Teaching standards slide deck: Innovation

BSI Education

Supporting the next generation of industry experts

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Enabling innovation through standardization

Building confidence and trust in the development of new technologies

About BSI Education

Universities make a significant contribution to standardization by teaching about standards, contributing academic research and participating in standards development.

BSI Education builds relationships and creates programmes with universities to help raise awareness of the benefits of standards to society and the economy and to encourage and increase participation in standards-making.

For more information visit **bsigroup.com/education** or contact **education@bsigroup.com**.

About these slides

These slides have been developed by BSI to support the teaching of undergraduates and postgraduates about standards and standardization, as part of a package of materials and resources to support standards education across a wide variety of programmes.

The latest version of these slides is available from bsigroup.com/education.

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Contents

Introduction

What are standards?

A standard is an agreed way of doing something.

This could be could be about making a product, managing a process, or delivering a service.

These agreements are made between people, who share an interest in improving how things are done.

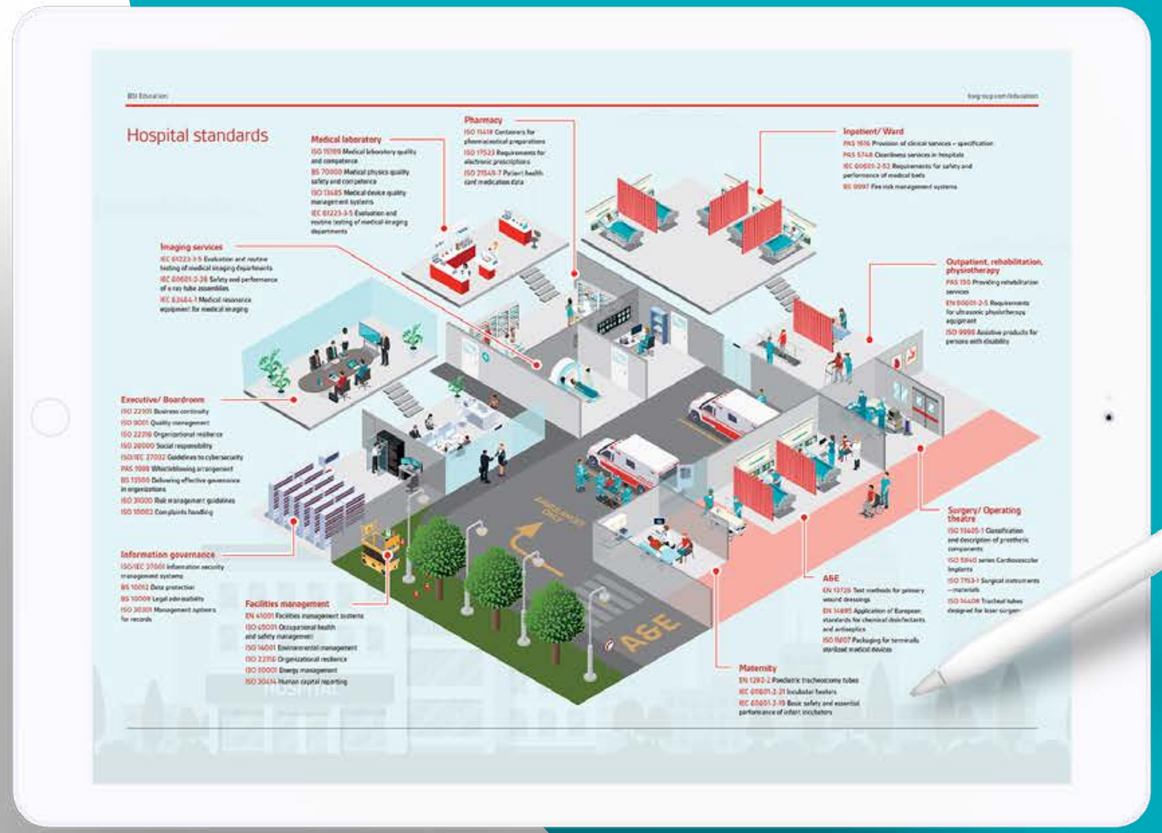
Working together they agree on what makes good practice, which helps to make things work properly, and improve the way organisations do things.

How standards are used

Because standards are all around us, they impact on almost all aspects of our lives. From construction to nanotechnology, from energy management to health and safety.

They provide solutions to problems, such as:

- Quality management standard to help to reduce product failures
- Environmental management standard to help reduce waste
- IT security standard to help keep sensitive information secure
- Smart working standard to help an organization modernize its working practices



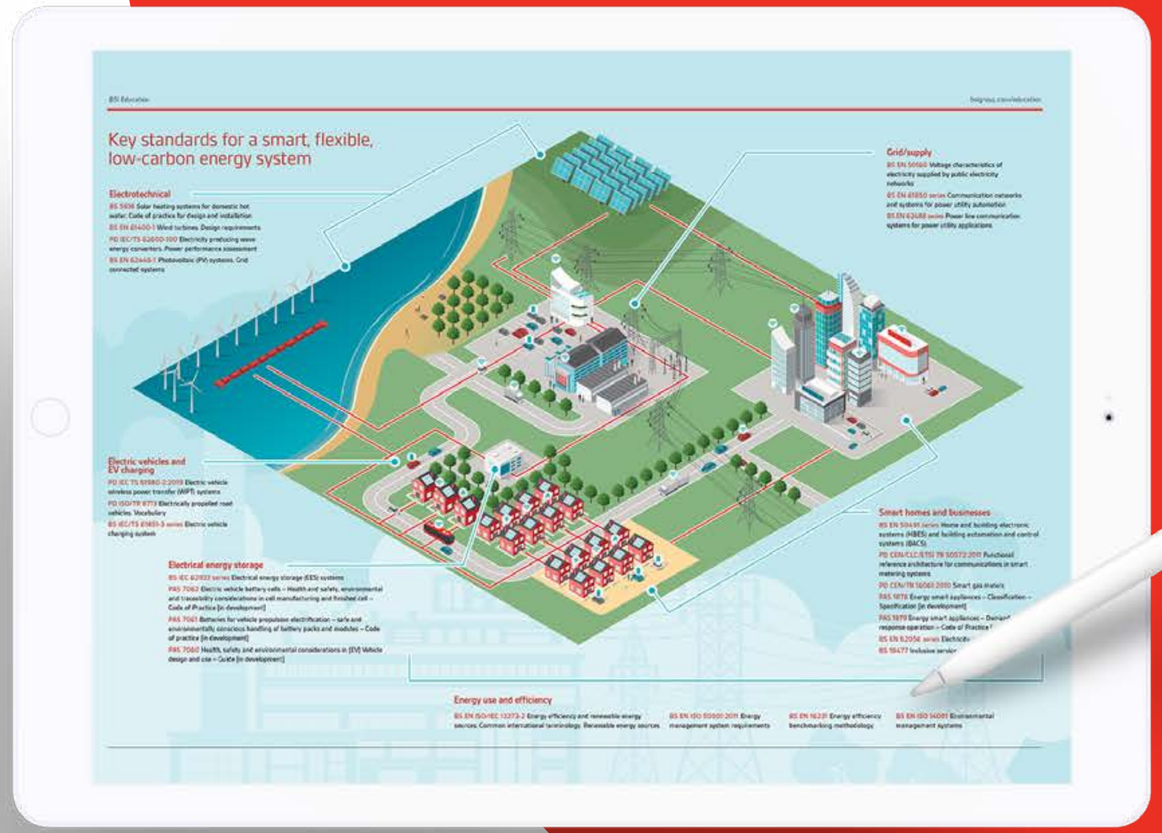
Why standards matter

Standards matter for everyone. They affect all of us every day, wherever we go, whatever we do. By defining good practice, they help people, business and the economy.

Our smart phones, the cars we drive, the toys children play with – are all developed in accordance with standards, helping to make sure they're easy to use, work properly and are as safe as possible.

Standards also help to raise the quality of public services too, in areas such as health, finance and energy. And standards help organizations too. They make it easier for them to create high quality goods and services - and speed up the process of innovating new ones – helping them to build trust with their customers.

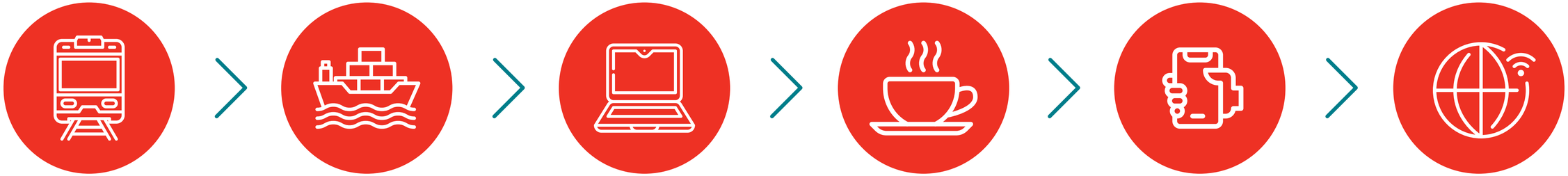
Standards also make it easier for organizations of all types to export these products and services around the world, contributing to economic growth and prosperity.



Standards – a brief history

Standards have proven to be a valuable tool for more than 2,000 years. Standards for products and services emerged at the end of the 19th and beginning of the 20th centuries, simplifying procurement and supporting trade and quality. Today, standards are the scaffolding of modern economies, shaping and influencing our personal lives and working environments.

From tram tracks to the Internet of Things...



Tram track gauges – the subject of BS:1 and the beginning of BSI

Shipping containers – facilitated the dramatic change in post-1950s world trade and impacted on other transport systems around the world

Laptop – there are more than 250 interoperability standards embodied in a single laptop

Cup of tea – tea tasters use a standard to ensure every tea is tasted in the same way

Smartphone – international standards help protect your data when paying for things on the move

Internet of Things – from predictive maintenance of equipment to improving air quality and remote health services

...and everything in between

Standards – key characteristics

A standard is an agreed way of doing something, incorporating the distilled wisdom of people with expertise in their subject matter, who know the needs of the organizations they represent.

- They are (in the main) voluntary and market-led
- They gain their legitimacy through consensus and public consultation
- They undergo systematic review to ensure their continuing validity
- They can be supported through testing, certification and accreditation
- They can be used to demonstrate compliance with regulations

Standards and regulations

The central difference between the two terms is that the adoption of standards is voluntary, whereas adoption of regulations is mandatory.

Regulations are legally-based instruments, backed up and enforced by a government authority.

Consensus in relation to standards means having general agreement, characterized by the absence of sustained opposition to substantial issues by any important part of the concerned interests.

Developing consensus involves seeking to take into account the views of all parties concerned and to reconcile any conflicting arguments. Consensus need not imply unanimity.

Standards	Regulations
Based on recommendations	Based on legislation
Adoption is usually voluntary	Adoption is mandatory for regulations, and potentially so for guidelines
Established by consensus of all parties concerned	Developed by a regulatory authority, usually involving consultation
Based on consolidated results of science, technology and experience	Guidelines provide technical specifications either directly or by reference, e.g. to standards
Approved and published by recognized standardization body	Adopted by a legal authority
Oversight by independent third party certification	Oversight by formal government-appointed regulatory bodies

About BSI

BSI is the UK's National Standards Body.

Our role is to help improve the quality and safety of products, services and systems by enabling the creation of standards and encouraging their use.

We've published over 40,000 standards and publish around 2,500 standards annually, underpinned by a collaborative approach, engaging with over 12,000 stakeholders to develop standards that reflect good practice.

We've more than 100 years' experience in shaping standards to help improve the quality and safety of products, services and systems and we have originated and shaped some of the most recognised standards.

We represent UK economic and societal interests across European and international standards organizations.

By Royal Charter

BSI is a private company incorporated by the British Royal Charter.

As BSI has grown and evolved our Royal Charter has been amended several times to reflect the magnitude and importance of the work we do nationally and internationally across industries to facilitate innovation, trade and consumer groups.

UK member of:

ISO ITU IEC

CEN CENELEC ETSI

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Standardization and innovation

What we mean by innovation

Innovation systems

Why standards matter for innovation

Economic functions of standards and their effect on innovation

Standards as market shapers

Standardization and innovation policy

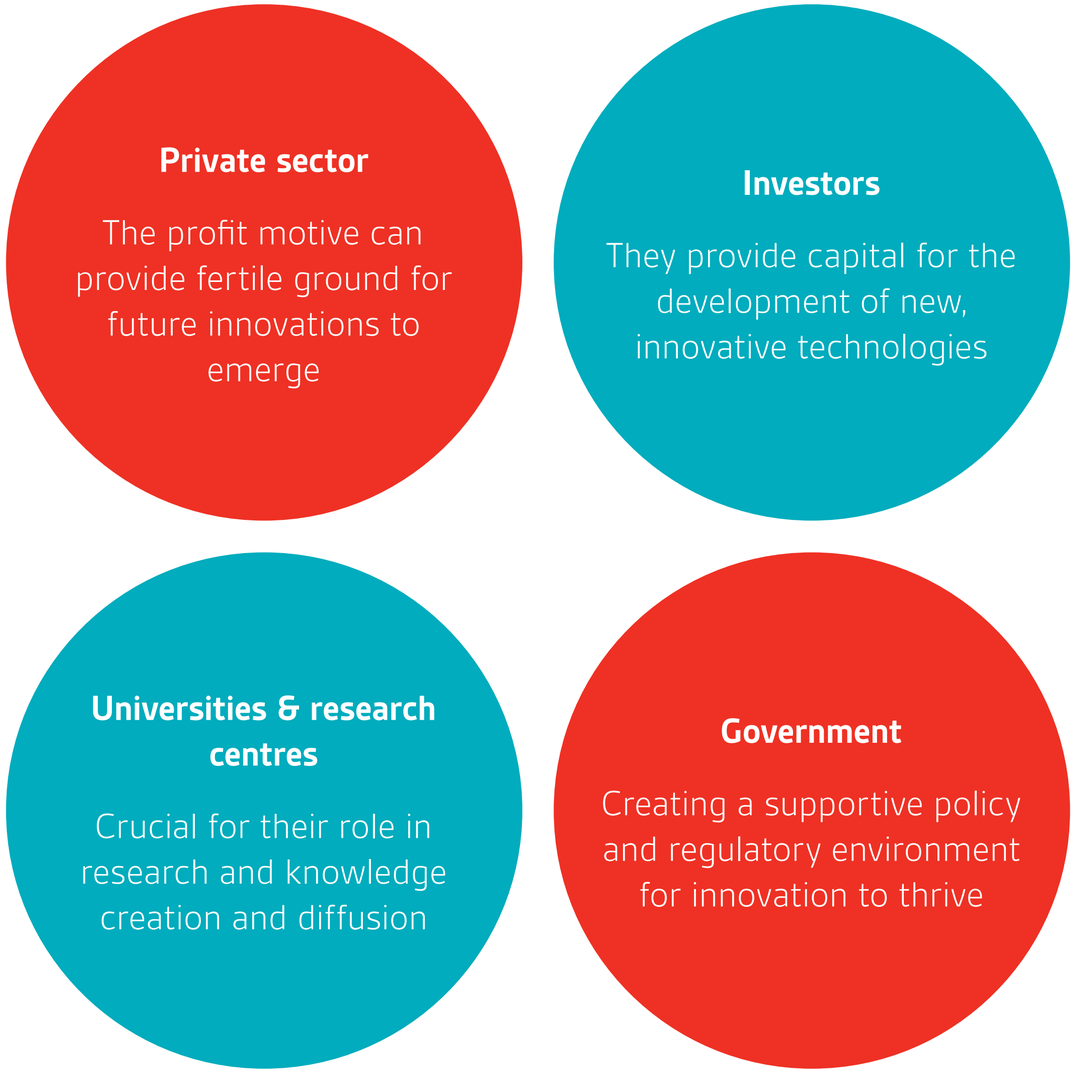
What we mean by innovation

Innovation is more than an idea or an invention.

It's a new or improved product or process made available to users. Innovations can affect individuals, organisations, industries and countries and are central to improvements in living standards.

Innovation is a dynamic activity that takes place in all sectors of the economy, but it's not a linear, sequential process. Instead, it involves many interactions and feedbacks in knowledge creation and use.

The diffusion and adoption of innovation is critical if new products and processes are to have an impact on the economy and society.



Innovation systems

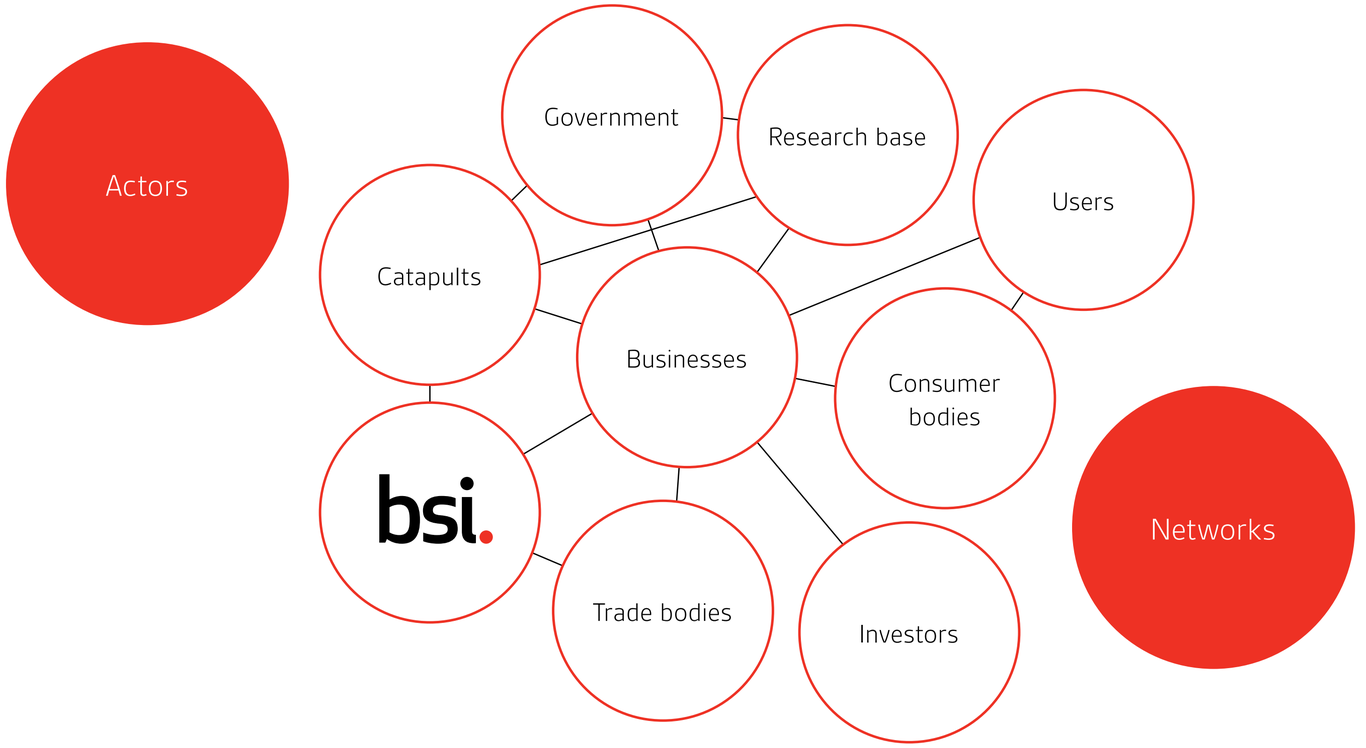
Innovation takes place within a system, one that it involves many interactions between a wide range of actors.

Innovation systems can be described by industry, technology, or geography and are often interrelated, with regional systems linked to national and global systems.

The behaviour of actors in an innovation system is shaped by governance frameworks ('the rules of the game') that create incentives for innovation. Standards are part of such governance frameworks, alongside regulations, metrology and intellectual property rights.

Other factors that influence innovation outcomes within a given system include R&D investment, access to finance, skills, manufacturing and marketing

Innovation systems are a very important determinant of technological change.



Why standards matter for innovation

In the modern world, innovation is most commonly associated with the development and use of new and emerging technologies.

Standardization plays an important role in how these technologies are developed, diffused and adopted.

It does this in three ways:

1. Standards define a common language

When establishing the essential characteristics of a new technology it's important everyone talks about it in the same way. Standards support innovative ideas and products by defining a common language.

Using a common language and common tools means innovative ideas can be spread more easily, and the market for new products and services can grow more quickly.

2. Standards are part of the ‘rules of the game’

Standards help to create the ‘rules of the game’ for any innovation, helping to promote the successful commercialization of new products and services. They define the essential parameters, safety considerations, testing processes and performance indicators that enable businesses to move from idea to prototype and full-scale production.

This makes a difference because:

Organizations are less likely to duplicate what’s already been produced, allowing them to concentrate on the activities in their products and services that really add value.

An organization’s products or services will be integrated more easily with those of others.

Consumers will feel more satisfied and reassured that the product or service they’re buying will have the expected levels of quality, safety and performance.

Investors will have more confidence that the innovation will be successful.

Technology leaders are often those who create the standards which are subsequently adopted by others

3. Standards provide a platform for more innovations

By defining a common language and helping to agree the rules of the game, standards serve as a platform upon which further innovations can be built.

Innovators can build on state-of-the-art knowledge rather than having to build from the ground up, so further cycles of innovation can happen sooner and more cost-effectively.

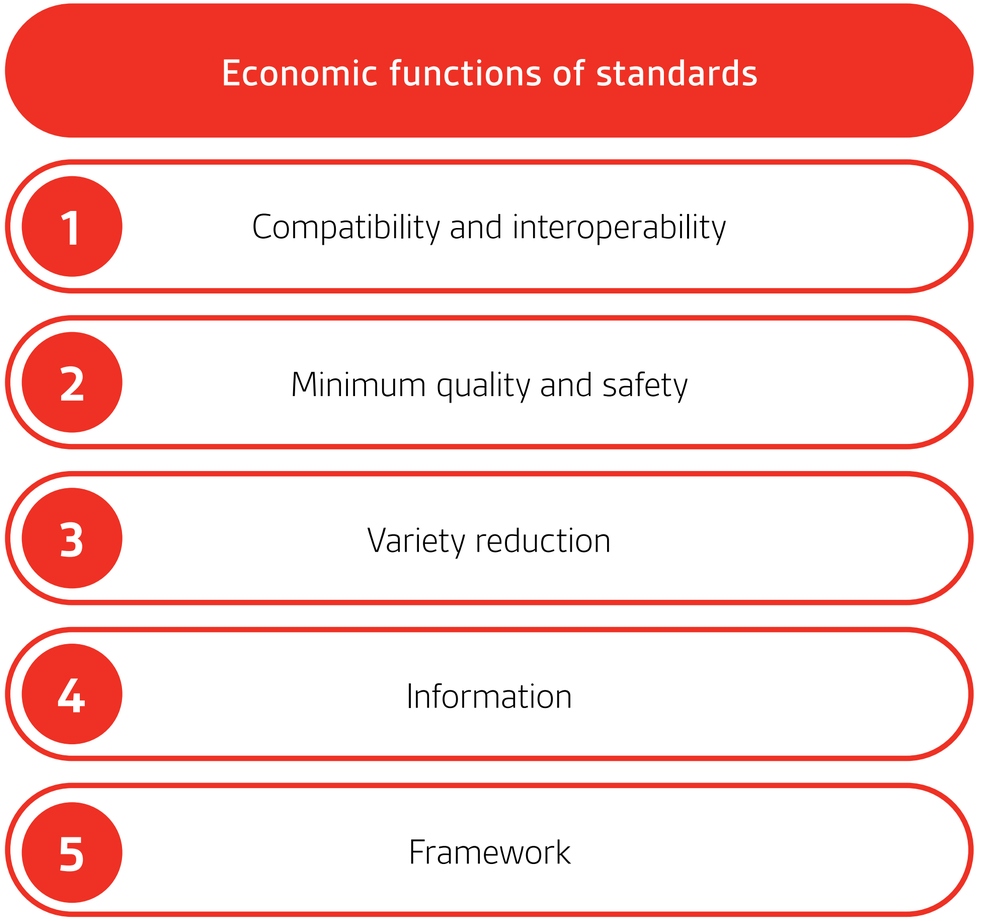
Because of this, the pace of innovation is accelerated, and commercial success is more likely.

New standards are being developed as new sectors, markets and business models emerge, and the sooner these standards are in place, the faster and more efficiently growth occurs.

Economic functions of standards and their effect on innovation

There are five key economic functions of standards:

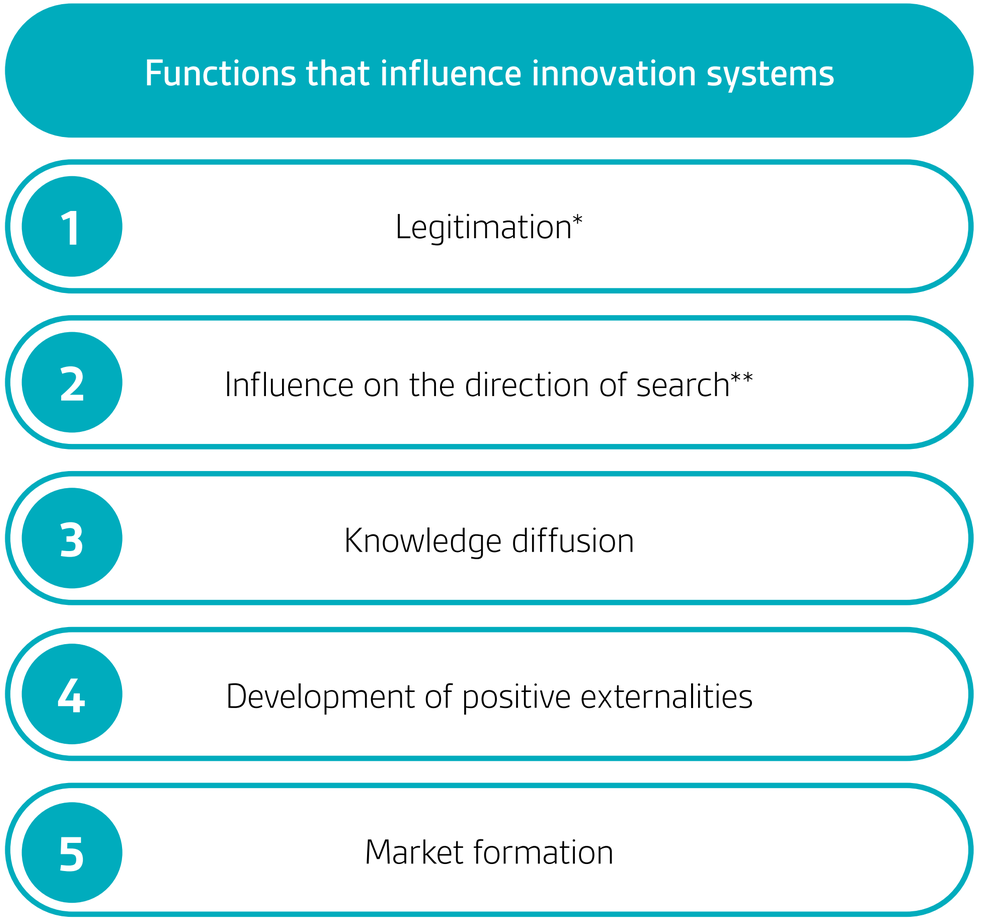
1. They enable interoperability of products and processes, which is particularly important in the field of ICT
2. They help businesses to enhance the quality of their products and the efficiency of their processes
3. They efficiently reduce the variety of goods and services to an optimal level for minimising cost
4. They efficiently make available technical information to organizations allowing an effective and less costly exchange of information
5. They help to deliver equitable relationships across companies and sectors, contributing to responsible organizational behaviour



Source: Blind, K. (2017). 'The Economic Functions of Standards in the Innovation Process', in Hawkins, Blind and Page (eds.) Handbook of Innovation and Standards, Edward Elgar, p.46

In turn these functions can influence innovation systems:

1. Leading to the legitimation of new technologies
2. Influencing the direction and development of new technologies
3. Helping to diffuse knowledge within and across innovation systems
4. Helping to develop of positive externalities and network effects
5. Leading to the formation of new markets



Source: Blind, K. (2017). 'The Economic Functions of Standards in the Innovation Process', in Hawkins, Blind and Page (eds.) Handbook of Innovation and Standards, Edward Elgar, p.46

Standards as market shapers

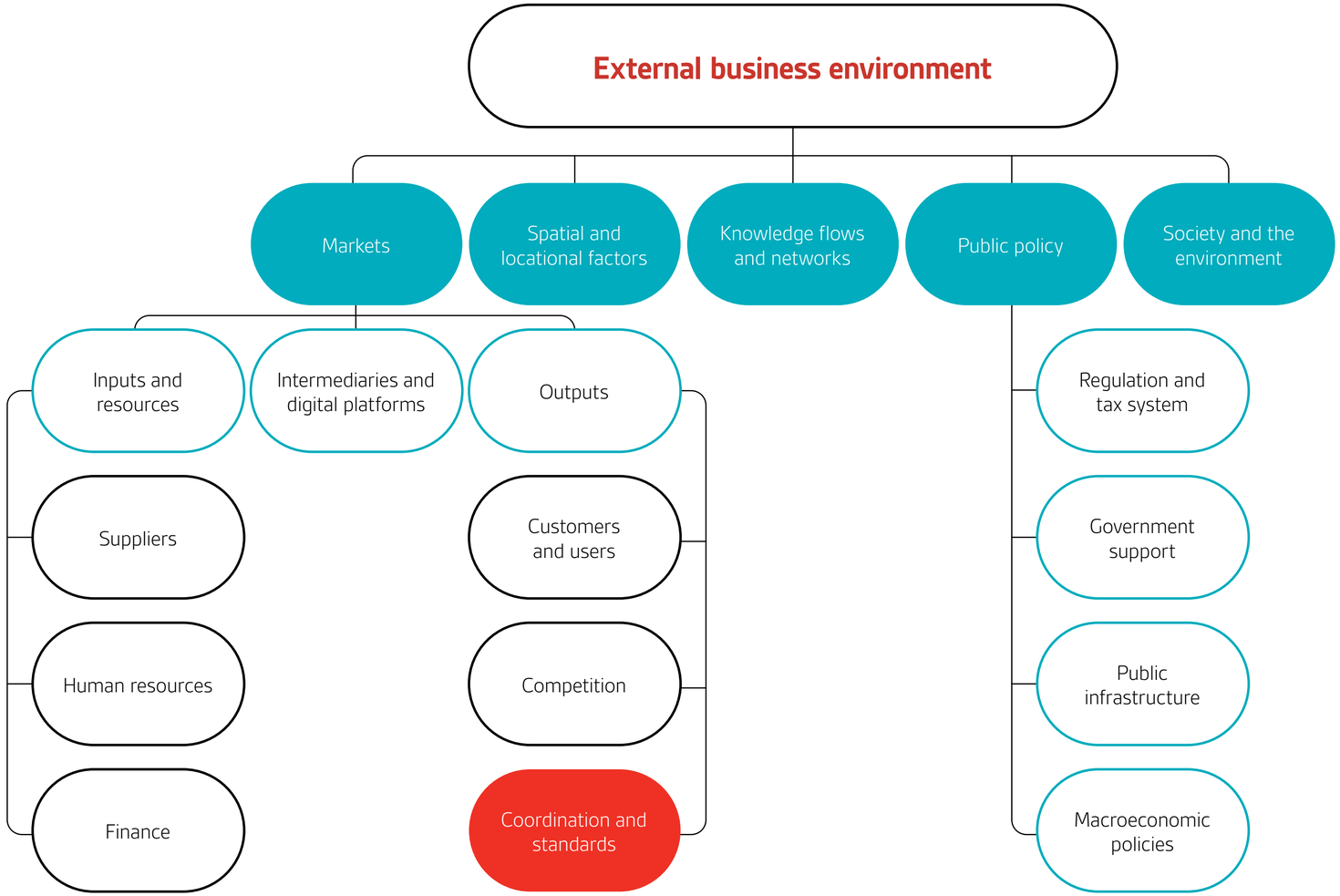
An organization's external environment includes factors that are beyond its immediate control.

These factors create challenges and opportunities that managers need to consider when making strategic choices.

Standards play an important co-ordination role in many markets and can influence the characteristics of product and business process innovations.

Standards can be important sources of knowledge and, therefore, can considered as a source of information for innovation or innovation objectives.

Organizations who hold certification for specific standards can offer potential customers guarantees that its products and processes are using best practice.



Standardization and innovation policy

International Research and Innovation Strategy

"The strengths and global reach of the UK's governance, intellectual property and standards frameworks can support the design of common, global regulatory approaches to support emerging, transformative technologies."

Advice to the Prime Minister on the future of the UK's international science collaboration

"Through the marketing and delivery of the strategy we want to build on our world-leading reputation on regulation, standards and intellectual property, working closely with the British Standards Institution, the National Physical Laboratory and the Intellectual Property Office."

Innovate UK Delivery Plan 2019

"We also work closely with regulators to ensure the UK regulatory system enables early introduction of technological innovation, including through our work with the British Standards Institution, and the Catapults play an important role driving innovation in regulation for their sectors."

Regulation for the 4th Industrial Revolution

"We will also continue to provide global leadership on standards, building on the British Standards Institution's strong track record in the international recognition and global adoption of UK standards."

Standardization and future technologies

Expanding role of standardization

Global R&D growth

Right standard at the right time

Expanding role of standardization

The role of standardization will continue to expand across industries and sectors:

- New generations of products and services require the integration of a portfolio of a large number of complex, digital technologies.
- There is a trend towards greater specialization and distribution of R&D across supply chains in all sectors of the economy.
- There is a need for organizations to scale-up at faster rates, including the deployment of new production processes targeting the right levels of quality and cost.
- As a result, there is a substantial increase in market transactions, in turn leading to an ever-increasing need to demonstrate confidence in performance.
- Innovation systems are a very important determinant of technological change.

Standards can help shape emerging technologies which in turn become the industries of the future

Global R&D growth

Global spending on R&D has reached a record high of almost US$ 1.96 trillion.[1]

What do the top 15 countries have in common? Signifcant R&D spending is an underlying factor for success.

The circles show the amounts countries are spending on R&D in purchasing power parity (in US dollars).

Countries farther to the right are spending relatively more in terms of their GDP.

Those closer to the top have higher numbers of researchers per 1 million inhabitants.

[1]In 2017 (the most recent year for which comprehensive data are available), global R&D expenditures were $1.961 trillion. Global Research and Development Expenditures: Fact Sheet: https://fas.org/sgp/crs/misc/R44283.pdf

Source: http://uis.unesco.org/apps/visualisations/research-and-development-spending/ https://fas.org/sgp/crs/misc/R44283.pdf

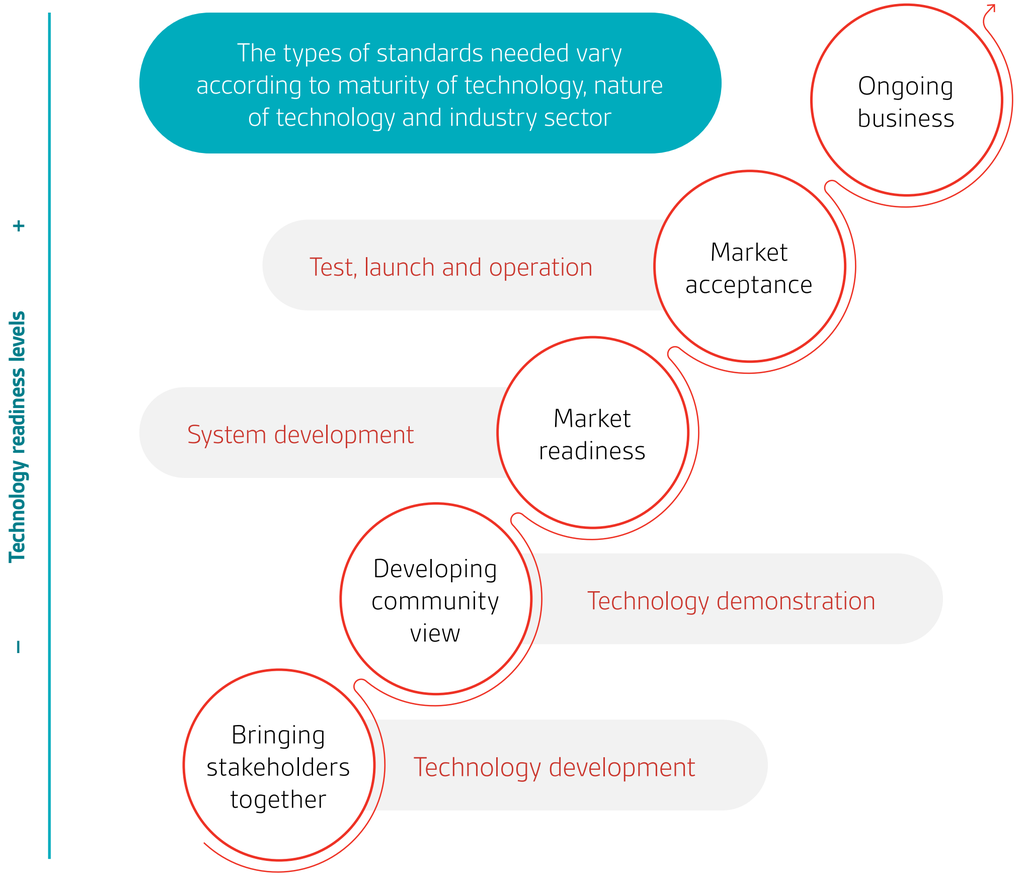
Right standard at the right time

A lack of standards at key phases in an emerging technology's lifecycle can potentially result in large economic inefficiency.

Although the innovation trajectories of emerging technologies tend to be non linear, there seems to be general acknowledgement that there are evolving levels of emphases on different types of standards at different phases in the emergence of a new technology

For example, more attention to terminology in the earlier stages, followed by efforts to address materials testing and measurement standards, then interface and interoperability standards, and eventually standards associated with quality, compatibility and variety reducing endeavours. This suggests the need for a more tailored approach to standards development for emerging technologies at different phases of maturity.

However, it is important to acknowledge the range of factors that influence the different trajectories of new technology emergence and associated evolving standards development needs, including: multiplicity of stakeholders; societal infrastructure; degree of regulation, system complexity of application; multiplicity of competing technological approaches; multiplicity of application domains; interest and investment of public bodies.



Source: O'Sullivan, E. and Brévignon-Dodin, L. (2012). Role of Standardization in Support of Emerging Technologies. Institute for Manufacturing, University of Cambridge

Case study: CAV

Defining CAV

UK CAV policy framework

BSI CAV standards programme

Emerging areas for standardization

PAS 1881

Influencing the international landscape

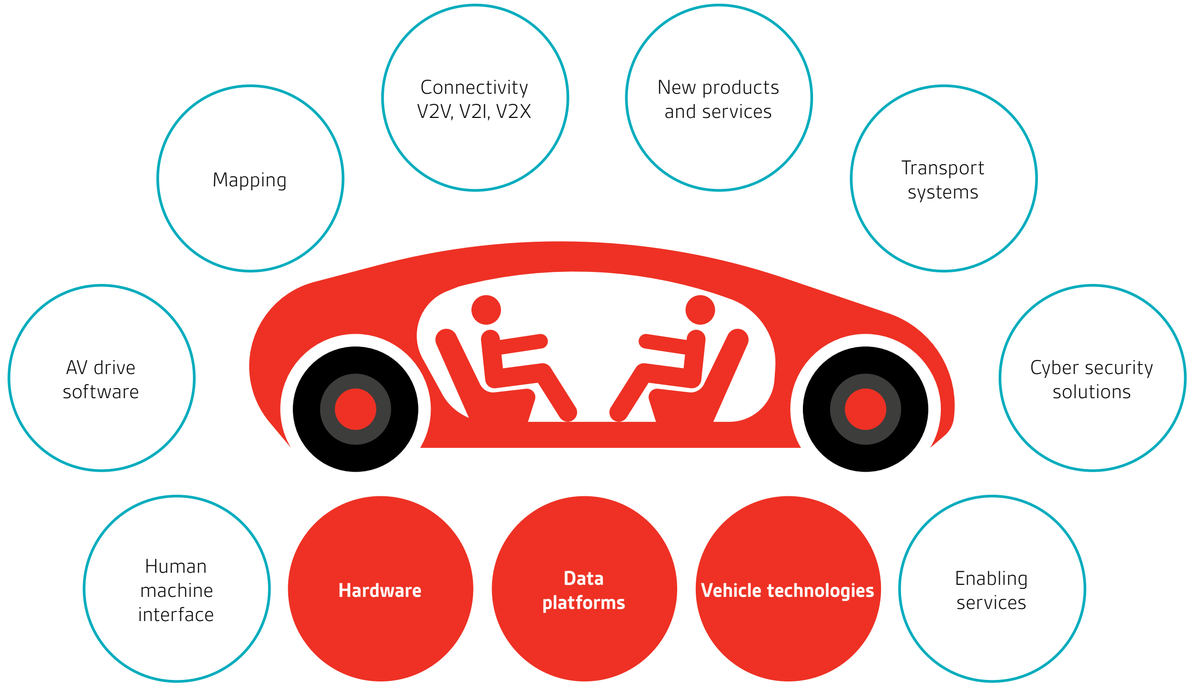
Defining CAV

With the introduction of new technologies, the automotive value chain is evolving very rapidly, unlocking the potential benefits of Connected and Autonomous (CAV) technologies, such as reduced accidents, increased productivity, efficiency and social inclusion.

Today's automotive sector's value chain encompasses technologies, solutions and services which were all not available in the past.

There is an ever-increasing reliance of cars on software and data, mapping, connectivity, cyber security solutions and so on.

At present, we use terms such as 'future of mobility' and 'mobility as a service' to describe plausible future scenarios for the whole transport system, of which CAVs are likely to be part.



Source: Zenzi

UK CAV policy framework

The UK CAV policy framework is in three parts:

An open regulatory framework that includes the Automated and Electric Vehicles Bill, the publication of CCAV's Code of Practice for testing vehicles on UK roads, influencing international regulations (e.g. UNECE) and the exploration of wider UK reforms to build public confidence in the technology and accelerate the deployment of CAVs on UK roads.

- Public investment in collaborative R&D resulting in over 73 funded projects involving more than 200 organizations (large corporates, SMEs, start-ups local authorities and universities).
- Public investment to create a coordinated testing ecosystem that positions the UK as global centre for CAV virtual and physical testing. The UK's comprehensive and integrated facilities are world-leading, with a unique ability to cross-share data and a collaborative way of working.

Open regulatory approach – you can test on UK roads now

£250m invested into R&D projects – cutting edge technology

£200m invested in testing infrastructure – a world leading ecosystem

Centre for Connected & Autonomous Vehicles

Source: CCAV, Zenzic

BSI CAV standards programme

As part of the UK CAV policy framework, BSI has partnered with CCAV, Innovate UK, DfT and Zenzic to deliver an initial 2-year programme of standards designed to achieve three key objectives:

- Accelerate and support the development of CAVs in the UK
- Support the UK as a global centre of excellence
- Shape the development of international standards to drive exports and overseas

The launch of the BSI CAV standards programme followed on from research conducted by BSI and the Connected Places Catapult (formerly Transport Systems Catapult).

It recommended to leverage the UK's expertise in CAV R&D programmes, national trials and demonstrator projects to inform and influence the development of international standards.

This evidence-based approach was fundamental to validate the need for a strategic UK approach to standardization in this emerging field with a range of key stakeholders.

As part of its CAV Standards Programme, BSI has established a cross-stakeholder advisory board that pulls in the leading voices from the UK CAV ecosystem including test beds and companies involved in national CAV trials. The Strategic Advisory Board meets quarterly and advises BSI on strategic standardization priorities for the UK.

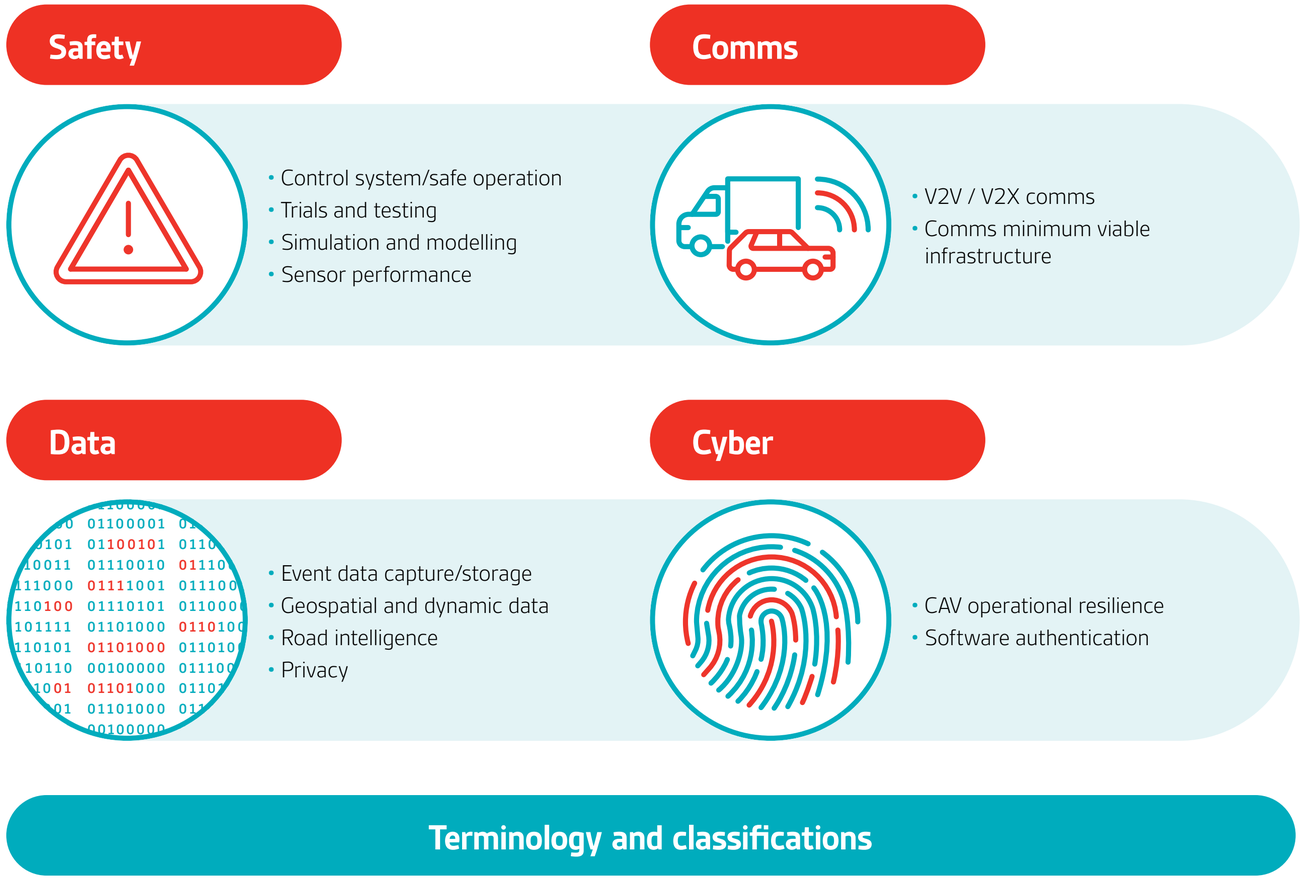
Emerging areas for standardization

The programme is delivering standardization solutions across key areas such as safety, data, cyber security and terminology including:

- PAS 1880: Guidelines for Developing and Assessing Control Systems for Automated Vehicle
- PAS 1881: Assuring safety for AV trials and testing
- PAS 1883: Operational design domain for an automated driving system

Online CAV vocabulary in response to industry calls for a consistent, reliable set of terms and definitions in the CAV sector

For more information, please visit:
www.bsigroup.com/en-GB/cav



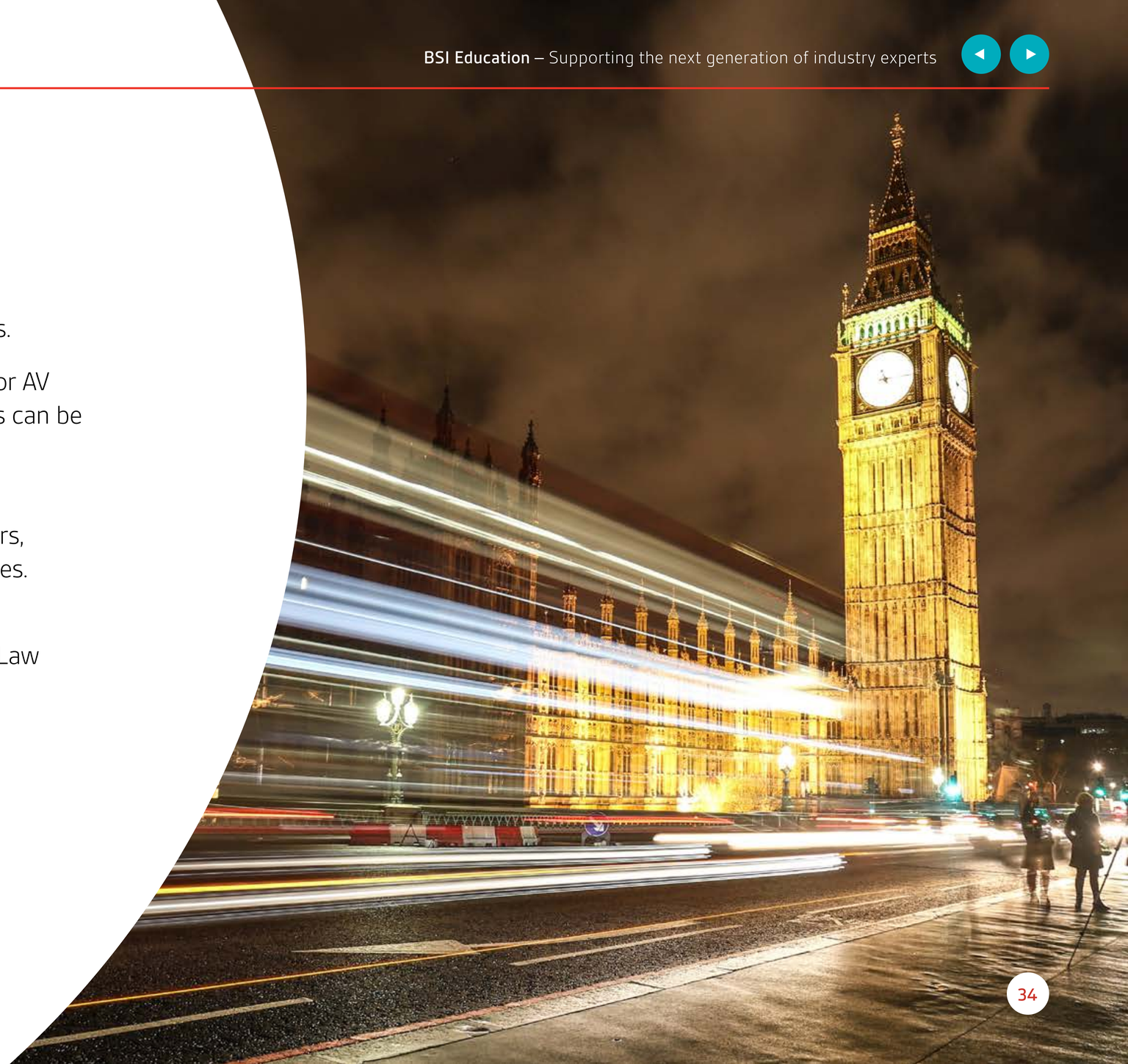
PAS 1881: Assuring safety for AV trials and testing

PAS 1881 is intended to support the safe testing and trials of CAVs.

This standard specifies minimum requirements for safety cases for AV trials and development testing in the UK to demonstrate activities can be undertaken safely.

It is relevant to stakeholders including (but not limited to) trialling organizations, local authorities, highway authorities, road operators, landowners, leaseholders, insurers, test beds and licensing agencies.

It provides an opportunity for standards to support the emerging regulatory framework around CAVs: CCAV's Code of Practice, the Law Commission's regulatory review, and UNECE's WP.29.



Challenges

- Increasing amount of AV testing
- Increased risk to road users during testing
- No safety standards or guidelines
- Lack of consistency
- Insurance companies unable to set a suitable insurance premium
- Uncertainty for landowners who may need to provide permissions for AV operation

Opportunities

- Minimise risks to all affected parties
- Facilitate transition between off road, controlled and uncontrolled test beds
- Develop a consistent approach to managing safety
- Develop clear requirements for insurers
- Build public trust in the technology
- Facilitate continuous improvement and learning

PAS 1881: Safety of automated vehicle trials and testing

Industry experts working with automated vehicles discuss safety trials, the future of CAV, and how PAS 1881 addresses safety concerns.

For more information visit:

www.bsigroup.com/en-GB/CAV/pas-1881

www.bsigroup.com/en-GB/about-bsi/media-centre/press-releases/2020/march/bsi-unveils-new-safety-requirements-to-help-ensure-safe-trials-and-tests-of-automated-vehicles

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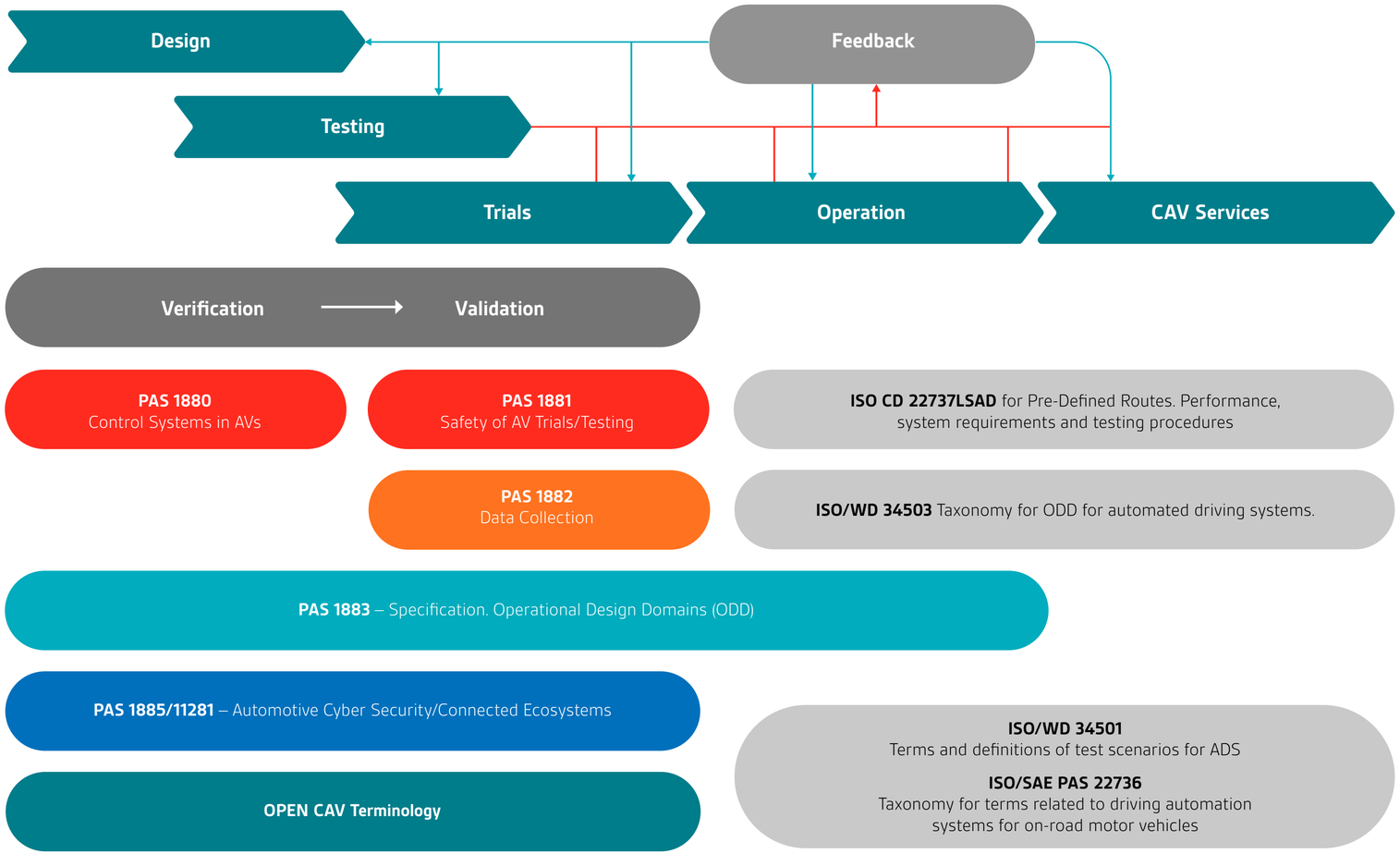
Influencing the international landscape

BSI's CAV Standards Programme has been designed to address identified gaps in the international standardization landscape, building on UK expertise and experience.

The initial phase of this programme is tackling standardization challenges around the design, testing and validation of CAVs.

In other words, this work focuses on pre-production aspects before CAVs can be widely deployed on roads.

It is intended that the BSI CAV Standards Programme will complement existing international standards and help shape new global standards.



Conclusions

BSI future standards programme

Strategic approach to standardization

Achieving impact

BSI future standards programme

We have delved into a specific example – that of CAVs.

However, BSI is working across a number of domains and industries.

From an innovation perspective, BSI is focusing on eight key sectors:

- Healthcare
- Built environment
- Energy
- Digital
- Transport and mobility
- Digital manufacturing
- Environment, social and governance

Examples of work programmes underway include energy smart appliances, sustainable finance, batteries for electric vehicles and many others.

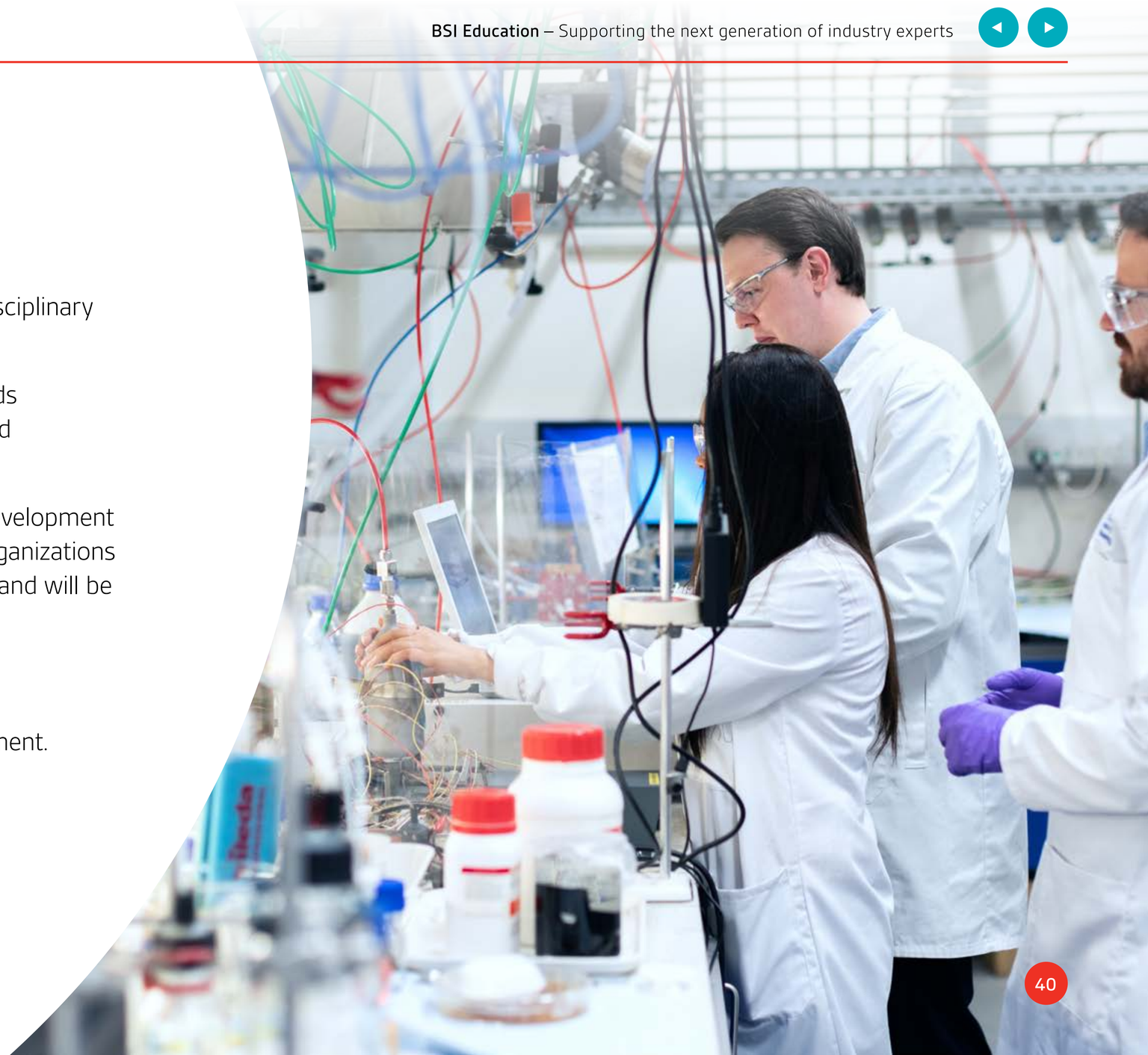
Strategic approach to standardization

As systems technologies become ever more complex and interdisciplinary standardization will play a critical role.

Moreover, there is a correlation between R&D spend and standards organization membership. In other words, technology leaders tend to define the rules of the game, including standards.

Standardization efforts should start early on in the technology development process, rather than be left out as an afterthought. Otherwise, organizations and economies will need to play catch-up with their competitors and will be less likely to influence or shape technological trajectories.

It is for these reasons that BSI advocates a strategic approach to standardization. Standardization should be considered in national R&D programmes, technology road mapping and public procurement.



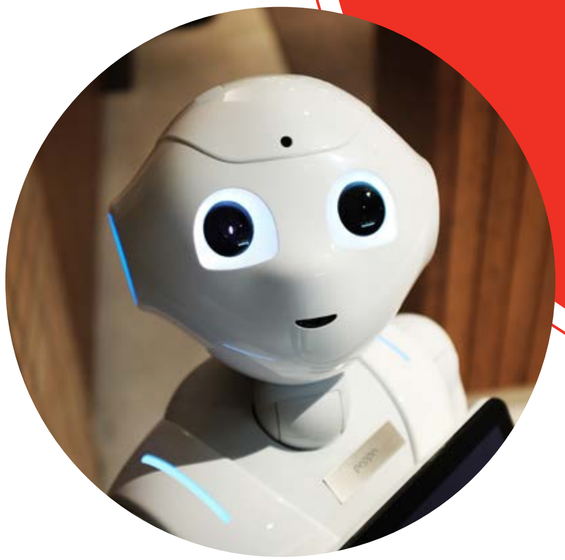
Achieving impact

By embedding standardization strategically into policy initiatives, BSI helps to:

- Maximize the impact of publicly-funded pilots, test beds, demonstrators and technology adoption programmes by enabling the diffusion of knowledge across industries and sectors
- De-risk investment in emerging technologies, in turn supporting the consolidation of emerging supply chains
- Create a global market platform for innovators in partnership with other countries
- Enable market barriers to be tackled that no single enterprise can achieve on its own, strengthening national capacity
- Support the creation of communities of interest around emerging industries, strengthening the impact of publicly-funded initiatives
- Support the creation of communities of interest around emerging industries, strengthening the impact of publicly-funded initiatives

Summary

Key learning points from sections 1-5



Introduction

- A standard is an agreed way of doing something. These agreements are made between people, who share an interest in improving how things are done
- Standards are all around us and they impact on almost all aspects of our lives
- BSI represents UK economic and societal interests across European and international standards organizations

Innovation systems

- Innovation is a dynamic activity that takes place in all sectors of the economy
- The diffusion and adoption of innovation is critical if new products and processes are to have an impact on the economy and society
- Innovation takes place within a system, one that involves many interactions between a wide range of actors
- Standards are an important part of any innovation system

Standardization and innovation

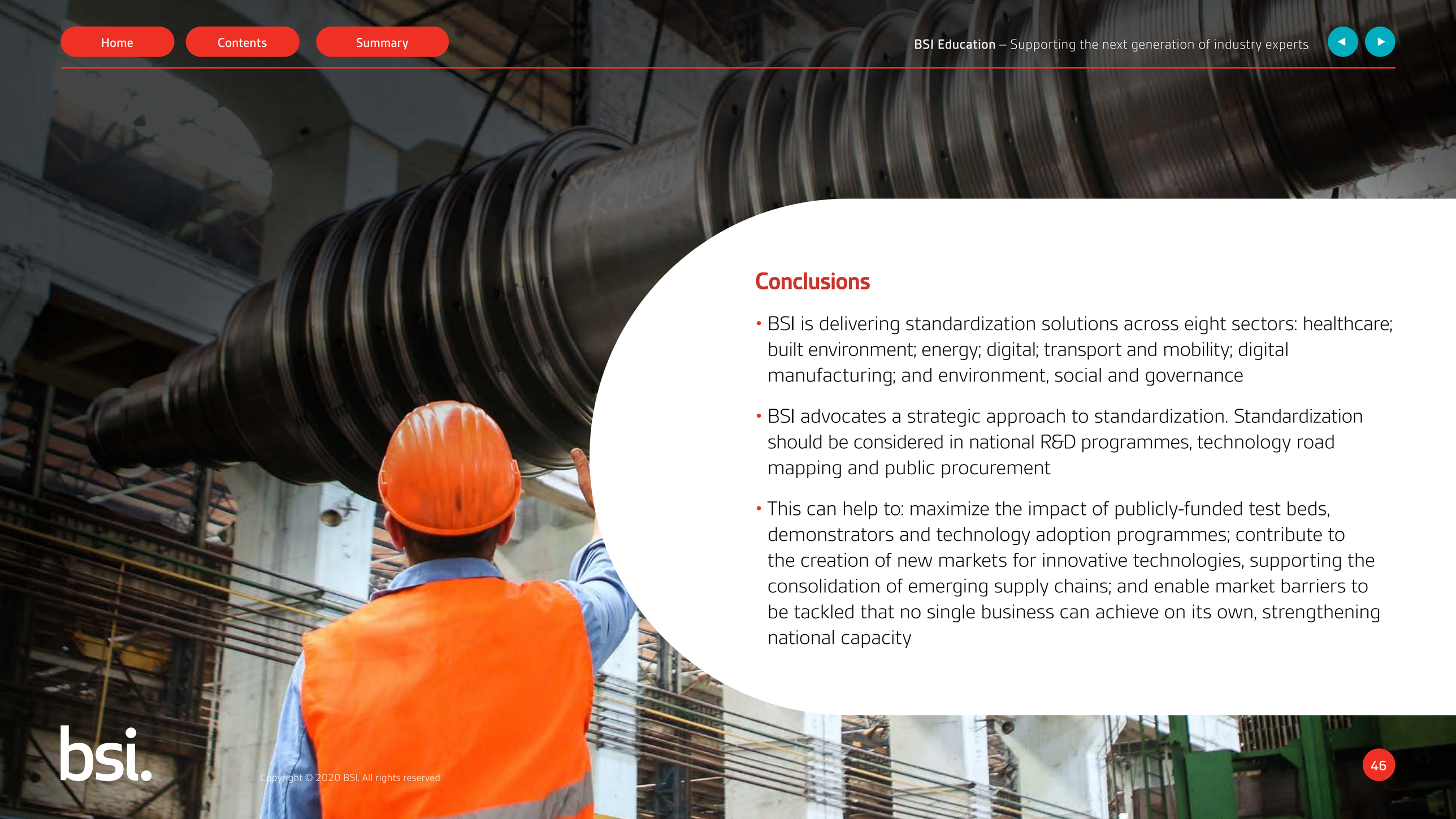
- Standards define a common language. They are also part of the rules of the game that shape how organisations behave and innovate. They can be used as a platform on which organizations can innovate
- The economic functions of standards can be mapped against the processes that describe how innovation systems work
- Standards have been formally recognized as a measure of innovation
- Standards coordination role makes them a key enabler and instrument of business strategy and activity

Standardization and future technologies

- The role of standardization will continue to expand across industries driven by continuous investment in R&D, as well as the need to integrate different technologies into new products and processes
- Standard can help to shape the evolution of emerging technologies, which become the new industries of the future
- A tailored approach to standards development for emerging technologies is needed. The types of standards required will vary by industry and according to the nature and maturity of the technology

Case study: CAV

- BSI has partnered with CCAV, Innovate UK, DfT and Zenzic to deliver a 2-year programme of standards to help position the UK as global centre for CAV development
- A Strategic Advisory Board comprising some of the leading voices from the UK CAV ecosystem is advising BSI on standardization priorities
- The programme is developing standardization solutions across areas such as safety, data, cyber security and terminology
- It is leveraging the UK's expertise in CAV R&D programmes, national trials and demonstrator projects to inform and influence the development of international standards



Conclusions

- BSI is delivering standardization solutions across eight sectors: healthcare; built environment; energy; digital; transport and mobility; digital manufacturing; and environment, social and governance
- BSI advocates a strategic approach to standardization. Standardization should be considered in national R&D programmes, technology road mapping and public procurement
- This can help to: maximize the impact of publicly-funded test beds, demonstrators and technology adoption programmes; contribute to the creation of new markets for innovative technologies, supporting the consolidation of emerging supply chains; and enable market barriers to be tackled that no single business can achieve on its own, strengthening national capacity

More information

References and further reading

Get involved with BSI and standards

Give us feedback

Contact us

References and further reading

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