Foresight study on the introduction of new technologies: the case of nanotechnology

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Bringing Responsible Innovation to Life

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The Long-range Research Initiative

Introduction

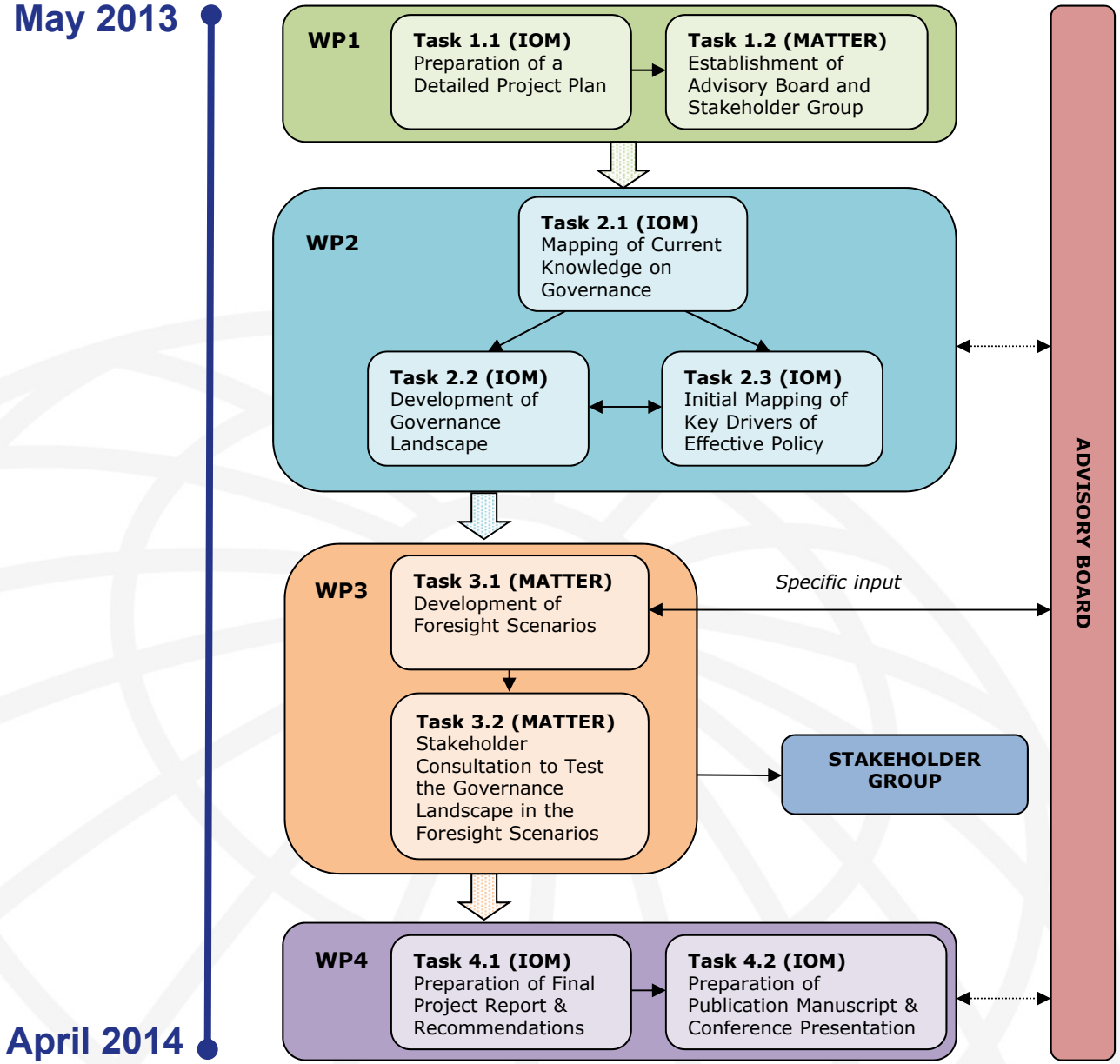
- New technologies are an important driver of international economic & industrial competitiveness
- There is considerable economic & political pressure to ensure that novel technologies deliver innovations in line with societal priorities and requirements
- New technologies challenge decision-making practices associated with traditional risk and benefit assessment approaches
- A need exists to identify and implement approaches suitable for effective *governance* of emerging technological innovations

Aims & objectives

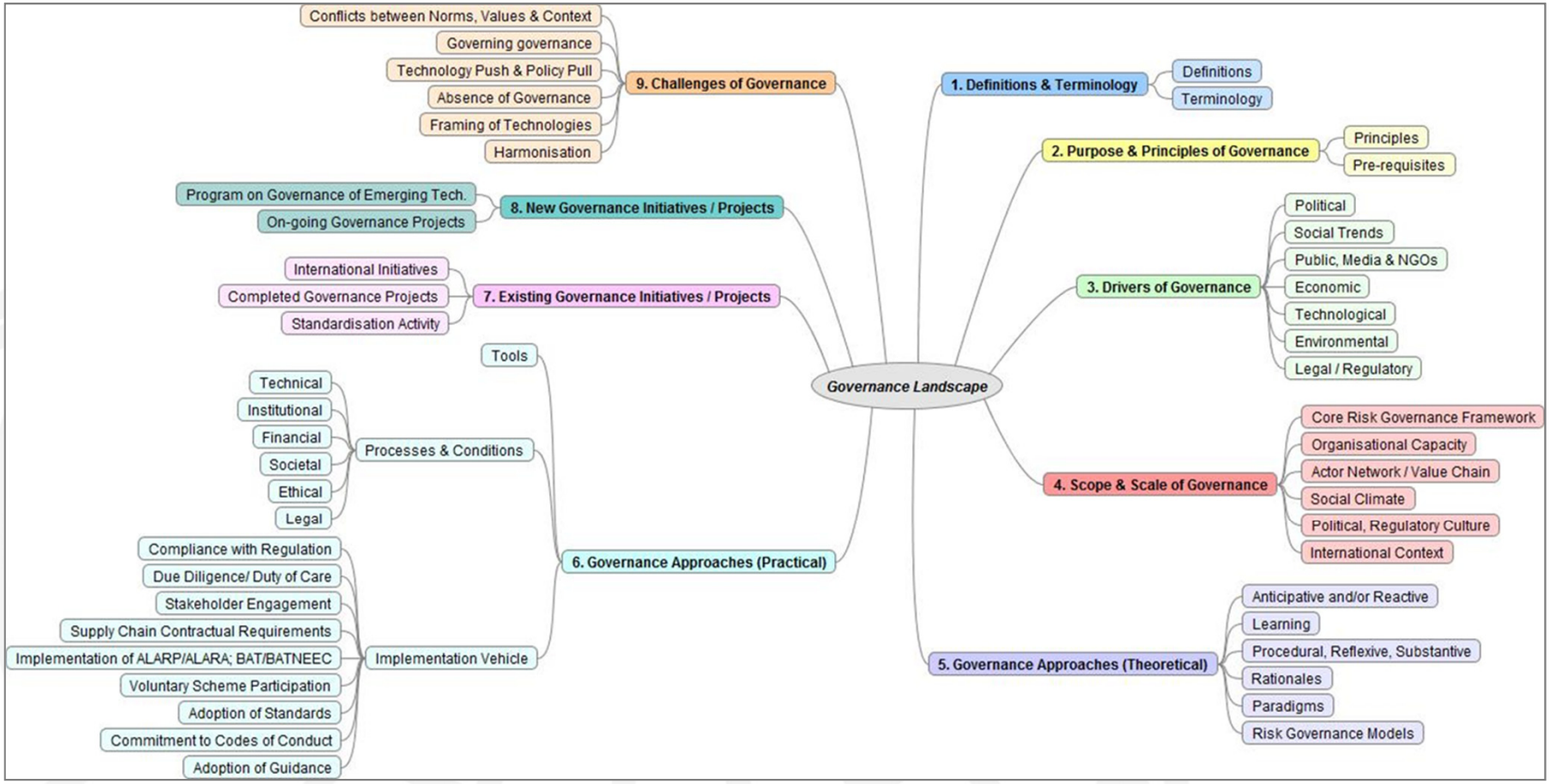
To identify the drivers of effective policy in the area of the strategic development of novel technologies, which would contribute to:

1. strengthening the link between technical expressions of risk resulting from health & environmental assessments;
2. identifying methodologies & institutional practices which can facilitate assessment of both the risks and benefits of an event or activity as an input to decision-making associated with technological innovation processes;
3. developing improved risk-benefit metrics to make decision-making explicit, rather than implicit as is the case at present;
4. developing methods to ensure that input from all stakeholders is formally taken into account in the development, governance and commercialisation of emerging technologies.

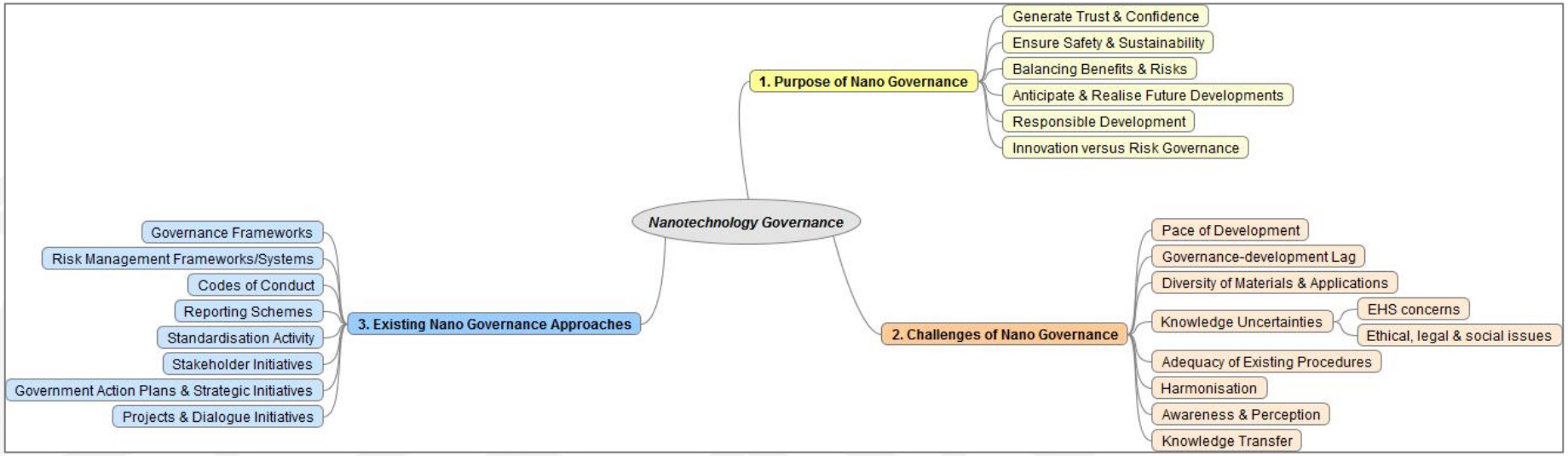
Work programme



The governance landscape



Nanotechnology and the governance landscape



Key attributes of existing nano governance approaches

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		Facilitates...						Comments
		Use of best available knowledge & technology	Foresight	Flexibility & versatility	Sufficient means/detail for implementation	Engagement of stakeholders along the value chain	Means to establish legitimacy of nanotechnology	
Governance Frameworks	IRGC Nano Risk Governance Framework							
	FramingNano Governance Platform							
	Responsible Care® Global Charter							
Risk Management Frameworks/ Systems	Nano Risk Framework							
	CENARIOS®							
	AssuredNano™							
Codes of Conduct (CoC)	E.C. CoC for Responsible N&N Research							Principles only
	Responsible Nanocode							Principles & examples only
	BASF Nano CoC							Principles & examples only
	IG DHS CoC for Nano							Principles only
	Bayer Code of Good Practice							Principles only
	NGO Principles on Nano							Principles only
Reporting Schemes	French Decree							Information gathering only
	NICNAS Scheme							Information gathering only
	UK Voluntary Reporting Scheme for Nano							Information gathering only
	US NMSP							Information gathering only
Standardisation Activity	ISO/TR 12885:2008							
	ISO/TR 12901-1:2012							
	ISO/TR 13121:2011							
	ISO/TR 13329:2012							
	CEN ISO/TS 13830							
	BS 13500:2013							
	BS PAS 130:2007							
	BS PD 6699-2:2007							
	BS PAS 137:2012							
	ASTM E2535-07							
	ASTM WK 34427							
	ASTM WK 38731							
	OECD WPMN Report No. 38							
	OECD WPMN Report No. 33							
	OECD WPMN Report No. 31							Information gathering only

- Use of best available knowledge and technology;
- Foresight;
- Flexibility and versatility;
- Sufficient means/detail for implementation;
- Engagement of stakeholders along the value chain;
- Means to establish legitimacy of nanotechnology.

	Evidence available to indicate that the output ***does*** facilitate, recommend or address the attribute.
	Evidence available to indicate that the output ***partially*** facilitates, recommends or addresses the attribute.
	No evidence available to indicate that the output facilitates, recommends or addresses the attribute.
	The nature of the output is ***not intended to*** facilitate, recommend or address the attribute.

Critical uncertainties

i. The style of governance

- ***Mandatory, formal, reactive, closed.*** The process of making laws, regulation and decisions is formal and narrow, characterised by a clear focus on codified and statutory requirements that prescribe action in response to challenge.
- ***Managed, anticipatory, open.*** Characterised by regulations and decisions that seek to identify, as far as reasonably practicable, risks and opportunities that may emerge and involves broad stakeholder involvement and participation in the making of laws.

ii. The scope of governance

- ***Fragmented, nano-specific regulation.*** The focus is on nanotechnologies by virtue of risks and benefits purported to arise from particular size-related properties and from a fragmentation across countries or sectors.
- ***Harmonised, generic regulation.*** There is no specific focus on 'nano' sized-related risks and benefits; these are integrated within generic laws or sector-based regimes.

iii. Perception of public perception

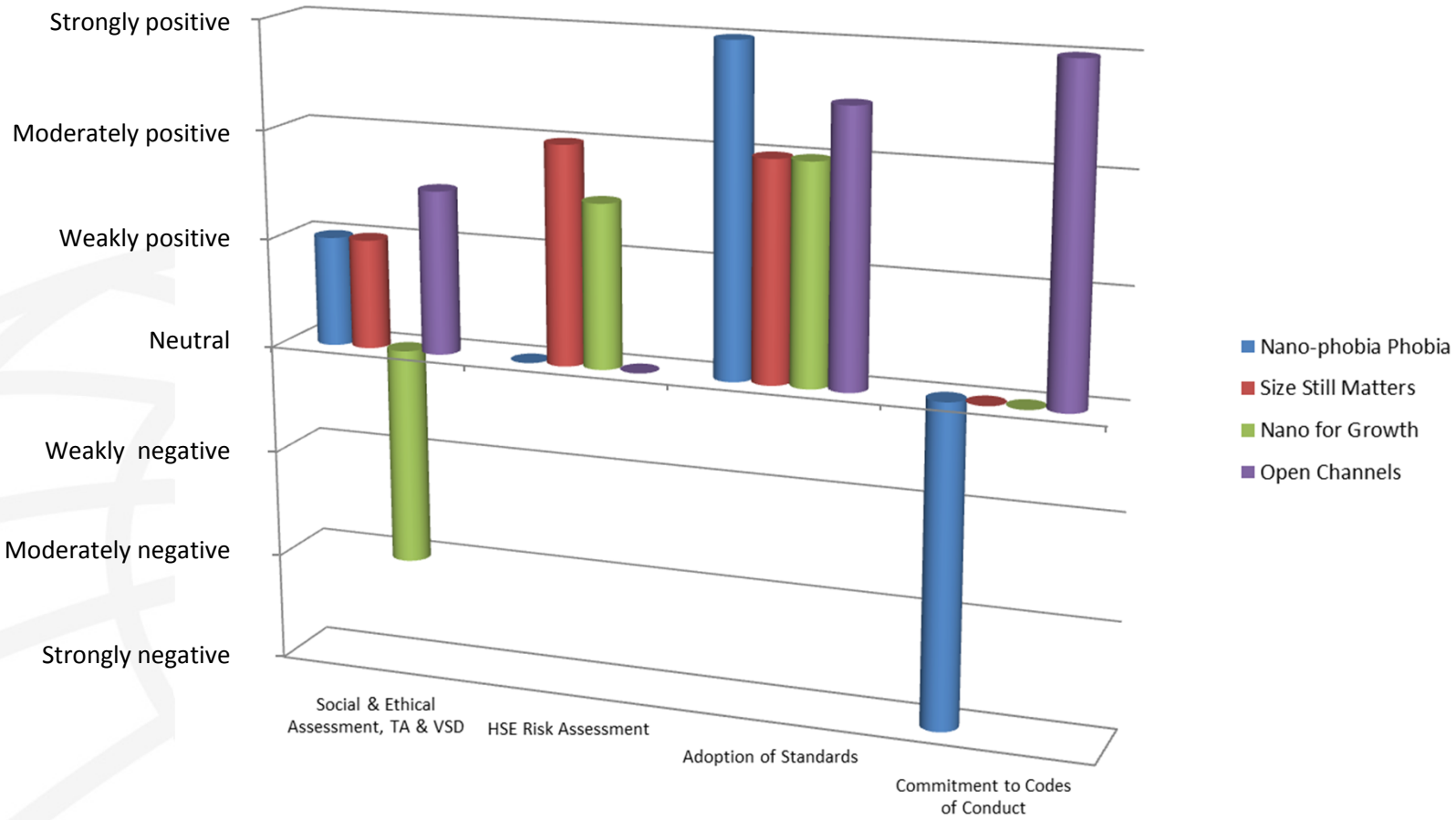
- ***Erroneous perception.*** Public attitudes are perceived erroneously as not accepting of nanotechnologies in products.
- ***Accurate perception.*** Public attitudes are perceived correctly as accepting of nanotechnologies in products.

The foresight scenarios

- **Scenario A: 'Nano-phobia phobia'**
  - Mandatory, formal, reactive and closed governance;
  - Fragmented, nano-specific regulation;
  - The public is erroneously perceived as not accepting nanotechnologies in products.
- **Scenario C: 'Size still matters'**
  - Managed, anticipatory and open governance;
  - Fragmented, nano-specific regulation;
  - The public is erroneously perceived as not accepting nanotechnologies in products.
- **Scenario F: 'Nano for growth'**
  - Mandatory, formal, reactive and closed governance;
  - Harmonised, generic regulation;
  - The public is accurately perceived as accepting of nanotechnologies.
- **Scenario H: 'Open Channels'**
  - Managed, anticipatory and open governance;
  - Harmonised, generic regulation;
  - The public is accurately perceived as accepting of nanotechnologies.

Relative performance of each governance element

		Nano-foresight scenario			
		Nano-phobia Phobia	**Size Still Matters**	**Nano for Growth**	**Open Channels**
Key element of the governance landscape	**Social & Ethical Assessment, Technology Assessment & Value-Sensitive Design**	Positive *(weakly)*	Positive *(weakly)*	Negative *(moderately)*	Positive *(weakly to moderately)*
	Health, Safety & Environmental Risk Assessment	Neutral	Positive *(moderately)*	Positive *(weakly to moderately)*	Neutral
	Adoption of Standards	Positive *(strongly)*	Positive *(moderately)*	Positive *(moderately)*	Positive *(moderately to strongly)*
	Commitment to Codes of Practice	Negative *(strongly)*	Neutral	Neutral	Positive *(strongly)*


Strongly positive
Moderately positive
Weakly positive
Neutral
Weakly negative
Moderately negative
Strongly negative
Social & Ethical Assessment, TA & VSD
HSE Risk Assessment
Adoption of Standards
Commitment to Codes of Conduct
Nano-phobia Phobia
Size Still Matters
Nano for Growth
Open Channels

SWOT analysis

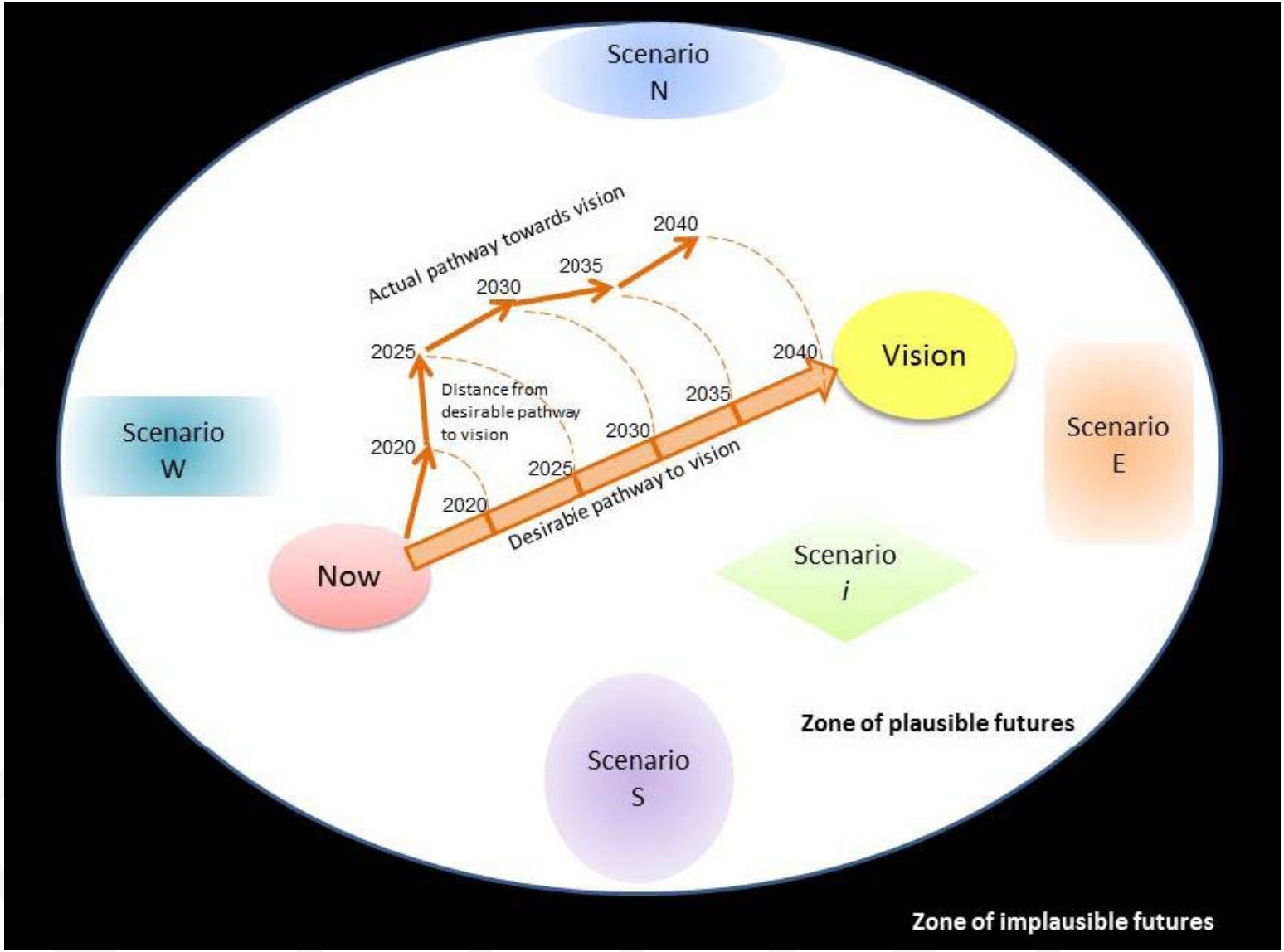
- Aimed to identify:
  - Current strengths of the nano governance landscape
  - Current weaknesses of the nano governance landscape
  - Future opportunities for the nano governance landscape (over the next 20 years)
  - Future threats facing the nano governance landscape (over the next 20 years)

- Key SWOTs analysed in a matrix to explore how:
  - Strengths of the current nano governance landscape might be exploited to:
    - capitalise on future opportunities;
    - counter future threats;
  - Weaknesses of the current nano governance landscape might be tackled to:
    - capitalise on future opportunities;
    - enable future threats to be countered.

SWOT analysis matrix

EXTERNAL (future) / INTERNAL (current)	OPPORTUNITIES - **Broader participation, more inclusive fora for debate & deliberation** - **Existing frameworks & momentum towards governance** - **Greater focus on governance itself and/or nanotechnology** - **Evidence of effectiveness of governance** - **High profile negative event**	THREATS - **Broader participation/inclusiveness** - **Fragmentation of governance regimes worldwide** - **Evaporation of interest in governance and/or nano** - **Evidence of ineffectiveness of governance** - **Discovery of new hazards/risk pathways that the system can't cope with**
STRENGTHS - **Inclusive** - **Adaptive (in part)** - **Designed to be open, transparent & facilitate disclosure** - **Evolutionary (builds on experience)** - **Precautionary**	- Focused, managed, streamlined participation; - Collaborative research/evidence gathering; - Evolve existing frameworks openly, inclusively and visibly reflecting broader sustainability agenda, including anticipation; - Preparedness for the negative event (don't only be reactive)	- Focused, managed, streamlined participation; - Develop process; operational guidance/tools; - Demonstrate value & effectiveness, (need evidence that it works); - Anticipatory & responsive approach; - International-level consensus with coordination/championing
WEAKNESSES - **Impractical at operational level** - **Not 'formally' adaptive** - **Lack of business followership** - **Lack of robust & relevant data to inform decision making**	- Convert existing frameworks into operational tools (including anticipation, VSD, TA, socio-economic assessment & risk assessment); - Build adaptive capability into existing frameworks (including anticipation); - Promotion/awareness raising of governance itself (what it means, what it includes, what it can achieve, what benefits it can bring); - Research into effectiveness (multi-stakeholder evaluation of current frameworks through research collaboration with a specific focus on what works and doesn't work at an operational level. Evaluation must cover the broad-scale sustainability agenda; - Preparedness for the negative event; - Assured bonds/shared liability	- Develop process; operational guidance/tools; - Formalise adaptive approach & build capability; - Evidence gathering on effectiveness of governance (including dissemination/knowledge exchange and brokering) & practical operational application; - Mandate (threat of) participation in governance; - Incentivise participation in governance (through e.g. threat of mandatory governance, financial incentive, reputation incentive, supply chain pressure, value chain pressure etc.); - Research into new hazard and risk pathways (academic & applied) and dissemination/knowledge exchange and brokering; - Funding stream for developing operationally-focussed tools (not academic)

Using strategic foresight to navigate the future governance landscape



Recommendations & research needs

- The interaction of stakeholders, including the general public, NGOs and civil society groups as well as policy makers, academia and business is likely to be an important component of the delivery of optimal governance.

- Actions to strengthen voluntary initiatives in the governance landscape for nanotechnologies might comprise:
  - encouraging the adoption of standards,
  - use of risk assessment,
  - use of social & ethical assessment,
  - an effectiveness review and adoption of codes of conduct.

- An aggregation of the critical outcomes from the SWOT analysis provides recommendations for policy actions (P1-5) and research (R1-3), considering the strengths and weaknesses of the current nanotechnology governance landscape that might be exploited to capitalise on future opportunities and counter future threats.

Recommendations & research needs

- P1. Encouragement, through policy adaptation or development, that due consideration be given to the **demonstration of the basic principles of governance**, through the use, or consideration, of relevant approaches and tools highlighted in the governance landscape. This may be achieved, for example, through adoption of the recommendations of the British Standards Institution's code of practice for delivering effective governance of organisations;
- P2. **Encouraging an anticipatory and responsive approach** in governance;
- P3. **Preparedness for a negative event**;
- P4. **Incentivising participation in governance** (e.g. financial incentive, reputation incentive, supply chain pressure, value chain pressure, threat of mandatory governance etc.);
- P5. **Mandating demonstration** of the adoption of governance approaches.

Recommendations & research needs

- R1. **Evidence gathering on effectiveness and value of governance** (including dissemination/knowledge exchange and brokering) and practical operational application, via a multi-stakeholder evaluation of current frameworks with a specific focus on what works and doesn't work at an operational level. The evaluation should cover the broad-scale sustainability agenda, and consider the value of existing hazard and risk data (scientific & commercial, academic & applied) as well as emerging evidence;
- R2. **Evolving existing frameworks** openly, inclusively and visibly reflecting broader sustainability agenda, including anticipation;
- R3. **Developing governance processes, operational tools** (including anticipation, VSD, Technology Assessment, socio-economic assessment & risk assessment) **and necessary guidance** for effective implementation;

Recommendations & research needs

- To implement the aforementioned policy and research recommendations, a series of specific activities through a multi-stakeholder initiative have been identified to ***clarify*, *test* and *implement* a Vision of optimal governance**, considering different governance approaches in the context of overall mandatory and voluntary pathways and understand if and how current initiatives may contribute.

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Thank you for your attention

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