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DESIGN CENTRE



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Shaping standards together

Enhancing stakeholder engagement in technical standards development for critical and emerging technologies

Research Report and Toolkit

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Glossary

AI	Artificial Intelligence
ARSO	African Organisation for Standardisation
BIS	Bureau of Indian Standards
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
COPANT	Pan American Standards Commission
EC	European Commission
EU	European Union
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things
ISO	International Organization for Standardization
KSA	Korean Standards Association
SDO	Standards Development Organisation

Definition of terms

Blockchain	A shared, immutable ledger enabling the recording of transactions and tracking assets in a network.
Critical and emerging technologies	Critical and emerging technologies are defined as those with the capacity to impact a nation's national interest. For Australia, recent examples include, but are not limited to, artificial intelligence, semiconductors, quantum computing, and telecommunications networks. ¹ For India, recent examples include, but are not limited to, 5G, artificial intelligence, blockchain, augmented reality and virtual reality, machine learning and deep learning, robots, and natural language processing. ²
De facto standards	Standards that are formed when a practice, behaviour or configuration has become widely accepted and adopted through repeated use and market dynamics, often driven by dominant enterprises or open-source software communities.
De jure standards	Standards developed through a formal process by a recognised standards development organisation (SDO), which may be voluntary or mandated through legal codes or regulations in certain jurisdictions.
Interoperability	The ability of different systems or technologies to work together, exchange information, and use shared resources effectively.
Standards Development Organisations (SDOs)	Formal organisations that are responsible for creating and disseminating technical standards, ensuring quality, interoperability and compatibility.
Technical standards	Established guidelines, specifications or protocols that define how a particular technology should be implemented, ensuring compatibility, interoperability and quality.

Table of contents

GLOSSARY	3
DEFINITION OF TERMS	4
EXECUTIVE SUMMARY	6
ABOUT THIS REPORT	7
1 INTRODUCTION	8
TECHNICAL STANDARDS ENABLE THE TECHNOLOGY ECOSYSTEM	8
MAXIMISING THE BENEFITS OF TECHNICAL STANDARDS REQUIRES DE JURE AND DE FACTO STANDARDS	9
2 CHALLENGES TO ENGAGING A RANGE OF STAKEHOLDERS IN DEVELOPING TECHNICAL STANDARDS	11
DEVELOPING EFFECTIVE STANDARDS REQUIRES INPUT FROM A DIVERSE RANGE OF STAKEHOLDERS	11
CHALLENGES TO ENGAGEMENT IN BLOCKCHAIN TECHNICAL STANDARDS DEVELOPMENT IN INDIA AND AUSTRALIA	13
CHALLENGES TO ENGAGEMENT IN STANDARDS DEVELOPMENT FOR CRITICAL AND EMERGING TECHNOLOGIES ACROSS DIFFERENT REGIONS	14
3 ESSENTIAL ELEMENTS TO BOOST STAKEHOLDER ENGAGEMENT IN STANDARDS DEVELOPMENT	17
4 CASE STUDIES: ENGAGEMENT INITIATIVES OF STANDARDS DEVELOPMENT ORGANISATIONS	19
CASE STUDY 1: NEXTGEN PROGRAM (STANDARDS AUSTRALIA)	21
CASE STUDY 2: AWARENESS AND CAPACITY BUILDING INITIATIVES (BIS)	22
CASE STUDY 3: CEN WORKSHOP AGREEMENT (CEN-CENELEC)	23
CASE STUDY 4: TRAINING PROGRAMS (COPANT)	24
CASE STUDY 5: TECHNICAL STANDARDS EDUCATION PROGRAMS (KSA)	25
CASE STUDY 6: ARSO DISNET (ARSO)	26
5 KEY RECOMMENDATION	27
6 AN ENGAGEMENT TOOLKIT FOR STANDARDS DEVELOPMENT ORGANISATIONS	30
ANNEX 1: METHOD – —RESEARCH AND INTERVIEWS	39

Executive summary

Technical standards enable the technology ecosystem, reflecting the values of the societies that contribute to making them and ensuring that technology can work anywhere in the world. When widely adopted, standards can facilitate international trade, expand the consumer base internationally and set requirements for safety, privacy and security. To ensure that technical standards can maximise their potential benefits, it is essential that a diverse range of stakeholders who apply these technologies contribute their expertise, experience, and knowledge to develop them.

A key challenge for organisations that lead technical standards development is securing stakeholders from a diverse range of sectors – across government, industry, academia and civil society – to engage in standards processes. In our previous analyses, we found that the majority of stakeholders across the blockchain ecosystem in Australia and India were not engaged in developing standards for blockchain, even though most were aware of the potential benefits of technical standards. This was largely because formal standards development processes were seen as lengthy and time-consuming, mostly without compensation for contributors, and standards were viewed as low priority for industry stakeholders and sought only as needed.

Several reports by blockchain stakeholders led us to hypothesise that low engagement in making standards could be a broader issue for other critical and emerging technologies. This refers to technologies still developing and/or identified as a national or international priority. Stakeholder perceptions were that the pace of development for technology is much faster than for technical standards, and this could result in standards that are too prescriptive, potentially stifling further innovation.

We tested this hypothesis with four internationally recognised standards development organisations (SDOs). We found that engagement patterns for other critical and emerging technologies were not necessarily similar to those we observed for blockchain in India and Australia. Instead, engagement in standards development of different stakeholder groups varied greatly depending on location (nation or region) and the technology subject area.

In this report, we present our analysis of stakeholder engagement experiences reported by SDOs in India, Australia, Europe, and the Americas for standards development in critical and emerging technology areas. We also share several different approaches that SDOs have implemented to improve engagement in standards processes for specific stakeholder groups. Combined with our previous analysis of the blockchain ecosystem, this new analysis informed our development of six essential elements of engagement, which are ways to boost engagement in standards development for specific stakeholder groups and can be applied when SDOs are designing new, targeted engagement initiatives.

Key recommendation

SDOs should develop tailored initiatives to improve engagement with specific stakeholder groups in critical and emerging technologies, informed by an understanding of those stakeholders’ specific challenges and best practice initiatives currently underway.

There is a significant opportunity for SDOs to boost engagement among key stakeholder groups who do not engage in standards development within their area of technical expertise. Without action, there is a risk that we will not be able to realise the full economic and strategic benefits that critical and emerging technologies can offer society. As a first step to addressing this recommendation, we have developed an *Engagement Toolkit* based on our research findings. The toolkit is designed to help SDOs create targeted initiatives to encourage participation from stakeholders with low engagement in standards-making for critical and emerging technologies.

About this report

This report shares the findings of the third and final phase of the research project, *Shaping blockchain technical standards consistent with Australia and India's shared vision for an open, free, rules-based Indo-Pacific*. The project aimed to understand the blockchain ecosystem, including its uses, key stakeholders and how they interact with technical standards development in Australia and India. This project is motivated by the opportunity to realise greater economic and social benefits through the wider adoption of high-quality and effective technical standards in critical and emerging technologies, such as blockchain. This project contributes to this goal by capturing and analysing the key barriers, perceptions and knowledge gaps. The findings from this project will help empower key stakeholders to increase their engagement in standards-making at the national, regional and international levels.

In the project's first two phases, we mapped the key stakeholders and emerging applications of the non-financial blockchain ecosystem in India and Australia and explored approaches to adopting and developing technical standards for this technology in both nations.³ We investigated whether there were any specific challenges for developing and adopting standards for blockchain technology and found that engagement in standards development for this technology was generally low. However, various challenges impacted consistent and meaningful engagement, which varied by stakeholder type and location (nation). Importantly, our findings also highlighted that engagement in developing standards impacts the likelihood of adoption. For example, stakeholders already engaged in standards development were more likely to adopt technical standards in their products and practices.

In this third and final phase of the project, we investigated whether stakeholder engagement in standards development was also low for other critical and emerging technologies more broadly and in locations outside Australia and India. This hypothesis was driven by our findings in this project's first and second phases, where industry stakeholders viewed developing technical standards as a low priority because the lengthy processes were too slow compared to the speed of technology innovation for areas like blockchain. Our findings from this third phase were used to inform the development of a toolkit, which provides guidance for SDOs to design and implement targeted initiatives to boost engagement with key stakeholder groups in the critical and emerging technologies ecosystem.

In this report, we present our findings in four parts:

1. **An analysis of the key challenges SDOs face to better engage specific stakeholder groups** in developing technical standards, including challenges specific to critical and emerging technologies. This analysis builds on findings from phases one and two of this project³ where we identified key challenges to engagement in standards development for the blockchain ecosystem in Australia and India. Through new interviews with four SDOs based in different regions around the world, we compared stakeholder engagement levels and engagement challenges for blockchain with those of other critical and emerging technologies.
2. **A guide to six essential elements of engagement**, which we have developed from the findings of our analysis of engagement challenges both for blockchain and other critical and emerging technologies and propose as the building blocks for enhancing engagement in standards development. These approaches were tested with SDOs and helped inform our toolkit development.
3. **A profile of current engagement initiatives set up by six different SDOs** internationally to boost engagement in standards-making for specific groups of stakeholders. These examples illustrate how the essential engagement elements can be put into practice.
4. **The Engagement Toolkit** is a simple guide designed as a standalone document to assist SDOs in better engaging stakeholders in standards-making for critical and emerging technologies. The toolkit provides examples of best practice engagement initiatives used by SDOs to target specific stakeholder groups and promote better standards-making at national and international levels.

1 Introduction

Technical standards enable the technology ecosystem

Technical standards are critical to the development of technology and society, playing an important enabling role in the technology ecosystem (Figure 1). Standards can reflect the views and values of societies who shape them by embedding approaches to security, safety, privacy, and data protection into technology.⁴ They can enhance innovation and economic growth by facilitating interoperability, ensuring that new technology can work anywhere in the world regardless of national borders.⁵

To ensure that national, regional and international technical standards can maximise these potential benefits, it is critical that stakeholders across industry, government,⁶ academia, and civil society who develop and apply the technologies understand and engage in the process of developing technical standards that support the technologies’ applications.⁷

Figure 1. Why are technical standards important?



Maximising the benefits of technical standards requires de jure and de facto standards

Both *de jure* and *de facto* standards (Box 1) are needed to realise the full spectrum of practical, economic and strategic benefits (Figure 1). Engagement of key stakeholders in developing technical standards and collaboration between the organisations who lead standards development (Box 2) is essential to fostering a thriving ecosystem.

This is supported by the findings from our previous studies on the blockchain ecosystem,³ which highlighted that *de jure* and *de facto* technical standards can complement each other. Still, collaboration between the organisations that develop them can often be hindered by their significant differences in organisational structure and how they engage with their stakeholders.

Box 1: What is the difference between <i>de jure</i> and <i>de facto</i> technical standards?		
	De facto standards	De jure standards
Compliance	Voluntary	Voluntary or mandated through legal codes or regulations in certain jurisdictions.
Standards development process	Informal Formed when a practice, behaviour or configuration has become widely accepted and adopted through repeated use. Development relies on a culture of active and sustained participation by key market actors.	Formal Formed through a robust process with wide consultation among key stakeholders across industry, government, research and consumer sectors.
Developed by	Typically, government-industry consortia or industry groups, alliances, associations and open-source software communities. Driven by market dynamics.	Recognised Standards Development Organisations (SDOs), which can be national, regional or international (global). ^a
Advantages	More responsive to advances and developments in the technical area. Often a lower cost to adopt.	Opportunity for greater accessibility and adoption by the global community. Maximises interoperability. Can open new markets with access to a multinational consumer base. Greater opportunity to realise the full strategic benefits of standards.
Disadvantages	Development process is focused on what is already being done rather than developing best practice. Often not easily accessible to technology users outside the groups who have set the <i>de facto</i> standard.	Less agile than processes for <i>de facto</i> standards development.

a: see Box 2

Box 2: Who develops technical standards?

International Standards Development Organisations:

At an international level, standards development for critical and emerging technologies like blockchain is driven and coordinated by a few key organisations that operate at an international (global) level. These include the International Organisation for Standardization (ISO)⁸, the International Telecommunication Union (ITU)⁹, and the Institute of Electrical and Electronics Engineers (IEEE)¹⁰.

Regional/National Standards Development Organisations:

The decisions of major national and/or regional SDOs from jurisdictions with significant technology markets and ecosystems can also shape the standards landscape of other countries. This group includes regional SDOs in Europe, such as the European Committee for Standardization (CEN) and national-level organisations, such as the Bureau of Indian Standards (India) and Standards Australia (Australia).

Industry Groups, Communities and Initiatives:

Industry groups, communities and initiatives play a crucial role in formulating standards alongside formal SDOs. Practices, protocols or configurations supported by such groups and initiatives often become widely accepted as *de facto* standards. For a technology like blockchain, this includes a wide range of groups and initiatives, including the World Wide Web Consortium (W3C)¹¹, the Hyperledger Foundation¹², the Enterprise Ethereum Alliance (EEA)¹³, and the InterWork Alliance (IWA)¹⁴.

2 Challenges to engaging a range of stakeholders in developing technical standards

Developing effective standards requires input from a diverse range of stakeholders

“Like a symphony, it takes a lot of people working together to develop a standard.”

International Standards Organisation (ISO), 2024

Technical standards need engagement from all stakeholders across the ecosystem during their development to provide the greatest opportunity to realise the economic, practical and strategic benefits when adopted (Figure 2).

Figure 2. Key stakeholders and their roles in the technical standards ecosystem



SDOs reported that they predominantly receive advice, expert input, and feedback on developing *de jure* standards through direct stakeholder participation in technical committees. Most of the engagement challenges SDOs face are related to gaining a commitment from a diverse range of stakeholders to join the committees or associated working groups. This is a similar commitment of significant time and resources regardless of whether at the national, regional or international (global) level.

Challenges to engagement in blockchain technical standards development in India and Australia

During our previous analysis of the Australian and Indian blockchain ecosystems, we found low levels of direct participation in developing standards by stakeholders with strong technical knowledge and understanding at national and international levels (Table 1). While many blockchain stakeholders were aware of major standards-related bodies, existing technical standards and similar frameworks relating to blockchain, many reported that they had not participated in standards-making processes. However, the stakeholders who reported high levels of engagement in standards development did not have strong technical knowledge of blockchain technology or its applications. The stakeholders who were not involved in developing the technology, its applications or making standards generally supported technical standards because they were seen as indicators that the products were trustworthy and safe for users.

Table 1. Key findings from stakeholder mapping of the blockchain ecosystem in India and Australia.³

Stakeholder type	Knowledge of standards and processes	Technical knowledge	Engagement in technical standards	General support for technical standards
Industry-based, applying blockchain technology	LOW	HIGH	LOW	VARIED
Enabling role (e.g. head of a research centre)	VARIED	VARIED	VARIED	nd
Involved in making blockchain standards	HIGH	LOW	HIGH	HIGH
Not involved in either blockchain technology or in making blockchain standards	LOW	LOW	LOW	HIGH

nd: no data available

Low and inconsistent levels of direct participation by a diverse range of stakeholders in blockchain standards development are underpinned by several key challenges:

- Few incentives to sufficiently compensate for the time and resources necessary to participate in *de jure* standards development. *De jure* standards development by SDOs is conducted over long time frames (months to years), which requires significant time and resource commitment. Monetary incentives and/or recognition for the contributions are needed to compensate individual experts sufficiently and, in turn, incentivise greater participation.
- A preference for *de facto* standards, developed by industry-based standard setting bodies, consortium-led groups, and other private associations as a more attractive alternative. Processes for developing *de facto* standards were viewed as more effective for formulating efficient and expedient standards, providing options that served their immediate purposes.
- Adoption of *de jure* technical standards was also low in the blockchain ecosystem, likely contributing to limited stakeholder incentives for participating in standards development processes. This was driven primarily by perceptions that *de jure* standards would represent a barrier to innovation or that they were not relevant to the context where the technology was being used. If standards were to be adopted, there was a preference for *de facto* standards. Consequently, if stakeholders are not incentivised to use the *de jure* standards, they would be unlikely to prioritise time and resources to participate in developing them.
- A broader underlying issue of a lack of diversity among stakeholders contributing to standards development, both in the types of stakeholders and broader demographic diversity factors such as age and gender. Industry groups were the dominant stakeholders in *de facto* standards-making, with little engagement outside these groups.

Challenges to engagement in standards development for critical and emerging technologies across different regions

In this third phase of the project, we next investigated whether these challenges for developing *de jure* standards for blockchain in Australia and India were similar for other critical and emerging technologies more broadly and for SDOs located elsewhere internationally. We interviewed regional SDOs in Europe (CEN-CENELEC) and the Americas (COPANT) and national SDOs in Australia (Standards Australia) and India (Bureau of Indian Standards) and compared their experiences and challenges with engaging stakeholders in standards development for critical and emerging technologies, including blockchain. Further information about each of the four SDOs interviewed is available in Table 2. Information about all six SDOs discussed in this report is available in the Case Studies section on page 19.

There were three key findings from our analysis and comparison of the four SDOs:

1. **All four SDOs experienced low levels of engagement by some stakeholders in standards development for critical and emerging technologies. This was caused by similar underlying challenges to those observed specifically for blockchain.**

All SDOs reported that there were some groups of stakeholders with low levels of engagement in standards-making for critical and emerging

technologies. The challenges leading to reduced engagement were alike across these groups and aligned with the difficulties conveyed by blockchain participants during the first and second phases of the project. For blockchain, many industry stakeholders in Australia and India viewed *de jure* standards development as onerous unless there was a clear business incentive. Often, *de facto* standards were perceived as sufficient or preferable for their commercial needs. Many research or academic stakeholders would engage early in the process but find it difficult to commit to the full-time period needed for developing the technical standard.

The two regional SDOs developing regional standards and/or facilitating coordination with different national SDOs faced similar challenges. However, they were also impacted by the additional layer of engagement needed through their national SDO members who were seeking engagement from their national stakeholders, all of whom have differing national and commercial interests.

2. Each SDO experienced different levels of engagement from different types of stakeholders, which was dependent on:

a) the subject area and technology focus of the technical standards being developed

b) the technical capabilities, priorities and interests of the nation or region that the SDO represents

SDOs indicated that engagement for critical and emerging technologies commonly presented greater challenges than established technology areas. In some cases, this was due to trying to engage a new community of stakeholders with specific technical expertise in standards-making, where there may not necessarily be awareness or a culture of making or adopting standards. However, the level of interest and motivation among the new community of stakeholders varied by technology area, which varied again by geographical location (Table 2).

One SDO reported that engagement was better for technologies, like AI, that:

- have an active set of key individuals and representative organisations within the region they represent
- a concentration of expertise with high levels of awareness about the value and importance of standards-making nationally and internationally
- the technology has a prominent public, national and/or international profile with readily identifiable applications and users.

Conversely, other technologies with less of a public profile or a smaller community of technical experts, like quantum, were reportedly more difficult to engage stakeholders.

In some cases, engagement depended on the context in which the technology had been applied. Another SDO reported that blockchain had lower engagement than other technologies like AI and the Internet of Things (IoT) since these technologies are more widely used within the industry. Issues around scalability reduced the overall participation in the blockchain ecosystem, and consequently, participation in blockchain standards-making.

One regional SDO reported that engagement levels were often driven by commercial incentives for industry in making standards and/or by national interests of their member SDOs or, where applicable, regional-level interests where there is a common trade area or regional-level government.

3. Engaging a diverse range of stakeholders and individuals in standards development is an ongoing challenge.

Across all stakeholder groups, SDOs reported that engaging across diverse groups of stakeholders continued to be a challenge. It was noted during our interviews that individual participants or representatives for technical committees or advisory groups on standards-making were often male, senior members of their organisation. Involvement by female representatives or representatives who were younger or earlier in their careers was far lower. Efforts to address this were most often focussed on improving the diversity in technical or discipline expertise of stakeholders who engaged and less often focussed on improving diversity among demographic aspects like gender. In some cases, SDOs had established engagement initiatives for capacity building or education on technical standards focused on increasing engagement by younger people or those early in their career, which helps to increase age diversity among stakeholders.

Table 2. Stakeholder engagement in critical and emerging technologies standards development by national and regional SDOs (Australia, India, Europe and the Americas)

	National SDOs	Regional SDOs
Role for SDO	Developing national standards. Participates in international (global) standards development (e.g. through ISO, IEC).	Developing regional standards. Facilitating intra-region international cooperation between members. Facilitating participation by members in international (global) standards development (e.g. through ISO, IEC).
SDOs interviewed for our analysis	Standards Australia (Australia) – national SDO for Australia. Bureau of Indian Standards (India) – national SDO for India.	CEN/CENELEC (Europe) – Represents 34 countries in the European Union COPANT (Americas) – Represents 31 national SDOs across North, South and Central America
Profile of key stakeholders	Stakeholders from industry, academia, industry groups and consortia, civil society and government.	National SDOs from nations in the region. Regional governments, where applicable (e.g. European Commission) Stakeholders (industry, academia, industry groups and consortia, civil society and government) who are engaged through national SDOs. International associate or affiliate members that are SDOs and related organisations outside their region.
Reasons reported by SDOs for varied levels of stakeholder engagement	Dependent on: - national capabilities, expertise and community around the technology - number of use cases and applications nationally - commercial interest in the technology. - Impacts engagement in national and international standards development. High engagement in technology areas with: - high public visibility - a local ecosystem that recognises the safety, usability and trust benefits that standardisation will bring to users. - the number of businesses and use cases for the technology by government and industry. <i>Example technologies: AI, Internet of Things</i> Low engagement in technology areas: - with few or limited use cases nationally - where the potential for scaling the technology is limited. <i>Example technologies: blockchain, quantum</i>	Dependent on: - national interest of their members and their national stakeholders - commercial incentives for standards on certain technologies - proactive engagement by the regional SDO for the region to lead on emerging technology areas - balance of resourcing and commercial drivers for international trade - requests from regional government (e.g. EC) for standards to align with legislation.

3

Essential elements to boost stakeholder engagement in standards development

We have developed six key elements of successful engagement (Figure 3) to help SDOs better target engagement initiatives for specific stakeholder groups or individuals. These were informed by our analysis of the challenges to stakeholder engagement in developing technical standards for blockchain and other critical and emerging technologies internationally, which were discussed in the previous section.

Figure 3. Six essential elements of stakeholder engagement in technical standards development



4

Case studies: Engagement initiatives of standards development organisations

This section presents case studies of key initiatives underway by various SDOs globally, which aim to increase the engagement of specific stakeholder groups (Table 3). These are targeted engagement initiatives tailored to a range of different audiences, incentives and goals, recognising that there are different challenges to engagement for different types of stakeholders.

Each initiative is underpinned by one or more of the six engagement elements discussed in the previous section. The role and governance structure of each SDO, whether national or regional, also impacts the design of the initiatives aimed at boosting engagement in standards development processes.

Table 3. Example engagement initiatives implemented by SDOs to boost engagement among key stakeholder groups in technical standards development.

	Regional SDOs			National SDOs		
	CEN–CENELEC ^a	ARSO ^b	COPANT ^c	Standards Australia	Bureau of Indian Standards	Korean Standards Association
<i>Description of engagement initiative</i>						
Name of initiative	CEN Workshop Agreement	ARSO DISNet	Member training programs	NEXTGen	Awareness and capacity building programs	Education programs
Type of initiative	Rapid development of pre-standards for innovative areas	Information sharing platform	Training programs – international standards	Professional development and training	Stakeholder focused awareness and capacity building	Education and professional development programs
Target stakeholders	Leaders – all stakeholder groups; National SDOs in Europe	National SDOs in Africa; Government representatives	National SDOs in the Americas	Emerging leaders – early career (Australia)	Industry, academia, students and youth (India)	School students, industry professionals, consumers
Primary engagement challenge it addresses	Lengthy standards development processes deter stakeholders	Low awareness about technical standards and their development	Limited resources for many individual member SDOs to engage internationally	Need for a pipeline of standards-savvy experts for development processes	Low awareness about technical standards and their development	Need to build standards engagement throughout all sectors
<i>Elements of engagement^d</i>						
Element 1: Incentivising direct participation	Yes	–	–	Yes	–	–
Element 2: Encouraging diversity among participants	–	–	–	Yes	–	–
Element 3: Building capacity in standards processes	–	Yes	Yes	Yes	Yes	Yes
Element 4: Creating and supporting informal networks	–	Yes	Yes	Yes	Yes	–
Element 5: Engaging sector leaders	Yes	–	–	–	Yes	Yes
Element 6: Facilitating International/regional coordination	Yes	Yes	Yes	–	–	–

a. CEN – European Committee for Standardization; CENELEC – European Committee for Electrotechnical Standardization

b. COPANT – Pan-American Standards Commission

c. ARSO – African Organisation for Standardisation

d. The six engagement elements are described in this report's previous section (see page 18).

Case study 1: NEXTGen Program (Standards Australia)

About Standards Australia

Standards Australia is Australia's non-government, national SDO. Their varied engagement initiatives aim to build networks of experts to advise on standards development, increase public awareness about the role of standards nationally and internationally, and ensure that Australia makes relevant and timely contributions to developing international standards.

Standards Australia is highly engaged in international standards development through ISO and IEC committees.^{15,16} In the Indo-Pacific region, Australia engages with Standards New Zealand to develop joint standards, is a founding member of the Pacific Area Standards Congress (PASC),¹⁷ and works on standards activities with the Asia-Pacific Economic Cooperation (APEC)¹⁸ and the Association of South-East Asian Nations (ASEAN).¹⁹

NEXTGen program

The NEXTgen program²⁰ aims to support the future of standards development by investing in the next generation of standards leaders and experts. Selected participants are emerging leaders who access training and gain the necessary skills to contribute to developing standards in their field of expertise, now and in the future. Participants gain direct exposure to the standards development process through webinars, meetings, and professional development activities, developing a deep understanding of what it takes to shape robust standards that contribute net benefits to the Australian community. The initiative builds connections between past and present participants, creating a valuable network of key Australian stakeholders and peers across the technology community who are informed and engaged in standards-making.

Elements of engagement for the NEXTGen program

- **Incentivising direct participation** – providing professional development, professional networks, and skills development opportunities targeting early career and younger professionals.
- **Building capacity in standards-making** – building a culture of awareness among new stakeholders about the importance of standards development and how technical standards are made.
- **Increasing diversity in standards-making processes** – addressing the lack of younger and early career stakeholders engaged in standards development.
- **Creating informal networks to increase engagement in standards-making** – builds a network of early-career technical experts who understand the value and process of standards-making. This helps foster continuous and sustainable leadership and engagement in Australia.

Case study 2: Awareness and capacity building initiatives (BIS)

About the BIS

The Bureau of Indian Standards (BIS) is India's statutory national body for standards development. It was set up to enable harmonious standards development in India. BIS acts as a formal platform for stakeholders to contribute to developing technical standards, including for emerging technologies. As the national standards body, BIS represents India at ISO and IEC and participates in technical committees through its national mirror committees.²¹

The BIS develops national standards and implements standards formulated internationally by SDOs such as the ISO and IEC. It periodically identifies high-priority subjects of strategic national importance for standardisation. It convenes relevant experts on such subjects to consider the development of national standards and participate in standards development at international SDOs.²¹ Currently, these include emerging technologies such as blockchain and distributed ledger technologies, AI and IoT.

Awareness and Capacity Building Initiative

BIS engages with various stakeholders, such as industry, academia, technical community members as well as the general public, through stakeholder-specific monthly discussion programs and training programs. This includes programs such as 'Manak Manthan', where discussions on new standards and information sharing on revisions or amendments take place,²² and training sessions by the National Institute on Training for Standardization (NITS) on standardisation, quality assurance, management systems, certification and laboratory testing.²³ Several programs also target young students about the roles of standards in technology used in day-to-day life,²⁴ encouraging youth engagement through participation in standards clubs in colleges,²⁵ and funding for research and development projects to collaborate with educational institutions.²⁶

BIS initiatives seek to engage with various stakeholders, including students, researchers, academics, the technical community, and industry, in an effort to increase capacity and awareness and improve diversity in the standards-making process in the long run.

Elements of engagement for BIS awareness and capacity building programs

- **Building capacity in standards-making** – building awareness amongst stakeholders about the importance of standards development and organising practical workshops on contributing effectively to international SDOs.
- **Engaging sector leaders in standards-making** – inviting industry leaders, prominent academics, and standards experts to share their insights with other stakeholders, encouraging them to leverage their networks to build a broader standards community.
- **Increasing diversity in standards-making processes** – engaging students, young researchers and other early-career stakeholders through awareness-building initiatives in educational and research institutions.
- **Creating informal networks to increase engagement in standards-making** – organising discussion programs involving industry bodies, regulatory bodies, civil society groups and academia to launch new standards and to share important amendments to existing standards.

Case study 3: CEN Workshop Agreement (CEN-Cenelec)

About CEN and CENELEC

The European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC) are two of the three European SDOs that are recognised by the European Union (EU) as responsible for leading the development and provision of voluntary technical standards for Europe.²⁷ Both CEN and CENELEC are member-based organisations, where CEN's members are 34 national SDOs of EU member countries. In contrast, CENELEC's members are the electrotechnical national committees of the CEN member nations. Together, stakeholders of CEN and CENELEC develop, adopt, and implement agreed European standards in their respective countries. While standards are largely voluntary, CEN and CENELEC also lead the development of European standards that support the legislative framework set by the European Commission.²⁸

CEN and CENELEC are highly engaged internationally outside Europe with other regions, encouraging the adoption of European and international standards and collaborating on training and awareness about standards and their commercial benefits. The Innovation Plan (2018) outlines its strategic approach to engagement with its members (national European SDOs), regional stakeholders, and the international standards community.²⁹

CEN Workshop Agreement initiative

The CEN Workshop Agreement is a pre-standard reference document that can be swiftly developed to serve an immediate need for standardisation in an innovative technical area.³⁰ The agreement creates a “rapid way to standardisation”, bringing the option of a fast track to standards development, aimed at boosting adoption for innovative areas by capturing the strategic and commercial benefits of standardisation, but developing them rapidly through one focussed workshop compared to months or years for developing a full standard. While not a complete technical standard, the agreement is a deliverable developed by a temporary working group called a CEN and/or CENELEC Workshop, assembled through an open call to all, including people outside Europe.

Elements of engagement for the CEN Workshop Agreement

- **Incentivising direct participation** – establishing a fast-track process for standard development reduces the time investment required from stakeholders and lowers the barrier to participation.
- **Engaging sector leaders** – the workshop approach targets sector leaders by focusing on standardisation's strategic and commercial benefits.
- **Facilitating International/regional coordination** – this template enables regional consistency in the format of fast-tracked guidelines.

Case study 4: Training Programs (COPANT)

About COPANT

The Pan American Standards Commission (COPANT) is the regional SDO and reference for technical standardisation and conformity assessment for the Americas,³¹ with 31 national SDO members from across the Americas and their 11 “adherent” members, who are international, national and regional SDOs from outside the Americas.

Their main role centres on facilitating regional collaboration among their members and promoting the adoption of international standards within the region. While they do not develop standards directly, COPANT promotes the development of its members by encouraging them to get involved in developing and adopting international standards, through collaboration with its international adherent members.

Member training programs

COPANT aims to upskill its members by developing knowledge and awareness of standards development processes through training programs and online training material. These training modules are short videos on topics such as accreditation, standardisation, technical regulation, and ISO and IEC training.³²

COPANT also hosts regular training and networking workshops, often co-hosting with their adherent members, focussing on developing standards processes and exchanging best practices and experiences in international standards development. The main objective of the workshops is to upskill its members on the utility of international standards, and in turn, to drive greater participation by their members in international standards development processes (through ISO and IEC).

Elements of engagement for COPANT member training programs

- **Building capacity in standards development processes** – through establishing training programs and workshops.
- **Creating and supporting informal networks** – by engaging with international SDOs to run workshops for COPANT members.
- **International coordination** – COPANT’s main role is to facilitate and build cooperation and collaboration within the region, and between the region and international (global) standards development processes.

Case study 5: Technical standards education programs (KSA)

About the KSA

The Korean Standards Association (KSA) is the main body for standards engagement services in South Korea. Founded by the South Korean government to contribute to the development of the nation's economy by boosting the survey, studies, development and distribution of industrial standards and quality management, thereby promoting scientific techniques and improving production efficiency.³³

KSA serves three main roles in the Korean standards ecosystem: publishing standards developed by the Korean Association of Technical Standards (KATS), analysing Korean standards, and upskilling the Korean standards community through education programs and certifications.³⁴

As a national body, KSA's main stakeholders are the South Korean industry and the general population. It informs and engages these stakeholders on the utility of standards development to the South Korean economy through international standards education programs, generally aimed at students.³⁴

Education Program

KSA has a well-developed and comprehensive standards education program that engages with people from elementary school to a university degree, as well as other programs targeted toward industry professionals, consumers, and the general public.

From elementary school to high school, standards education programs focus on small standards education exercises and the utility of standards in technology. More than 50 universities have standardisation programs, and technology standards are incorporated into human resource learning and development programs.³⁴ KSA also hosts an International Standards Olympiad competition for young students to uplift standards awareness internationally.

For industry and standards professionals, KSA aims to upskill people to have greater awareness of international standards, and increase their expertise and professional knowledge on standards, standards management strategy, and responses de facto standards education.

Elements of engagement for KSA education programs

- **Building capacity in standards-making** – creating awareness of the utility of standards to the South Korean economy at a young age, as well as uplifting awareness and expertise of professionals in the workforce to engage with standards-making.
- **Engaging sector leaders in standards-making** – emphasising standards in technology, KSA aims to engage the South Korean tech sector in standards awareness and development.

Case study 6: ARSO DISNET (ARSO)

About ARSO

The African Organisation for Standardisation (ARSO) is a regional standards organisation with members from 42 African countries. It includes national SDOs for African nations or individuals who deal with standards if their nation does not have a national SDO³⁵. ARSO develops tools for standards development, harmonisation, and implementation of these systems to enhance Africa's internal trading capacity and global competitiveness.³⁶

ARSO is focused on developing accessibility and upskilling the capacity for standards-making in the African region. Engagement with technical standards development is predominantly making international standards available to ARSO members.

ARSO DISNET

ARSO-DISNET is a web portal that hosts documents related to standards and technical regulations activities in Africa. Through this online resource, ARSO aims to promote engagement with technical standards by raising awareness of standardisation efforts in the region. This awareness of standards-making efforts may help with a greater capacity for making or being aware of standardisation utility. The resource increases regional international cooperation in standardisation efforts. It provides an easy way for its members to see what other regional national SDOs are working on, allowing them to align or coordinate standardisation priorities where relevant. This, in turn, will help to harmonise standardisation efforts in the region, creating a lower likelihood of duplication and more clarity around technical standards.

Elements of engagement for ARSO DISNet

- **Building capacity in standards-making** – Equip stakeholders in African countries with information on standards work in the region so they can benefit from the economic opportunities presented by standards work.
- **International cooperation** – Promote awareness of standardisation activities in the region,³⁷ encouraging cooperation and reducing technical trade barriers. It also reduces duplication of efforts and supports intergovernmental networks of standards development.
- **Creating and supporting informal networks of technology users** – the web portal aims to harmonise African regional standards by enabling ready access to current standards in the region.

5 Key Recommendation

SDOs should develop tailored initiatives to improve engagement with specific stakeholder groups in critical and emerging technologies, informed by an understanding of those stakeholders' specific challenges and best practice initiatives currently underway.

There is a significant opportunity for SDOs to boost engagement among key stakeholder groups who do not engage in standards development within their area of technical expertise. Without action, there is a risk that we will not be able to realise the full economic and strategic benefits that critical and emerging technologies can offer society.

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6 An engagement toolkit for standards development organisations

As a first step to addressing our key recommendation from this project, we have developed an Engagement Toolkit, which is aimed at helping SDOs design targeted engagement initiatives for stakeholders who may currently be engaging at low levels in standards development for critical and emerging technologies.

The toolkit is intended to be used as a standalone document, providing an at-a-glance guide for use among SDOs and stakeholders globally to design new engagement initiatives. Its content and style have been developed by implementing and responding to the main outcomes of the research described in this report – that different engagement initiatives will be needed to target different types of stakeholders and build on an understanding of their awareness, motivations, knowledge and role in the technology ecosystem. The Engagement Toolkit shares practical advice about how to design new engagement initiatives by applying the outcomes of our research as outlined in Table 4. A copy of the toolkit has been provided in this section.

Table 4. Considerations for SDOs: design of new stakeholder engagement initiatives.

Consideration for engagement initiative design	Research findings	Engagement Toolkit section (toolkit page is indicated)
Boosting engagement from a diverse range of stakeholders	Different stakeholder groups bring different perspectives on technology and its applications, depending on their role in the broader ecosystem. A stakeholder in industry, who is innovating and developing the technology, will provide a different perspective for standards development from a technology consumer, who uses applications of the technology in products and services.	Cover page (Page 1) Introductory paragraph that explains why seeking input from a diverse range of stakeholders is needed to realise the potential benefits of technical standards.

Consideration for engagement initiative design	Research findings	Engagement Toolkit section (toolkit page is indicated)
Understanding your different stakeholders	There are few incentives for stakeholders to provide input, technical advice and perspectives for standards development, largely because it is volunteer-based and can be a significant time commitment. Some stakeholders that do not generally engage in standards development could provide valuable perspectives, but may not be aware of the role of technical standards and how they are developed and adopted. To increase engagement from specific stakeholder groups or individuals, it is important to design incentives for participation that appeal directly to their motivations and current awareness about the potential benefits that standards could bring for their business, research or consumer experience – this differs for each group in the technology ecosystem.	“What can technical standards do for your key stakeholders?” (Page 2) This section raises key questions for SDOs to address in their engagement initiatives, such as highlighting the specific benefits of standards for different stakeholder groups. It guides how to apply an understanding of the benefits to each stakeholder group to incentivise greater participation. For example, consumers are likely to be most interested in how standards can create an experience of the technology that means it works regardless of where they are in the world. In contrast, industry – companies of all sizes – are likely to be interested in opportunities to scale products and reach new markets. “Standards in action” provides two examples of technical standards applicable to two different technologies – blockchain and AI.
The essential elements of engagement in standards development	There are six essential elements of engagement. A combination of two or more elements usually underpins engagement initiatives used by SDOs globally. The specific combination of elements depends on the stakeholder group being targeted and their role in the technology ecosystem.	“Six ways to boost stakeholder engagement in technical standards development” (Page 3) Practical advice about applying the six elements of engagement has been included in the toolkit alongside general examples of ways they could be implemented in an engagement initiative.
Learning from other SDOs	Analysis of specific engagement initiatives in place at SDOs worldwide demonstrates application of the six engagement elements and how initiatives can be effectively tailored to specific stakeholder groups. These examples can help other SDOs who may be developing standards in a new technology area and need to seek engagement from a new group of stakeholders.	“Engagement initiatives at standards organisations” (Page 4) Six engagement initiatives have been featured in the toolkit to demonstrate how different SDOs worldwide are implementing these considerations. The elements of engagement that underpin each initiative have been indicated.

ENGAGEMENT TOOLKIT

Boosting your stakeholder involvement in standards development for critical and emerging technologies

For national, regional & international standards organisations

Creating technical standards that maximise the potential benefits for businesses, governments and consumers means understanding how the technology will be applied, who is using it and the outcomes they want to see.

To achieve this, it is essential that we hear from a diverse group of stakeholders when technical standards are being developed.



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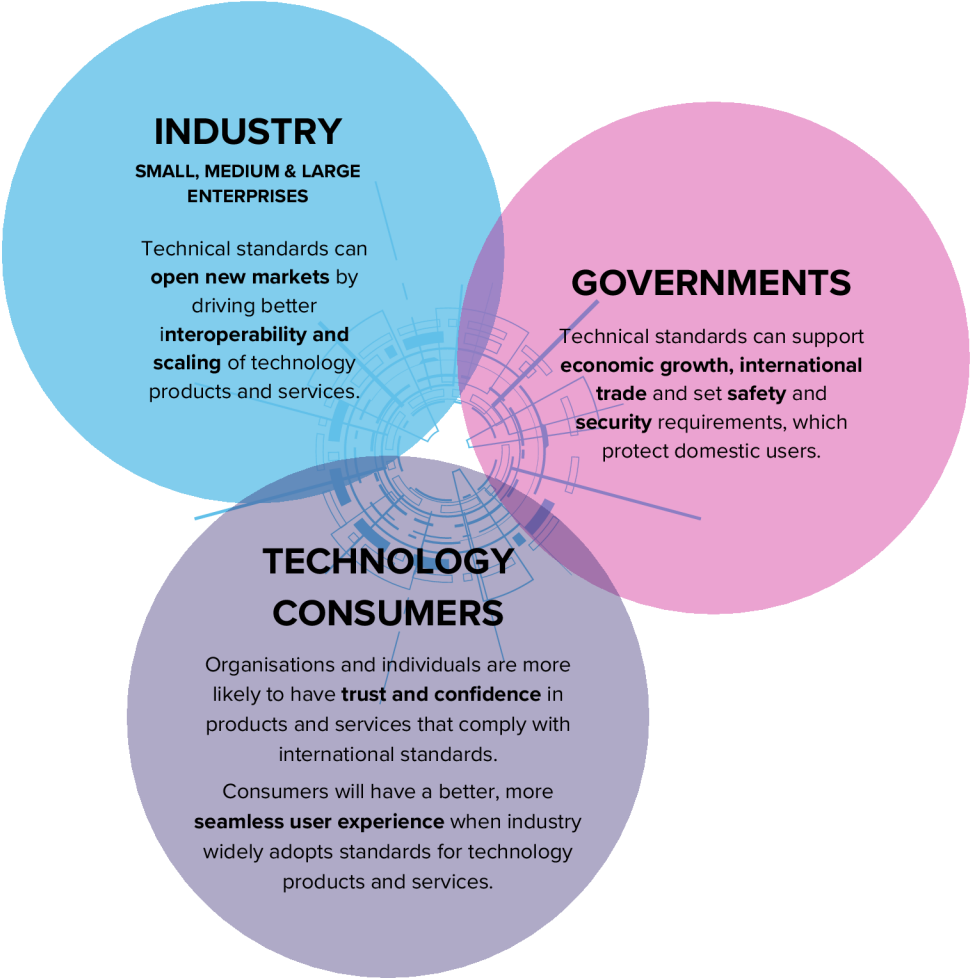


WHAT CAN TECHNICAL STANDARDS DO FOR YOUR KEY STAKEHOLDERS?

Your key stakeholders may not be aware that technical standards could boost their commercial returns, reduce barriers to trade and set product safety and security specifications.

For new and emerging technologies, many organisations, individuals and groups who develop, apply or use these technologies may not know how standards are developed, the benefits of adopting them or that they can have their say in that process.

Providing ways for critical and emerging technologies stakeholders to learn about how standards could benefit them is the first step to boosting their engagement. This can encourage them to participate in processes for national, regional and international standards development, especially if you can reward them for their commitment of time and resources.



STANDARDS IN ACTION: CRITICAL AND EMERGING TECHNOLOGIES

BLOCKCHAIN



SHA-256: standard that defines cryptographic security for blockchain based applications.

TECH APPLICATION:

Blockchain based Students Record Management System

USED FOR: preventing data tampering of certificate systems and facilitating trust in data sharing between different government departments or educational institutes.

ARTIFICIAL INTELLIGENCE



ISO 42001: standard for an AI system framework - best practices to ensure responsible use of AI, and strategies to mitigate risks.

TECH APPLICATION:

Generative AI-based solutions

USED FOR: helping enterprises and organisations adopt AI responsibly by monitoring and protecting AI models and systems from risks and threats.

SIX WAYS TO BOOST STAKEHOLDER ENGAGEMENT IN TECHNICAL STANDARDS DEVELOPMENT

1 CREATE TAILORED INCENTIVES

- Best for:** All stakeholder types
- How to implement:** Understand different barriers for the different stakeholder groups and respond directly to these in how you design your engagement initiatives.
- Example:** Public recognition of professional contributions to standards development through awards, media and publications can incentivise academic or research experts to commit the time to standards development because it helps their careers.

2 PRIORITISE WAYS TO INCREASE DIVERSITY

- Best for:** Underrepresented groups by demographics, sector or technical discipline
- How to implement:** Programs that offer tailored opportunities and incentives to increase participation from under-represented stakeholder groups (eg early career professionals, women).
- Example:** Networking and mentoring programs, events or professional training initiatives where there is a special focus on encouraging gender diversity as a part of the SDO's engagement and outreach programs. Specific support to address barriers to attendance can help (eg language translation or carer-friendly timing for meetings).

3 PROMOTE BENEFITS TO NEW AUDIENCES

- Best for:** Stakeholders who are new to technical standards and related processes
- How to implement:** Design key messages that highlight the specific benefits for target stakeholder groups and/or dispel myths about standards processes. Initiatives aim to build capacity among new groups of stakeholders.
- Example:** Commercial benefits such as opening new markets and enhanced consumer experience should be central to messaging in communications targeted to new industry-based stakeholders (eg social media, traditional media, public webinars).

4 CREATE AND SUPPORT INFORMAL NETWORKS

- Best for:** All stakeholder types (national standards organisations, industry groups, individual experts)
- How to implement:** Initiatives that provide ways for stakeholders to connect with each other about standards related matters, building a culture of standards-making and adoption in their technology community.
- Example:** Online platforms that facilitate knowledge and resources sharing, communication and ways to expand stakeholder networks around technical standards. Standards clubs for younger stakeholders such as university students, to discuss technical standards processes.

5 ENGAGE SECTOR LEADERS

- Best for:** Senior leaders in organisations across industry, government and academia who are developing or applying technology that could benefit from technical standards
- How to implement:** Programs that connect high-profile leaders across multiple target organisations and sectors can drive greater engagement by theirs and other organisations.
- Example:** Events and initiatives that provide an opportunity to network with other leaders and/or policy-makers can incentivise their attendance.

6 FACILITATE INTERNATIONAL CONNECTIONS

- Best for:** Members of regional/international standards organisations, which are usually national standards organisations and their stakeholders.
- How to implement:** Initiatives that facilitate knowledge sharing and collaboration among stakeholders of national organisations through meetings, workshops or online platforms.
- Example:** An online repository where national standards organisations can access and share their working documents and other standards resources with other international and regional standards organisations.

ENGAGEMENT INITIATIVES AT STANDARDS ORGANISATIONS

Six engagement initiatives show how standards organisations are using targeted approaches to attract and retain key stakeholder groups in technical

standards development. These initiatives are based on different combinations of the six ways to boost engagement and designed to target specific stakeholder groups.



EUROPE

CEN Workshop agreement

Creating a fast-track to standardisation in new, innovative technology areas

A rapid way to realise the benefits of standardisation through one stakeholder workshop, reducing the time commitment needed from stakeholders for standards development.

For more information, see the European Committee for Standardization (CEN) and the European Committee for Electrochemical Standardization (CENELEC): <https://www.cencenelec.eu/>

1 CREATE TAILORED INCENTIVES

5 ENGAGE SECTOR LEADERS

6 FACILITATE INTERNATIONAL CONNECTIONS



AFRICA

ARSO DISNET

Online portal and repository for technical standards and regulations between African nations

ARSO DISNET is web portal for stakeholders in African nations providing documentation and information systems on standards, technical regulations and related activities in Africa.

For more information, see the African Organisation for Standards (ARSO): <https://www.arso-aran.org/>

3 PROMOTE BENEFITS TO NEW AUDIENCES

4 CREATE AND SUPPORT INFORMAL NETWORKS

6 FACILITATE INTERNATIONAL CONNECTIONS



AUSTRALIA

NEXTGen program

Building the next generation of standards-savvy technical experts

NEXTGen provides professional development workshops, webinars and networking activities for emerging leaders to learn about standards-making and how they can contribute to the process in their area of expertise.

For more information, see Standards Australia: <https://www.standards.org.au/>

1 CREATE TAILORED INCENTIVES

2 PRIORITISE WAYS TO INCREASE DIVERSITY

3 PROMOTE BENEFITS TO NEW AUDIENCES

4 CREATE AND SUPPORT INFORMAL NETWORKS



INDIA

Awareness and capacity building programs

Facilitating stakeholder-based awareness, engagement and training

Capacity building initiatives that include a platform for a series of monthly awareness building and training programs focused on knowledge-sharing and engaging students and younger stakeholders.

For more information, see the Bureau of Indian Standards: <https://www.bis.gov.in/>

2 PRIORITISE WAYS TO INCREASE DIVERSITY

3 PROMOTE BENEFITS TO NEW AUDIENCES

4 CREATE AND SUPPORT INFORMAL NETWORKS

5 ENGAGE SECTOR LEADERS



SOUTH KOREA

Technical standards education programs

Education for students, industry professionals and the public.

Focusing on the utility of standards in technology through to building expertise and professional knowledge on standards processes. Programs target different education and career stages - elementary and high school, human resource learning and development programs and courses at more than 50 universities.

For more information, see the Korean Standards Association: <https://eng.ksa.or.kr/>

3 PROMOTE BENEFITS TO NEW AUDIENCES

5 ENGAGE SECTOR LEADERS



AMERICAS

Member training and networking workshops

Sharing best practice and building capacity through international cooperation

Regular training and networking workshops focused on exchanging best practice and experiences in international standards development. Workshops are available to stakeholders from 31 member countries across North, Central and South America.

For more information, see the Pan-American Standards Commission: <https://copant.org/en/>

3 PROMOTE BENEFITS TO NEW AUDIENCES

4 CREATE AND SUPPORT INFORMAL NETWORKS

6 FACILITATE INTERNATIONAL CONNECTIONS

ANNEX 1: METHOD – RESEARCH AND INTERVIEWS

The research conducted in this project's final phase builds on our extensive body of work mapping the stakeholders and use cases of blockchain technology in Australia and India. Low engagement in standards development by some stakeholder groups was an unexpected finding from our blockchain work. This led us to shift the focus for this final phase of the research project, seeking broader applicability of our research findings to other critical and emerging technologies and settings outside Australia and India.

The research questions we investigated and described in this report were shaped by the findings of the first two phases of the project:

1. Are the challenges to engaging key stakeholders in developing technical standards for a new technology like blockchain also observed for other critical and emerging technologies?
2. Are these challenges to engagement, which were identified in the Australian and Indian ecosystems, similar in other locations internationally?
3. If so, can we help address these challenges and boost engagement by developing a simple guide for key stakeholders that will help address these challenges and highlight benefits and incentives for engaging in standards-making for critical and emerging technologies?

We conducted desktop research and interviews with four SDOs internationally to identify engagement challenges in critical and emerging technologies standards development, which we then compared with our findings from the blockchain ecosystem in Australia and India. We would like to acknowledge and thank the interviewees from Standards Australia, the Bureau of Indian Standards, the European Commission for Standardization and the European Commission for Electrotechnical Standardization (CEN-CENELEC), Pan-American Standards Commission (COPANT) who generously gave their time and shared perspectives with the research teams at TPDC and CCG.

Interviewees were asked about:

- their experiences engaging with stakeholders to develop standards for emerging technologies, critical technologies or, more broadly, for other technical areas with high levels of innovation
- their engagement with other SDOs internationally, including in the Indo-Pacific region
- the six essential elements of engagement, and whether these adequately describe approaches taken in their SDO's engagement initiatives
- examples of engagement initiatives that were established to directly address key challenges.

The interviewees were also asked to comment on their engagement in making blockchain standards in relation to the broader challenges they reported for critical and emerging technologies.

Analysing all our collective findings led to refining the six elements of engagement, developing the key recommendation and shaping a set of considerations that are recommended for SDOs when designing a new engagement initiative that targets new stakeholder groups.

The Engagement Toolkit was created by condensing these considerations into a concise four-page brochure for SDOs, using effective communication and design strategies to ensure the information is easily accessible and can be implemented.



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