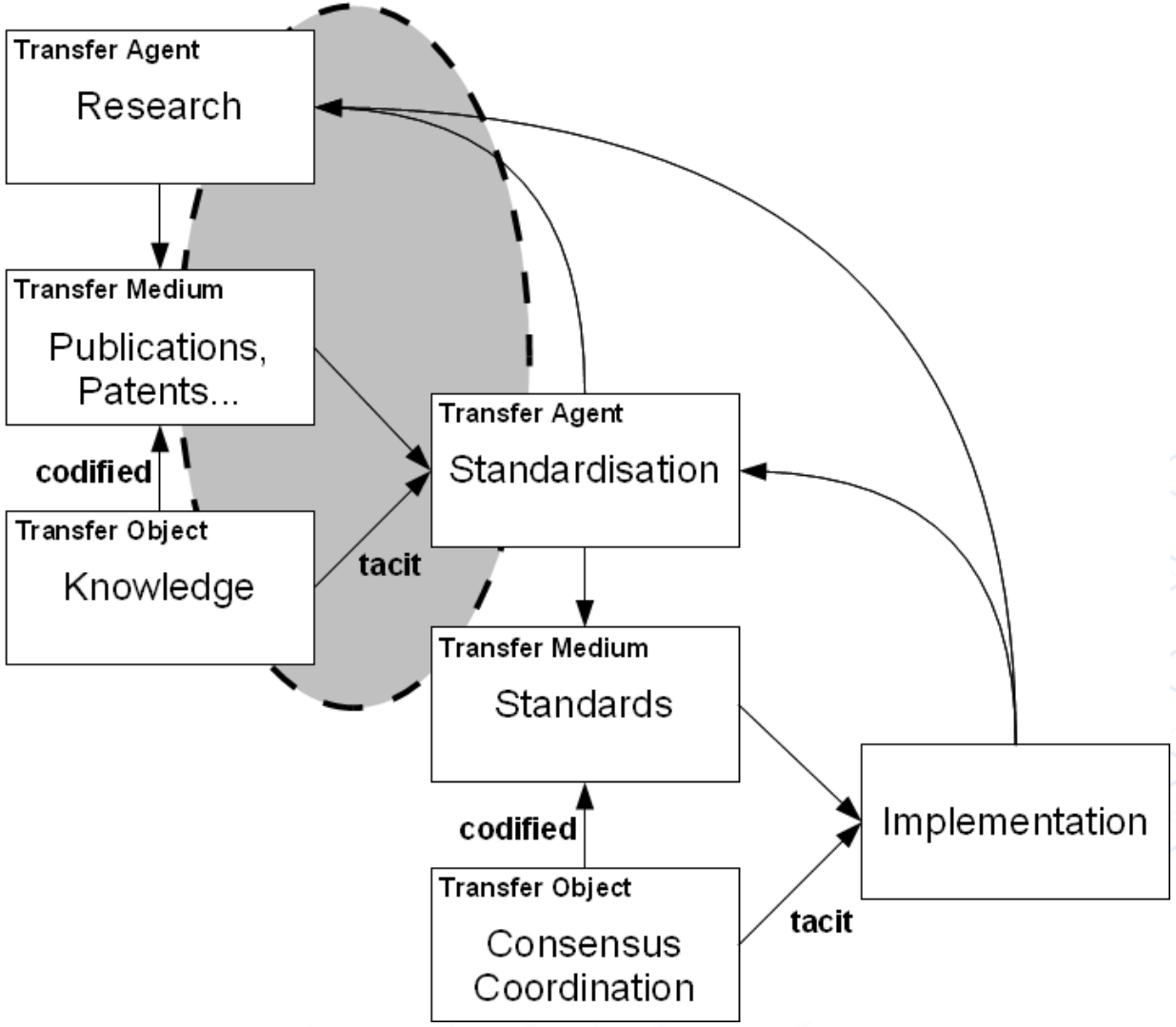
Source: Blind 204

2. Interlinkages between R&D and standardisation: A Recursive Model of Research and Standardisation



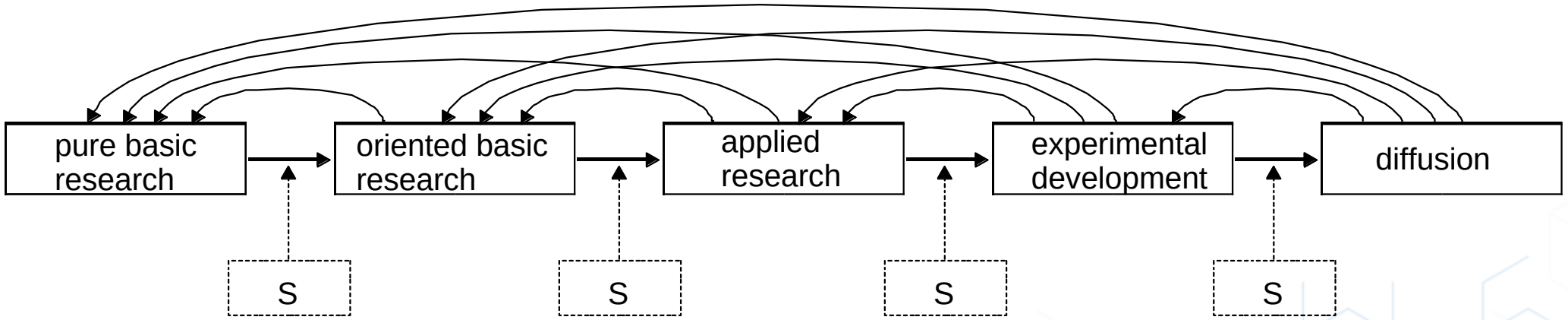
Source: Blind and Gauch 2009

2. Interlinkages between R&D and standardisation: A Cascading Knowledge Transfer Model



Source: Blind and Gauch 2009

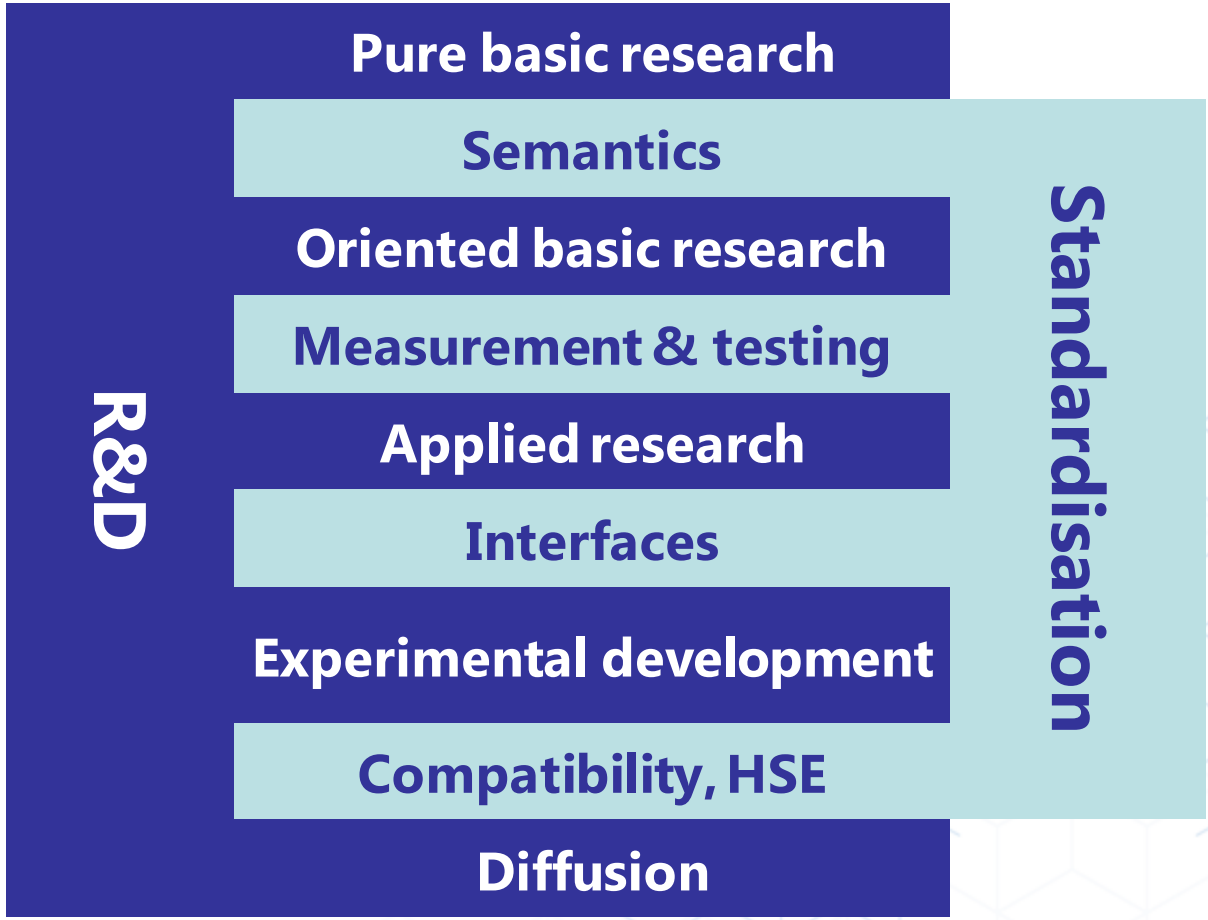
2. Various roles of different types of standards in the research and innovation process



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)

2. Standards in the research and innovation process

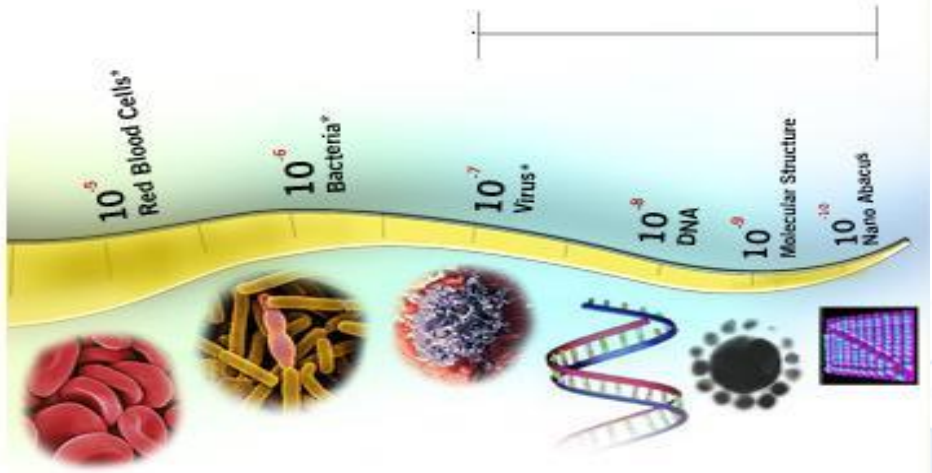


Source: Blind 2009

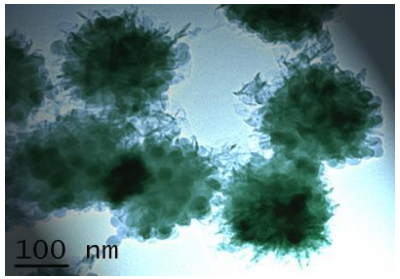
2. Examples: ISO Activities on Terminology in Nanotechnology

100 nm 1 nm

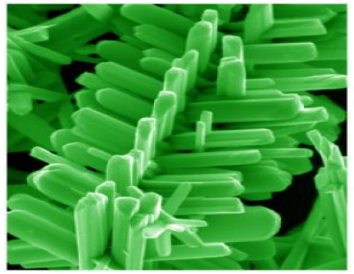
nanoscale



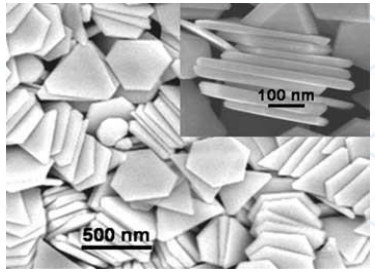
nano-object



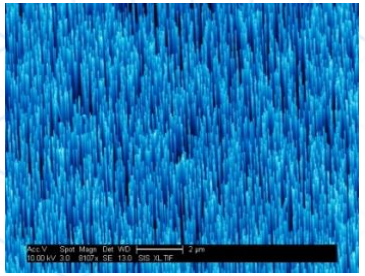
nanoparticles



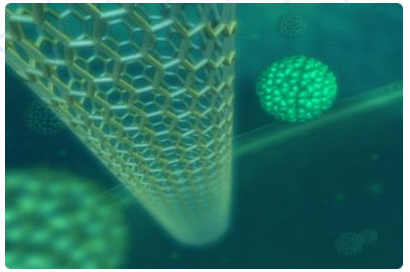
nanoplates



nanocylinder



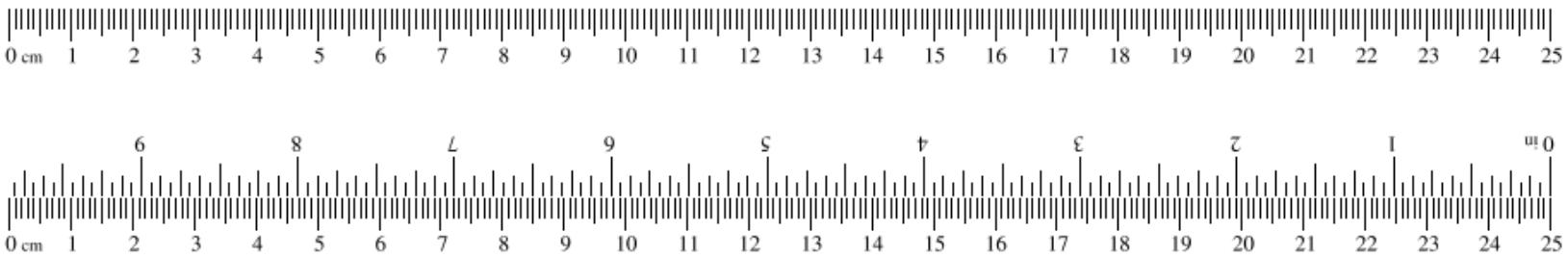
nanotube



Source: Blind 2009

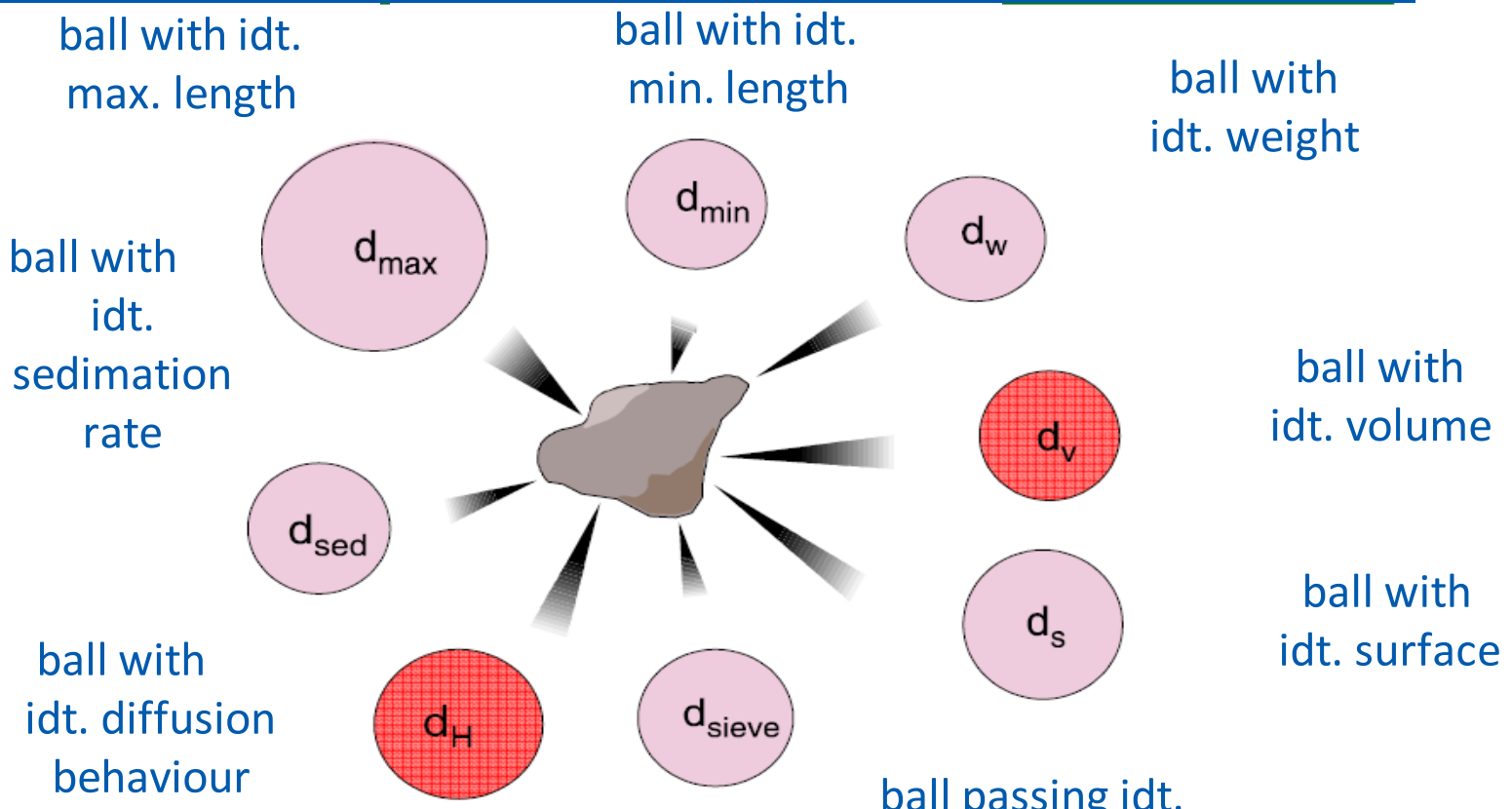
2. Examples: Information and measurement standards

- 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.



2. Examples: Measurable characteristics

Particle characteristic “Equivalence diameter”



Source: Malvern GmbH

3. Impacts of standards on research and innovation

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

3. 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)
- Participation in standardisation is positively correlated with innovation success (Blind et al. 2022)

4. Research and innovation and blockchain standards

- The presented taxonomy of the role of standards along the different phases of the research and innovation cycle can also be observed by looking at the so far published blockchain standards by ISO/TC 307 Blockchain and distributed ledger technologies
  - some basic aspects, like terminology, ontologies or governance, have been defined in standards
  - however, some standards already define use case and specific applications, which are becoming relevant later in the innovation cycle
  - consequently, we observe a parallel development of standards addressing the different phases of the research and innovation cycle in blockchain, which underlines the high dynamics of the technology and the pressure to develop standards in time

4. Blockchain standards of ISO TC 307 differentiated in basic and applied aspects

- Basic aspects:
  - ISO 22739:2024 Blockchain and distributed ledger technologies — Vocabulary
  - ISO/TS 23258:2021 Blockchain and distributed ledger technologies — Taxonomy and Ontology
  - ISO 23257:2022 Blockchain and distributed ledger technologies — Reference architecture
  - ISO/TS 23635:2022 Blockchain and distributed ledger technologies — Guidelines for governance
- Application aspects:
  - ISO/TR 6039:2023 Blockchain and distributed ledger technologies — Identifiers of subjects and objects for the design of blockchain systems
  - ISO/TR 3242:2022 Blockchain and distributed ledger technologies – Use cases
  - ISO/TR 6277:2024 Blockchain and distributed ledger technologies — Data flow models for blockchain and DLT use cases
  - ISO/TR 23249:2022 Blockchain and distributed ledger technologies – Overview of existing DLT systems for identity management
  - ISO/TR 23644:2023 Blockchain and distributed ledger technologies (DLTs) — Overview of trust anchors for DLT-based identity management
  - ISO/TR 23244:2020 Blockchain and distributed ledger technologies — Privacy and personally identifiable information protection considerations
  - ISO/TR 23576:2020 Blockchain and distributed ledger technologies — Security management of digital asset custodians
  - ISO/TR 23455:2019 Blockchain and distributed ledger technologies — Overview of and interactions between smart contracts in blockchain and distributed ledger technology systems

4. Example: DIN SPEC 16597 “Terminology for Blockchains“

- Since the blockchain technology was a revolutionary approach in the context of decentralised data systems, starting with the introduction of the cryptocurrency Bitcoin, the clarification of basic terminology was particularly relevant for this young field of technology. To this end, the BlockOne project developed a terminology specification based on the accelerated DIN-SPEC process within the German Standardisation Body DIN started in 2017.

4. Development of a DIN SPEC

- Proposal for the development
- Preparation of a business plan
- Publishing of the business plan

- Starting the content work
- Finalization of the manuscript
- Publishing of a draft SPEC
- Workshop participants adopt the SPEC

- Publishing of the DIN SPEC

- Development of this DIN SPEC (whole process): ≈ 8 months

4. Key goals for the development of DIN SPEC 16597

- Definitions of general blockchain terms
- Industry and usage independence
- Consideration of a variety of existing blockchain specifications
- Examples Terms
  - Block
  - Blockchain
  - Consensus process
  - Cryptocurrency
  - Decentralized
  - Distributed ledger
  - Double spending
  - Hard fork
  - Soft fork
  - Node
  - Nonce
  - PoS
  - PoW
  - Smart contract
  - 51% attack
  - Mining

4. Methodology applied for the development of DIN SPEC 16597

Importance index

- Online resources
- Academic resources

Definition process

- Historical origin of terms
- Current usage
- Identifying keywords
- Creating definitions

Terms	Bitcoin.org	Coindesk Glossary	Bitcoin Magazine I II	BC tech	blockchain.com	ethdocs.org	Eth github	dinbits	ibm	blockchainhub	Bedeutungsindex
Block	1		1	1	1	1	1	1	1	1	9
Double spending	1	1	1	1	1	1	1	1		1	9
Blockchain	1	1	1	1	1			1	1	1	8
Public-private keys, Asymmetric cryptography	1	1	1	1	1	1	1		1		8
Address	1	1	1	1		1	1	1			7
Hash, hashing rate	1	1		1		1	1		1	1	7
Mining	1	1		1	1	1	1			1	7
P2P, Blockchain network	1	1	1	1		1		1			6
(Digital) signature	1	1	1			1	1		1		6
ASIC		1		1		1		1		1	5
Cryptography, Encryption	1		1			1	1	1			5
Difficulty		1	1	1	1	1					5
Genesis block		1	1	1		1				1	5
Proof of work/PoW		1		1		1	1			1	5
Smart contracts				1		1	1		1	1	5
Wallet	1	1	1			1				1	5
...											

Source: Wurster et al. (2024)

4. Selected terms for the development of DIN SPEC 16597

Selected terms with an importance index ≥ 6 based on the selected sources

- Block
- Double spending
- Blockchain
- Public-private keys
- Asymmetric cryptography
- Address
- Hash
- Hashing rate
- Mining
- Peer to peer network (P2P)
- Digital signature

Selected additional terms with and importance index of 1 – 5

- Cryptography
- Difficulty
- Genesis block
- Proof of work
- Smart contracts
- Wallet
- Block reward
- Confirmation
- Consensus process
- Nonce
- Proof of stake
- Transaction
- Transaction fee
- 51% attack
- Cryptocurrency
- Fork
- Node
- Permissioned ledger
- Unpermissioned ledger
- Token
- Unconfirmed transaction
- Account
- Block header
- Block height
- Block validation
- Decentralized (system)
- (Distributed) ledger
- Hard Fork
- Orphan block
- Reversing transaction
- Script
- Soft fork
- State
- Time stamp
- Miner

Source: Wurster et al. (2024)

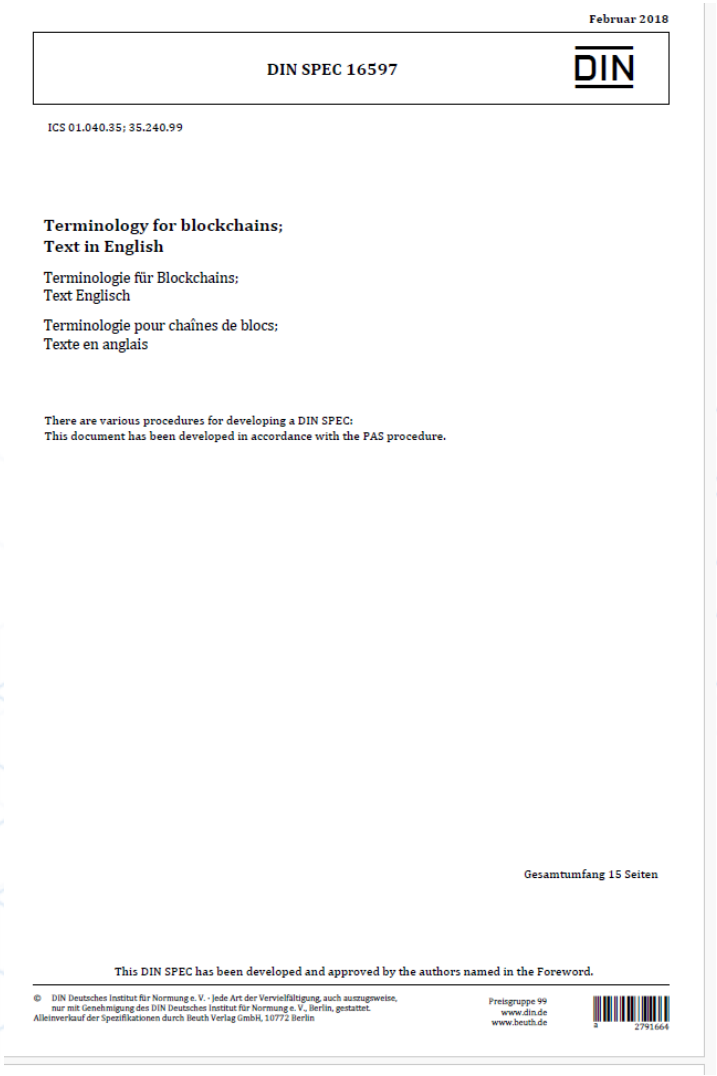
4. Results for the development of DIN SPEC 16597

Statistics

- 6 categories
- 60 terms

Categories of terms

- (Basic) IT terms
- Cryptographic terms
- Main blockchain terms
- Elements and attributes of blockchains
- Blockchain based processes
- Specific situations in the blockchain context



Februar 2018

DIN SPEC 16597

DIN

ICS 01.040.35; 35.240.99

Terminology for blockchains;
Text in English

Terminologie für Blockchains;
Text Englisch

Terminologie pour chaînes de blocs;
Texte en anglais

There are various procedures for developing a DIN SPEC:
This document has been developed in accordance with the PAS procedure.

Gesamtumfang 15 Seiten

This DIN SPEC has been developed and approved by the authors named in the Foreword.

Preisgruppe 99
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4. Implications for blockchain standardisation

- Consider standardisation as early as possible as transfer channel for your blockchain research and innovation outputs
- Provide scientific evidence as input into standardisation processes
- Consider standards as input for your research and innovation processes

THANK YOU FOR YOUR ATTENTION.

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