



NANO2ALL

SOCIETAL ENGAGEMENT ON RESPONSIBLE NANOTECHNOLOGY

Scenario Exploration Game

Instructions



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General game explanation

The purpose of the Scenario Exploration Game is to have participants experience and act through plausible alternative futures, by thinking and conversing systemically outside of their usual frame of reference.

Four characters (a policy maker, a business, a researcher, and a civil society organization) take actions to reach their visions over three rounds in a 15 year time horizon. A fifth participant, the Public Voice, analyses the actions taken at every round and gives feedback and value to the actions taken by the characters.

Success takes several forms: the character that has wielded most influence throughout the three rounds; who has reached their own long-term objective; collectively by how close their actions has brought them to a desirable future.

Two contrasting scenarios are explored in order to get an understanding of the importance of external drivers on how to reach one's objectives.

Scenarios

The broad societal scenarios that are used in the game were developed using a classic scenario building methodology. When considering the future of nanotechnologies, two drivers of change that were considered both the most important and the most uncertain were selected to create a logical frame: how technology friendly society will be and what type of governance will dominate. On that basis, two axes were constructed. The extremes of the vertical axe were technophilic and technophobic society. The extremes of the horizontal axe were centralised governance and decentralised governance. This creates a 2x2 logic matrix that serves as a basis to develop the scenarios (see Fig. 1).

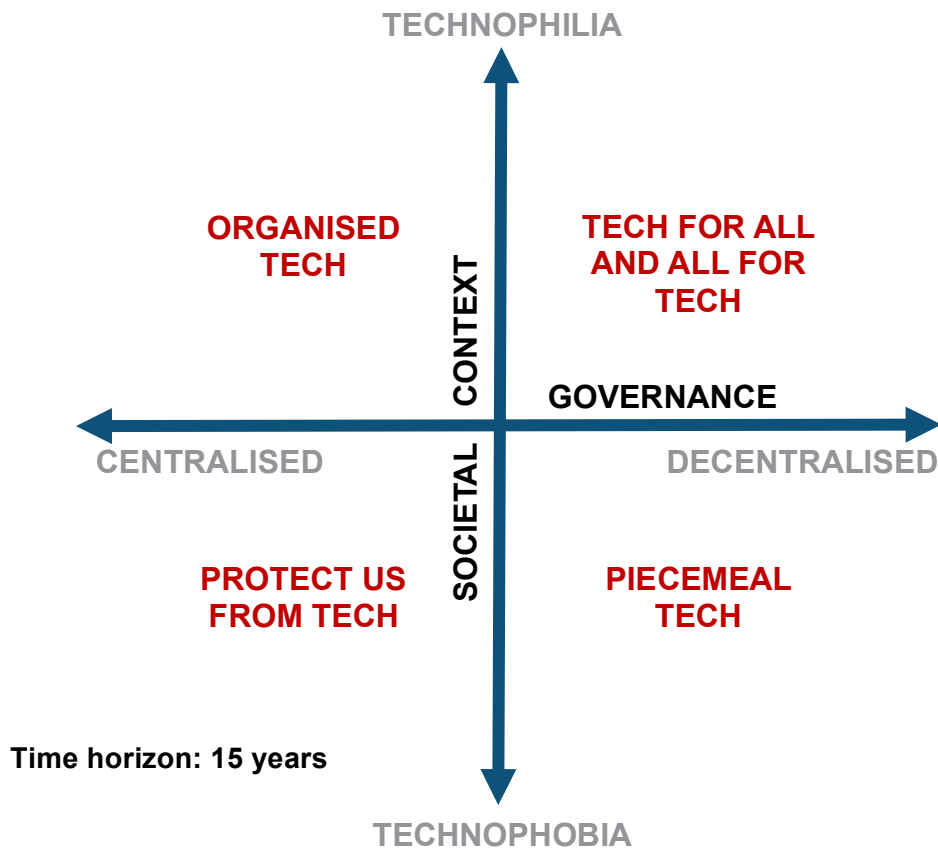


Fig.1 The logical framework of the scenarios

To play the scenario exploration game, only two contrasting scenarios are needed. On the logic matrix, scenarios that are at the two extremes of a diagonal contrast most. Therefore, and to ensure consistency across national dialogue events, it was decided to work with the diagonal running from top right to bottom left. As a result, only the scenarios "*Technology for all and all for technology*" and "*Protect us from Technology*" were developed and adapted to the Scenario Exploration System. The detailed scenario stories are presented at the end of this document.

In each of the scenarios, we also introduced technology-specific information, which is presented on the technology detail cards used in the game. These cards specify which particular application of [topic field] is widely available on the market at a specific point in time in the scenario that is played. These cards are different for each of the sub-topics (i.e. nanomedicine, nanotextiles, nano in BCIs). You can find the details of the technology detail cards at the end of this document.

Game elements overview

Each scenario exploration game consists of the following components:

Megatrend cards



Megatrend cards present strong driving forces that affect all scenarios

Action cards and forms



Scenario detail cards provide a sequence of events at 5-year, 10-year and 15-year horizons leading to each scenario

Scenario cards



The 2 circular scenario cards give an overview of the social and economic conditions created by the scenarios



Scenario detail cards provide a sequence of events at 5-year, 10-year and 15-year horizons leading to each scenario



Technology detail cards indicate what type of specific (topic field) applications are widely available on the market at a particular point in time .

Actor description forms and record of play forms help the players to define their role and give account to their actions

The scoring sheets are used to keep track of the scores of the players throughout the game

General game elements



One game board (A0 size)



Resource tokens – colour coded to match each role



Red impact tokens for the Public Voice

Real-life cards



Real-life cards are used by players to unexpectedly change the impact of someone's actions



One dice

Stepwise explanation

Step 0: Preparing the board

Put down one of the two scenario circles and explain participants that in this game we will act through 2 contrasting future scenarios, starting with this first one. Put the stack with real-life cards on the designated spot on the board.

Step 1: Role formulation.

In the game, each player needs to take up a specific stakeholder role that they would like play. There are 5 roles: policy-maker, researcher, industry/business representative, CSO representative, and the public voice. The public voice is played by the 2 citizen representatives who are invited to the dialogue. The rest of the roles can be divided among the other participants. It is important that a stakeholder picks the role of another stakeholder category than he/she belongs to in real life. This way, participants can experience what it is like to be in someone else's shoes. Give all the players a role description form with general information about their role. Ask them to add detail to their role and write these details down on the form. The role of the public voice is slightly different in the game, and therefore the questions on the role description form are also slightly different.

Step 2: Introduction round.

Give each participant 1 minute to introduce the details of his/her role (e.g. name of organization, vision etc.). Make sure that the public voice has stated clearly enough what values/needs/concerns he/she finds particularly important and will use to judge the actions of players throughout the game.

Step 3: Hand out resource tokens, action cards, and real-life cards.

Explain why the different stakeholders receive different amounts of resource tokens. Resource tokens are used to give strengths to actions. Players can use the resource tokens as they please. However, remind players that the resource tokens they receive now should be used in all 3 scenario rounds. Make sure to save some for the last round! In the first round players act individually, in the second and third round they can, in addition to acting individually, also collaborate upon request with one, two, or three other players. They also need resource tokens for this. The public voice receives 30 impact tokens (10 for each round).

Give each of the players (except for the public voice) action cards, and 2 real-life cards. Indicate that they can use the real-life cards at the end of each scenario round if they want to. Explain that they can only play one real-life card per round and that they should have 2 real-life cards at hand at all times (i.e. take one from the stack after having used one).

Action card division: **business/industry = blue**, **CSO = orange**, **policy-maker = green**, **researcher = purple**

Step 4: Play scenario 1

Scenario 1; round 1

- A:** Introduce the mega trends to illustrate the broader context in which the scenarios are embedded (similar for scenario 1 and scenario 2). These trends will affect all scenario steps over the next 15 years.
- B:** Subsequently, focus on the first 5-year time step of scenario 1 (round 1). Use the scenario-detail cards to sketch the societal/political context 2022 in scenario 1. Take your time to sketch this scenario and to draw the players convincingly into the scenario. To get inspired on what story you could build around these cards, read the section “scenario stories”.
- C:** In addition, display technical detail card 1 and use it to explain what type of specific (topic field) applications are (widely available) on the market in 2022.
- D:** Now, let each player (except for the public voice) think about an action that they would like to undertake in this first round in order to work towards their long-term vision. Ask participants to specifically take into account 1 or more of the scenario details just introduced.
- E:** Now, one by one the other players share which action they will undertake, and why. They also have to indicate how many resource tokens they would like to invest in their action. The action cards and allocated resource tokens are placed on the game board.
- F:** In round 1, no collaboration between players takes place.
- G:** After all actions and resource tokens have been placed on the board, the public voice comes in and judges the actions of the players. The public voice judges by distributing 10 impact tokens between the actions of the players. Encourage the public voice to also motivate his/her decision.
- H:** Ask the players who would like to play a real-life card, and let them do so. If a player has used one of his/her real-life cards, he/she needs to put the used one aside and take a new real-life card from the stack. A player can only play 1 real-life card per round.
- I:** Let everyone count and write down the points that they earned during the first scenario round. Points = [number of resource tokens] x [number of impact tokens]. Use the scoring sheet.

Scenario 1; round 2

Repeat step B-E, as performed in round 1. Make sure to use the materials (e.g. scenario detail cards) that belong to round 2 (the year 2027).

- F:** In round 2, players can decide to collaborate. They could do this to increase the number of points that they earn in this round and/or to support actions of other stakeholders that match their own long-term vision and goal. A player can collaborate by putting 1 or more resource tokens on the action card of someone else. The collaboration can only take place if the other player accepts this resource token and thus agrees to collaborate. Ask who would like to collaborate and let them do so.
- G:** After all actions and resource tokens have been placed on the board, the public voice comes in and judges the actions of the players. The public voice judges by distributing 10

impact tokens between the actions of the players. Encourage the public voice to also motivate his/her decision.

- H:** In round 2 and 3, players can decide to collaborate. They could do this to increase the number of points that they earn in this round and/or to support actions of other stakeholders that match their own long-term vision and goal, for example. Ask who would like to collaborate and let them do so. Collaboration takes place when a player puts one or more of his/her own resource tokens on the action of another player. Collaboration takes place when a player puts one or more of his/her own resource tokens on the action of another player.
- I:** Ask the players who would like to play a real-life card, and let them do so. If a player has used one of his/her real-life cards, he/she needs to put the used one aside and take a new real-life card from the stack. A player can only play 1 real-life card per round.
- J:** Let everyone count and write down the points that they earned during the first scenario round. Use the scoring sheet. Players receive points for their own actions, as well as actions of others in which they collaborated. In the case of collaborations, each collaborating partner receives the total obtained by the action, i.e. total of resource tokens played by all players multiplied by the impact tokens attributed by the Public Voice.

Scenario 1; round 3

Repeat all steps as performed in round 2. Make sure to use the materials (e.g. scenario detail cards) that belong to round 3 (the year 2032).

Scoring

Let each player add up all the points he/she earned in round 1 to 3 to come to a final score for scenario 1. Use the scoring sheet.

Step 5: Play scenario 2

Repeat all steps as played in scenario 1 (step 4), now using the material for scenario 2.

Scenario stories

Scenario 1: "Tech for All and All for Tech" (Technophilia - Decentralized government)

THE PATH TO THE SCENARIO

- **5 years:**

Today is [month] [date] 2022. After a range of elections across the EU, nationalist parties have made significant gains in a number of countries (1). Citizens' deception in politics and a feeling that too much of what is happening in EU and national government circles is not relevant to their daily concerns pushes people to want decisions taken closer to them (2). In this context, immigration and climate change loom large (3). However, in view of the many challenges facing people and in view of the pace of technological developments, technology is perceived as an interesting source of possible solutions (4). Overall, citizens keep abreast of technology news and are aware of new technological developments (5). This general context spurs creativity and enterprise (6).

- **10 years:**

We are now in 2027. *[Add a quick review of the actions that the scenario explorers have taken in the previous round]*. Following the public's desire to bring decision making closer to home and its faith in technology, regions have pushed the development of local innovation hubs (1) and (local) governments promote local products (2). The belief at all levels that innovation is important is leading to the diversification of funding sources for innovation (3). The fast development of I.T. and robotics is enabling work to change a lot in many domains (4). Technological advances allow society to book diverse successes in the fight against climate change, in health and other applications improving wellbeing (5). At the same time, this pervasive attraction for technology in society coupled to the fast evolution of technologies means that technology is often the object of fashion and can be fast discarded (6).

- **15 years:**

We are now in 2032. *[Add a quick review of the actions that the scenario explorers have taken in the previous round]*. The radical changes brought by technology to the nature of work and the increased pressure on material resources mean that governments must adapt taxes to the new economic and social reality (1). Overall, taxes on labour are decreased and taxes on energy and goods are increased. Flexible life-long learning is new norm (2). The fast pace of change translates into high individual responsibility and lots of experimentation, also at individual level (3). In response, insurance companies push technology to reduce risks (4). In turn, people increasingly use

technology for decision support in taking responsibility (5). Familiarity with many technologies allows people to apply a range of technologies to fulfill many specific needs, from the most basic to the most mundane, depending on personal choices.

Table 1: Main elements of Scenario 1: “Tech for All – And All for Tech”

Parameter	Scenario 1: All for Technology – And Technology for All
Society and values	<p>Interest in technology, creativity, diversity, randomness</p> <p>Society is avid of novelty, fashions are a strong phenomenon</p> <p>Your data is everyone's, for a price</p> <p>Potentially limited concern for privacy as people understand the usefulness of data for tech development</p> <p>Thanks to technology, virtual lives develop</p> <p>Connected, platform society</p> <p>Collaboration and co-creation, potential for sharing</p> <p>Local initiatives, more community action, more local diversity</p>
Technology	<p>Fast and cheap, trial and error, co-creation in technology</p> <p>Lots of innovation: many people innovate in many different ways and different places</p> <p>Adaptable and diverse technologies</p> <p>Strong crowdfunding</p> <p>Cities and other local governmental bodies have their own innovation policies to stimulate technological development</p>
Environment	<p>In general, high awareness about the environment, but probably unequal</p> <p>Solutions for the environment are sought in technology itself (green tech) but not centrally organized → own/local initiatives, diversity of solutions</p>
Economy	<p>Market oriented, flexible, driven by a decentralised approach to technology development</p> <p>Very dynamic platform economy</p> <p>In this fairly liberal economy, industry strives to adapt to local markets and fast changing technology</p>
Policy	<p>Small and nimble government that focusses on the organization of some matters and delegates responsibilities related to other matters.</p> <p>Pragmatic opportunism (less attention for long-term issues, or large, complex and boundary-crossing societal problems)</p> <p>It is cities and local governments that create policies that are targeted at innovation.</p>

Scenario 2: "Protect us from Tech" (Technophobia - Centralized government)

THE PATH TO THE SCENARIO

- **5 years:**

Today is [month] [date] 2022. A spate of major cyber-attacks and large industrial accidents has created a negative view of technology. People now feel vulnerable to technology (1). In response, citizens want technology to be better regulated (2). The prevalence of algorithms supposed to streamline everything for you and to make your life easier (especially sending you 'targeted' advertisement) kills serendipity and the probability of 'chance encounters' (3). In reaction, and to fulfill a desire to take one's own life back into one's own hands, 'low tech' becomes fashionable (4). The desire for social innovation takes precedence over technological innovation. Some specific technologies (especially those deemed to monitor or control what one does under pretext of being helpful or protective) start to be viewed suspiciously by ever larger numbers of people (6).

- **10 years:**

We are now in 2027. *[Add a quick review of the actions that the scenario explorers have taken in the previous round]*. Technology is largely in private hands and many jobs are disappearing due to automation, robotics and artificial intelligence (1). In reaction, the regulation of technologies is strengthened (2). The 'EU Quality Institute' is created. In order to avoid the problems created by technologies in the past, this large and powerful body must certify all new technologies before they are put on the EU market (3). However, developing the capacity to perform the thorough safety assessment of technologies creates few jobs (4). Overall, technology development is guided by policy (5) and new technological applications are only authorized case by case, once all relevant assessments have been performed.

- **15 years:**

We are now in 2032. *[Add a quick review of the actions that the scenario explorers have taken in the previous round]*. A few high profile failures following a strong promotion of robots by industry (especially a case of large scale hacking of robots) creates a backlash: robophobia in the public expands (1). EU technology standards become the most stringent globally (2). Technology is mostly in the hands of a few large industrial players who alone have the power resources to get over all the hurdles to get to market in the EU (3). Overall, R&D moves largely out of EU (4) and there is less technological diversity in Europe than elsewhere (5). On the other hand, certified technological applications slowly gain acceptance (6).

Table2: Main elements of Scenario 2: “Protect us from Tech”

Parameter	Scenario 2: Protect us from Tech
Society and values	<p>Risk averse, fearful society. Overall, society doubts technology, especially when coming from private sector innovation</p> <p>People look at government for protection - Trust in government experts only</p> <p>People seek influence through centralized/higher level NGOs or national/EU dialogues.</p> <p>Collectivist trends</p> <p>Strict and standardised technological risk assessment</p> <p>Individual actors feel they have little scope for action</p>
Technology	<p>Rational, systematic, centralised pursuit of safety: public R&D focused on safety</p> <p>New tech must prove its worth before allowed on market</p> <p>New tech mostly promoted by large private interests</p> <p>Technology is only used where society perceives it is absolutely needed</p> <p>New tech needs to prove itself before entering the market</p> <p>Frugal technologies instead of high-tech → technologies that also function in low-tech environment, but that are still implemented in a standardized and centralized fashion</p> <p>Preference to use existing tried and tested solutions to solve problems instead of new fancy technologies that could have their own problems</p> <p>Battle of interests: industry wants to innovate, but government and society want to regulate.</p> <p>Industries have to lobby with the government, which is difficult, but now and then they reach an agreement</p>
Environment	<p>High environmental awareness spread through central mechanisms, such as education → strong societal focus on environmental protection</p> <p>Centrally organized inspection to control technological development → everything needs to be certified</p> <p>Many rules and regulations on what you are allowed to do (and what not)</p> <p>Risk management and risk assessment are separated</p>
Economy	<p>Planned economy</p> <p>General dynamics of the system is slow → technological development becomes slow.</p> <p>Stable economy, stagnation</p> <p>Economy must respect many rules: very protective, trying to control</p>
Policy	<p>Lobbying from industry to get tech authorised, incentives for bribing authorities</p> <p>Lots of government control</p> <p>Moratoria on technology roll outs</p> <p>This pushes industry to move R&D operations outside of the EU</p>

Technology detail cards

Below, you will find some examples that you can use for each of the technology detail cards.

Nanotextiles

- **5 years:** Textiles with new enhanced properties
 - dirt-repellent, stronger, antibacterial, electric conductivity
- **10 years:** textiles that can monitor
 - embedded sensors to measure/monitor bodily function, environmental conditions, machine function
- **15 years:** textiles that actively intervene
 - monitoring of pressure/temperature → make textile more rigid/flexible
 - monitoring of bodily function → respond by delivery of hormones, food supplements etc.
 - Lifestyle: clothes that can express your mood

Nanomedicine

- **5 years:** molecular diagnostics in lab & targeted treatment
 - Tumour recognition and treatment
 - Based on human-expert system
- **10 years:** molecular monitoring, diagnosis & treatment within the body
 - Real-time insulin monitoring
 - Based on technology-expert system inside the body
- **15 years:** interventions in genetic make-up
 - DNA surgery, in situ tissue/organ regeneration

Brain Computer Interfaces

- **5 years:** monitoring neural activity
 - more sensitive signal detection of electrical activity in the brain
- **10 years:** neuro-stimulation
 - used for mood control in depression or mood disorders
- **15 years:** human - machine integrations
 - enhance mental capacities, machine input for thought, bio clock



NANO*futures*



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