Standardization Readiness and its Application

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Today

- Introductions
- Standardization Readiness Concept
- Elements Description
- Standardization Strategy

Note: Standardization Readiness is an evolving concept—your input will be most welcome!

Standardization Readiness Concept

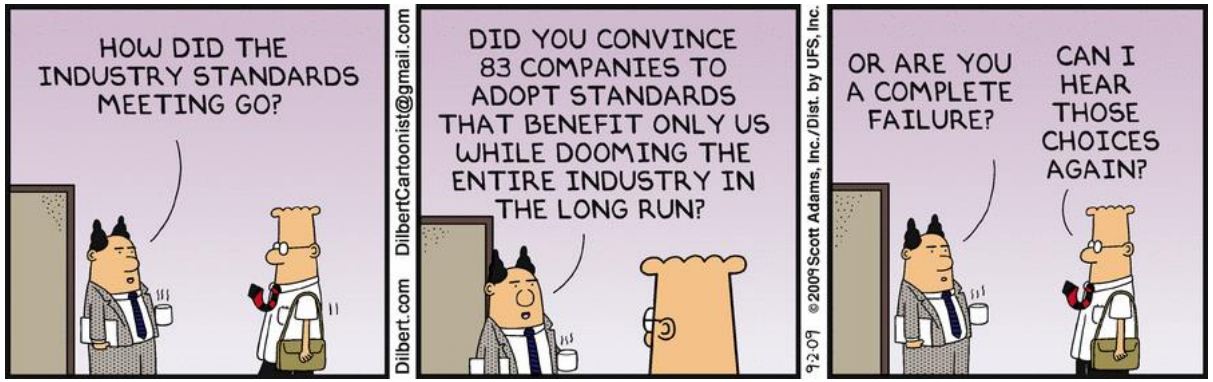
- **Standardization Readiness (SR):** a tool to inform evaluation of whether current and potential products based on an aspect of a given technology would benefit from standardization activities
- Reflects principles of standardization
  - Provides considerations for all requirements to develop a standard
  - Structures a framework for evaluation and prioritization of standardization projects and work programmes
  - Informs roadmapping and strategic initiatives
  - Provides a structured and logical means to explain standardization and evaluate ideas

How are Standards Developed?

THIS (per ISO/IEC):

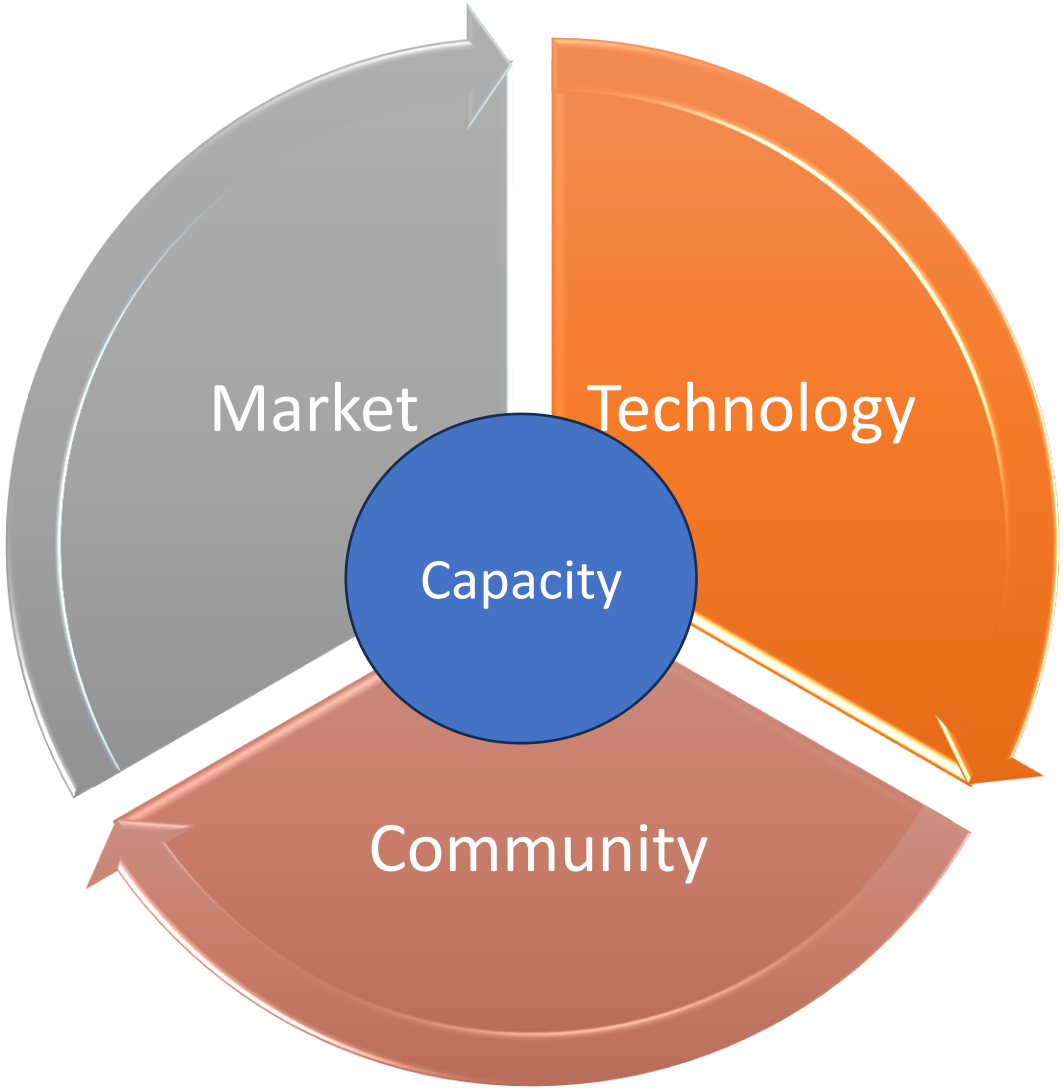
- Global Market need (implies a use case)
- Clearly defined scope with International Consensus
- Committed Global expertise from a broad array of backgrounds / locales / roles
- Sufficient technology maturity

NOT THIS:

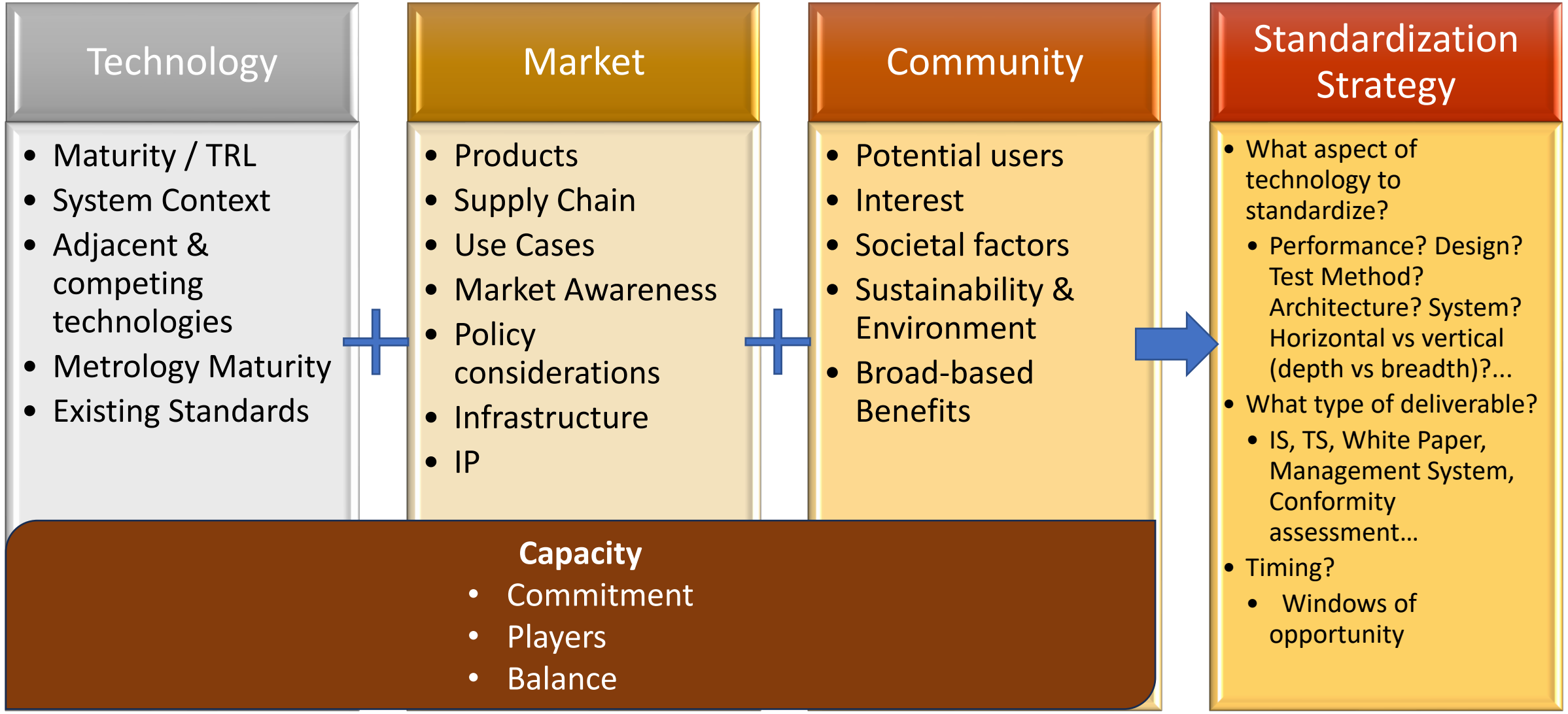


http://dilbert.com/strip/2009-09-02

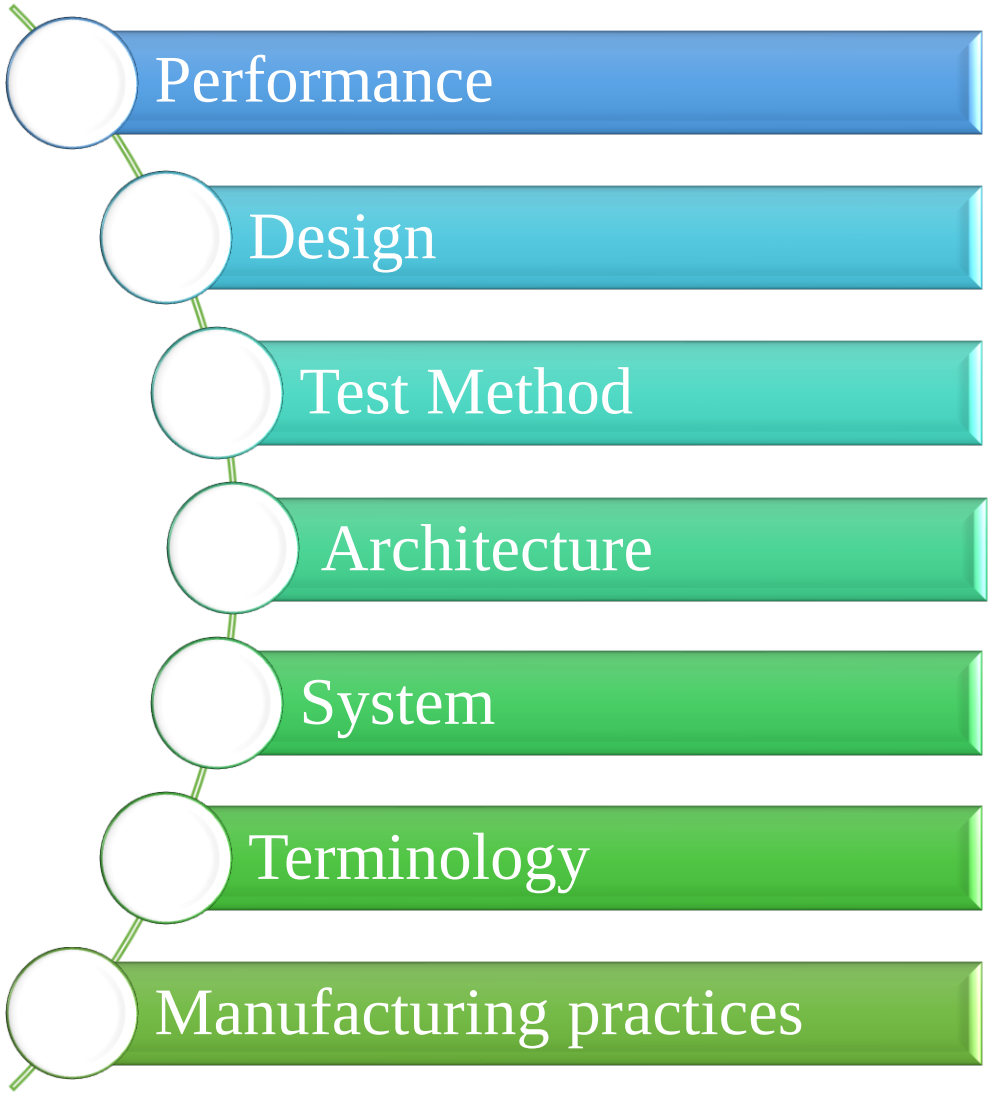
Standardization Readiness Level (SRL) Dimensions



SRL Dimensions Inform a Standardization Strategy



Informing a Standardization Strategy / Roadmap: What to Standardize?



- Value Proposition Considerations:
  - Is it appropriate to develop a technology agnostic standard that could apply to competing technologies?
  - Horizontal vs vertical standard (broad usage or specific?)
  - Are there gaps (business or technical) that would prevent usefulness of the standard(s) under consideration?

Possible responses may include, but are not limited to, System Performance; Device Design; Performance Characterization and Benchmarking; Architecture; Systems, Components, or Interfaces; Terminology and Definitions; Manufacturing Practices…

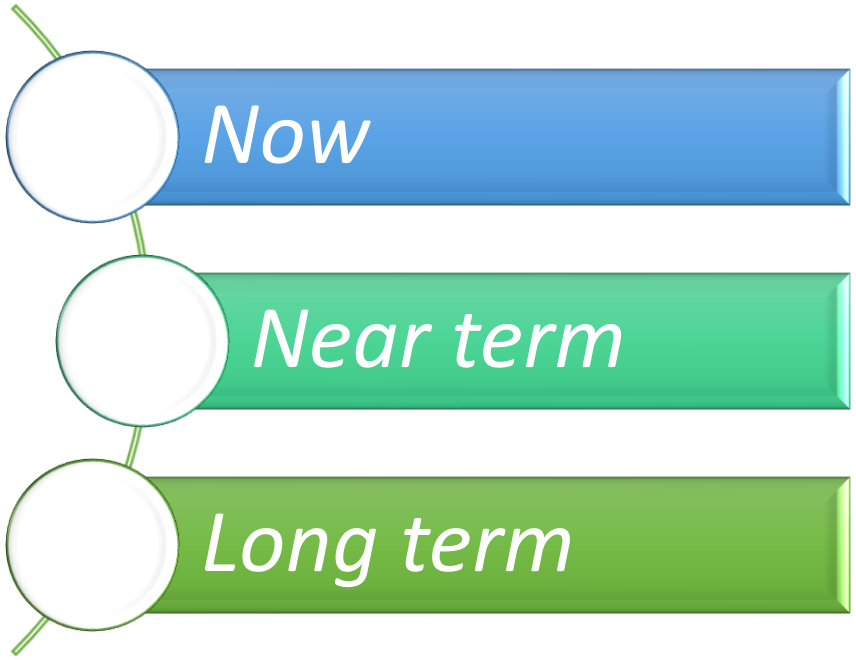
Informing a Standardization Strategy / Roadmap: In what form?

- Value Proposition Considerations:
  - How extensive are requirements?
  - Consensus level required for approval?
  - Intended Use?
  - Life limit / review cycle?
  - What level of user assurance is needed?
  - How mature and stable is the technology?

Note: In ISO/IEC, the only "standard" is an international standard (IS)
Standardization = standards and related deliverables

→ ***Normative (Requirements) or Informative (No Requirements)?***

Informing a Standardization Strategy / Roadmap: When?



- Value Proposition Considerations:
  - Windows of opportunity
  - Timing for standardization initiation and/or engagement
  - Availability of experts, interested parties

→ ***Normative (Requirements) or Informative (No Requirements)?***

Thank you

Any Questions?

SRL Dimension: Technology Considerations

Technology Value Proposition: Is the technology sufficiently mature for the type of standard or related deliverable you would be recommending? For example, is the relationship between a characteristic of the technology and performance in a product understood? Does any needed metrology exist and will it enable distinctions among performance?

What impact would the development of a standard (or other deliverable) have on the future of technology development/innovation in this area? How would this encourage the development of further standards?

Maturity/TRL (Technology Readiness Level)	Systems Context	Adjacent & competing technologies	Metrology	Existing Standards
• *Has the technology been proven, and in what setting (ie: laboratory, test environment, operational environment, fielded as a product)?*	• *Is the technology intended to be part of a system of technologies?* • *If so, what is the maturity level and forecast for system-level technologies? If the technology is at the system level itself, how mature are the component technologies?* • *What potential risks might be associated with developing standards at this technology maturity level(s)?*	• *Are there alternate technologies that might overtake this technology, or co-exist with it?* • *Does this technology rely on other technologies, components or systems, and how mature are they?* • *Is it possible to create a technology-agnostic standard to allow interoperability across competing technologies?*	• *Is there a consensus on what properties need to be measured to support the technology?* • *Does the measurement science exist, is it proven, and is it accessible?* • *Can you measure the properties that will differentiate performance in a meaningful way, that might warrant being included in a standard?*	• *Do any relevant standards already exist, or that can be modified to accommodate the technology?*

SRL Dimension: Market

Market Value Proposition: Is there a sufficient business case to justify the pursuit of a standard? Keep in mind that the purpose of standards is to provide for equitable access to the global marketplace, while stimulating innovation.

Products

- *How many products from how many companies exist, and how mature are they?*
- *Are there competing technologies?*
- *Would standards support competition or down-selection?*
- *How confident are consumers?*
- *What risks do consumers face in product adoption?*

Supply chain

- *How many suppliers exist?*
- *How secure and robust is the supply chain? Where are they geographically?*
- *Are there single points of failure?*
- *Is there adequate end user demand to support the suppliers?*
- *Does the supply chain support the full product space and multiple product generations?*

Use cases

- *Have use cases been defined?*
- *How relevant are they to what sectors?*
- *What is the status of the needed enabling technologies for these use cases?*

Market awareness

- *Have market forecasts been conducted, and has consensus emerged?*
- *Are there technology and/or commercializati on roadmaps, in the public & private sectors?*

Policy considerations

- *Is the sector regulated?*
- *Are there national and/or international compliance requirements?*
- *What are the regulatory requirements that need to be met for market entry?*

Infrastructure

- *Does the infrastructure exist to support products in the field (e.g., do charging stations exist to support electric cars?)*
- *Can products be maintained and repaired?*
- *Are there means to support access and storage needs?*

IP (Intellectual Property)

- *Are there IP issues that need to be considered?*

SRL Dimension: Community

Community Value Proposition: Are all of the interests of the stakeholders sufficiently understood (and are they aligned with the project idea) to pursue a standard?

Potential users	*Interest*	*Societal factors*	*Sustainability & environment*
• *Who are the intended users of the standardization deliverable?* • *Have they expressed a need for this deliverable?*	• *Is there evidence of entities showing interest in following the progress of particular standards, even if not fully committed to developing the standard (e.g., due to insufficient resources for full participation)?* • *Are there mechanisms in place to continually provide information and solicit feedback during standards development?*	• *What societal factors might affect one's approach to standardization?* • *Are there societal risks in the production, use or disposal of the products?* • *Are there safety, security, health, energy, or environmental concerns? Are there issues of equity, inclusion, … that should be considered?*	• *Are there risks in the production, use or disposal of the products? Are there safety, security, health, energy, or environmental concerns?*

All SRL Dimensions: Capacity

Capacity Value Proposition: Are there enough experts representing the globe (in the case of an international deliverable) who cover the competencies needed to develop the standard, and are they committed to actually working on it?

Commitment

- *Is there committed and available global expertise? - and who are the experts?*
- *Are these experts willing and available to develop the standard(s)? How can they be engaged?*
- *Are the committed experts representative of all aspects of the technology / standardization effort?*

Players

- *Who are the players in the standardization landscape?*
- *What has been their level / direction of commitment?*
- *Are there organizations already developing standards in this area?*

Balance

- *Is the participation in standardization appropriately distributed across a number of countries / regions and stakeholder communities?*
- *Is it specific to a region? market sector? part of a supply chain?*

Test Case Project Information

Test Case Project Information			
Primary Category (SEG14 category: select from drop-down list)	**Secondary Category** (In format "category_type:category", e.g., "hardware:cold atoms" or "metrology:gate noise" or "end user apps:QML & AI" -- refer to tables for examples)	**Project Area Idea/Title**	**Project Area Idea/ Description** (1-2 sentences)
Quantum benchmarks	metrology:metrics	Definition of metrics	Compile definitions of metrics for fundamental quantum technologies

SRL Considerations and Minimum Gate Assessments: Technology & Market

Standardization Readiness Level (SRL) Considerations and Minimum Gate Assessments			
Technology (qualitative assessment, including Yes/No minimum gate assessment)	**Technology: what is still needed?** If minimum gate has not yet been met, what is still needed?	**Market** (qualitative assessment, including Yes/No minimum gate assessment)	**Market: Gaps** If minimum gate has not yet been met, what is still needed?
Characteristics of fundamental quantum technologies (eg qubits, single-photon sources) are well understood. Where possible, measurement technology exists, is proven and accessible through NMIs and other laboratories. As a step towards unbiased and neutral test methods, the important metrics for each technology have to be agreed/defined. Yes, gate met.	while the gate has been met for many metrics broadly, it has not been met for others - be careful that specific scope addresses aspects that are technically ready...	Testing facilities, mainly in national metrology institutes, are developing testing services for fundamental quantum technologies. Some services already exist. In the future a transfer of this facilities to a broader range of independent service providers is planned/expected. Yes, gate met. multi-layer: direct customers, e.g., NMIs who would use to build instruments, testing labs, measurement services etc - both products and services indirect: those who could use the standard to develop other standards, instrument manufacturers, researchers	NA

SRL Considerations and Minimum Gate Assessments: Community & Capacity

SRL Considerations and Minimum Gate Assessments (cont.)		SRL/Operational Capacity
Community (qualitative assessment, including Yes/No minimum gate assessment)	**Community: Gaps** If minimum gate has not yet been met, what is still needed?	**Capacity** (qualitative assessment)
NMIs and other test facilities are ready to participate in this and further standard test method development. The quantum technology suppliers have sought device characterisation. Governments are keen to see a rapidly developed ecosystem of quantum suppliers with assurance for their products and services. Yes, gate met. indirect: those who could use the standard to develop other standards, researchers, those who use the metrics for technology development, those who will facilitate market growth for the wider technology,	NA	Experts from NMIs around the world are ready to get involved, e.g., Germany, UK, USA, Canada, Japan, South Korea. Partly also academia.

Formulation of Standardization Roadmap

Formulation of Standardization Roadmap				
What might be standardized, if anything? (Use one spreadsheet row per distinct activity type identified: e.g., for "quantum computing->metrology:qubit decoherence", could identify both "measurement procedures" and "known noise models"); fine to suggest multiple potential standards ideas	**Who is the intended audience (sphere of engagement)?** (For each identified standardization activity in previous column) quantum community, suppliers, end users, workforce, wider community	**In what form?** (What kind of standards deliverable? Select from drop-down list: Normative, Informative)	**Overall Value Proposition: Summary assessment** (What is the case for or against the identified standardization activity, based on the technology, market and community dimensions, not including capacity?)	**When?** (Based on the overall value proposition summary assessment, when should the standardization activity be undertaken? Select from drop-down list: "now", "near-term" or "long-term")
Definition of metrics for quantum tech	NMIs (suppliers), Quantum tech manufacturers (buyers), later standards developers, researchers	normative (requirements)	For: rapidly developing market for assurance services. Stepping-stone to development of neutral and unbiased test methods. Highly important for establishing a world-wide QT industrial supply-chain. This could potentially be an umbrella over others	now

Quantum Technologies: Moving Forward

- Result: Approval of formation of JTC-Q!
- Package for transfer to JTC-Q, including
  - Background information on research, market, and standardization landscapes
  - Methodology for Standardization Evaluation of Potential Projects
- Does this yield a roadmap? No; necessary, but not sufficient

CHIPS Template Development

	SRL Elements			Standardization Strategy		
Project Idea	**Technology**	**Market**	**Community**	**What to Standardize?**	**In what form (how) to Standardize?**	**When to Standardize?**
Title / Description	Select relevant sub-element(s) and questions for consideration; address value proposition at the element level			Examples: Terminology / Methods / Architecture …	Normative vs Informative	Now / Near term / Long term