NANO2ALL

SOCIETAL ENGAGEMENT ON RESPONSIBLE NANOTECHNOLOGY

Report on the public understanding, attitudes and fears of nanotechnology research for the Nano2All Ethics Board

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Project acronym changed to NANO2ALL

Dissemination and uptake

This deliverable will be made available to the public to inform interested parties about how the results of this project can be utilised.

Short Summary of results (<250 words)

This report presents Nano2All's ethics panel findings on public understanding, attitudes and fears of nanotech research. Such findings were based on the results of the Nano2All citizen and stakeholder dialogues, game theory and case study evaluations that revealed some important measurements concerning this, providing a bridge between the research community and other stakeholders as envisioned in the EU Research Executive Agency's Responsible Research and Innovation strategy.

Evidence of accomplishment

Report

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1. Introduction

1. INTRODUCTION

Nano2All is an initiative funded by the European Union's Horizon 2020 Research and Innovation programme under the Grant Agreement Number 685931. It supports the establishment of Responsible Research and Innovation (RRI) policy and governance on nanotechnologies. Nano2All also aims to identify RRI practices, with a focus on societal engagement in nanotechnology research and innovation (R&I) across Europe and beyond, with the purpose to share knowledge, experiences and recommendations with other nanotechnology stakeholders and motivate a wider application of such mechanisms in Europe. Deliverable 5.5 presents Nano2All's ethics panel findings on public understanding, attitudes and fears of nanotech research.

The Horizon 2020 Nano2All project created a bridge between the nanotechnology research community and the citizen. Its multi-stakeholder approach provided the means to measure the public understanding, attitudes and fears non-specialists may have developed concerning nanotechnology research activities and achievements. This report will take many of the findings from the Nano2All stakeholder and citizen dialogues and process them within the context of the EU's Responsible Research and Innovation initiative – integrating the ethical and societal concerns of lay-persons into the research process.

Today with social media tribes informing the public within tight echo-chambers where fear and doubt more readily guide public perceptions, the research community tasks are no longer just limited to the lab. Scrutiny on the scientist is no longer limited merely to the efficacy of the research achievements, innovations and solutions to important technological problems. The scientist now has to be accountable to public demands for transparency, public buy in, open access to data, non-exclusionary benefits affordable to all and protection of personal data and respect for privacy.

The Nano2All dialogues produced a wealth of information to consider these points in furthering the goals of the Research Executive Agency's demands for Responsible Research and Innovation (RRI).

2. Methodology

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The Nano2All Ethics Board compiled this report on the basis of desk research on the findings of six stakeholder dialogues and six citizen dialogues held in Spain, Israel, Sweden, France, Poland and Italy in 2017-18 as well as the EU multi-stakeholder dialogue held in Brussels in 2018. These dialogues produced information from presentations, discussions, working groups and the rolling out of the Nano2All Scenario Exploration Game on topics from nanotechnology innovations in nano-medicines, smart textiles and brain-computer interfaces. It will also take examples from nanotech research case studies the project reported on. All of the sources are publicly available on the Nano2All website[2]

General information on each of the ethical concerns will be briefly introduced with the emphasis on integrating the findings from the dialogues into the EU RRI framework.

[2] http://www.nano2all.eu

3. Fundamental Research Principles

3. FUNDAMENTAL RESEARCH PRINCIPLES

Responsible Research and Innovation is a guiding benchmark for EU research. It "implies that societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society." The aim of RRI is to develop a more inclusive and more sustainable research process.

The European Code of Conduct for Research Integrity puts forward four key concepts: reliability, honesty, respect and accountability. Within the context of responsible citizen engagement on nanotechnology, this involves proper resource use, transparent, fair and unbiased communicating on research results, a respect for society, ecosystems, cultural heritage and the environment and an accountability for the wider impacts of research achievements.

3.1. Ethical Issues

Societal concerns on nanotechnology research are similar to many other issues raised from emerging technologies. **Uncertainty** about innovations leads to an increased public distrust. **Trust** is an important element that the research community must earn from the public, without which, public acceptance of the research and uptake of innovations will be less likely. Vulnerable agents may feel the loss of **agency** in the research process and crave **inclusiveness** at all levels of the decision-making process. For the public to give their buy-in, they demand both **transparency** from the researchers and an **access** to all of the research findings (which they expect to be easily accessible in layman's terms).

Regarding **benefits** from innovations in nanotechnology, there is a concern about how large corporations may profit from developments and applications. Ensuring **equitable distribution** of nano-research benefits (that the fruits of such research must not be limited to those able to pay the high costs) was raised as an issue in many of the Nano2All dialogues.

There was a fear that many companies would rush new products to market without proper controls on the **hazards to public health and the environment**. This implies a

distrust in the regulatory authorities' capacity to properly implement risk management measures. There was also a further concern of **potential misuse** of these technologies to exploit or harm individuals or populations.

Finally, the very nature of nano-materials creates difficulties for public acceptance. Its **imperceptibility** creates public uncertainty about exposure levels. This would suggest a **hazard-based approach** implying a precautionary reflex. This could lead to **conflicts** between stakeholders.

3.2. Ethics in a World of Fear and Uncertainty

The Internet and the socialisation of media have, like all communications revolutions before it, transformed societal structures. Like all other social activities, ethics has evolved in the age of social media. Christian cardinal virtues that have guided Western value judgements for millennia have ceded to digital-age virtues like transparency and sustainability. Decisions are made within social tribes of like-minded individuals leading to a diminished role for the expert or the intellectual. In the age of the citizen scientist, individuals are empowered to inform themselves and play a concrete role in the decision-making process. RRI redefines a role for science and research to remain relevant in a world where respect for expertise is fragmenting.

The post-modernist approach has been highly critical of the scientific establishment;[3] that a system built on shifting paradigms is unable to provide truths or certainty, and as uncertainty is the norm, different forms of knowledge have equal importance to the decision-making process. A group of social theorists have put forward a post-normal scientific approach where, in cases of technological uncertainty, all forms of knowledge need to be brought into the risk management process.[4] The values of the research endeavour and trust in the scientific method have eroded in this post-modern, post-normal uncertainty narrative leaving scientists needing to be heard in another manner. The RRI emphasis on engagement and dialogue is essential to ensure researchers play a role in societal debates on future research directions.

[3] Kuntz, Marcel (2012) The postmodern assault on science, EMBO Reports 13 p 885-889, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3463968/

[4] Funtowicz, S and Ravetz, J (1993) Science for the post-normal age, Futures 25 p 739-755, https://www.sciencedirect.com/science/article/pii/001632879390022L

Into this vacuum of uncertainty, individuals become more vulnerable and less trusting. Without the trust and buy-in from stakeholders in civil society, no research endeavour or technology can survive the moral outrage, regardless of the benefits. A good example would be the general European population's rejection of transgenic seed breeding (GMOs). From the mid-1990s trust in these seed breeding technologies had broken down with fear of corporate interest and unfounded safety rumours creating an atmosphere where researchers were not welcome at the table. This vulnerability towards any uncertainties continues to this day, to the point where civil society stakeholders successfully campaigned in 2018 to get new plant breeding techniques like CRISPR-Cas9 classified under the 2001 GMO regulation[5] even though the process involves no transgenic modification and the potential benefits should provide enormous opportunity for society. This decision was left to the courts through years of inaction by the authorities in DG Santé under NGO[6] pressure and cognisant of certain loud voices behind the public's latent moral outrage towards a technology they did not trust and were unwilling to accept.

In the period between 2005-2010, many researchers and social theorists began to fear that nanotechnology would go the same way as GMOs. During this time, media started to share stories about "grey goo", carbon nanotubes as the "next asbestos" and titanium dioxide risks in sunscreens. New nano-material products were taken off the market and regulators were Fissuing safety statements while consulting the research community. The European Commission introduced a consultation and then, in 2009, released a Code of Conduct for Responsible Nanosciences and Nanotechnologies Research[7].

Interestingly, the societal response to nanotechnology did not follow the GMO case study. What happened in this period that prevented a moral reaction against the emerging nanotechnologies? That is what this Nano2All report will consider on the basis of the citizens and stakeholder dialogue feedback.

[5] https://curia.europa.eu/jcms/upload/docs/application/pdf/2018-07/cp180111en.pdf
[6] https://corporateeurope.org/sites/default/files/attachments/biotechlobbies.pdf
[7] http://ec.europa.eu/research/science-society/document_library/pdf_06/nanocode-apr09_en.pdf

4. NANO2ALL Findings

4. NANO2ALL FINDINGS

1. Trust, Transparency and Agency

Essential to public acceptance of an emerging technology, or rather, avoiding societal moral outrage, is trust: trust in the technology; trust in the research community; trust in the regulatory authorities; trust in the products and societal benefits. But what is trust based on? Trust is an emotional reaction to a situation (usually sought in a state of vulnerability) so seeking a rational basis will not bear much fruit. Similar to concepts like love and dignity, everyone intuitively understands trust but it is difficult to articulate or define. Some definitions[8] include:

- **Familiarity**: People trust what or whom they know, usually developed over a long period of habitual use or contact. If a new nanomaterial can be associated as an improvement on long-standing practices, trust can be earned.
- **Kinship**: Trust is found within common practices or communities. A community of ultra-runners trust other runners so if one recommends a new, smart nanofibre material, others will be open to the opportunity.
- **Authenticity**: We trust something when experience meets expectation – it is authentic. The public tends to trust natural products over synthetic as they have had a catalogue of man-made risk scandals that have left a legacy of community outrage. This is the hardest challenge for building trust of any chemical technology, especially one at the nano-scale.
- **Predictability**: If my car fails to start several times when I needed it to, then it is time for a new car. The ability of a nanotechnology to deliver the expected benefits is, like any product, essential for public trust.
- **Agency**: People fear flying more than driving their cars because they are in control. The public do not want to leave the decision-process to others if it affects them. They need to be engaged and buy-into the process, they need to understand the technology and how it might affect them.

[8] As there is a dearth of literature on trust, see selected notes put online for students: https://risk-monger.com/2016/11/05/the-importance-of-trust-in-our-decisions/

In the 1990s, several NGOs presented GMOs as something being unnecessarily forced upon them. Without involvement in the process, they were quick to reject the seed technologies. As they were not convinced that GMOs were safe (predictable) and the concept was presented as something foreign (Frankenfoods), these unfamiliar products were not seen as authentic, not worth the risk, not to be trusted. After some missteps in the mid 2000s, the nanotech research community started actively engaging with publics, providing options and not forcing the products onto the market, presenting the benefits within familiar contexts; trust was built.

But like moral virtues, trust has evolved with the social media communications revolution. People are sorted into communities of shared concerns by search engine algorithms. These social media tribes can both reassure and breed fear and vulnerability which has cemented the decline in the influence of the expert and the public authority with fake news merely becoming acceptable alternative facts in a post-truth world. Trust now is found within the consensus of the tribe where everyone is rating, evaluating and monitoring everyone else (like Uber and AirBnB, this could be called a blockchain trust[9]). Trust only works under the guarantee of total transparency. If the community feels a person or organisation is not transparent, there will be no trust and the tribe will excommunicate this opaque source.

In the Nano2All dialogues, on several occasions, individuals felt that industry was secretive and needed to be better controlled. The French multi-stakeholder dialogue[10] wanted NGOs to be better equipped to monitor industry-driven nano-research. This lies behind the public demand for more citizen science. “People like us” (familiarity and kinship) would be better trusted to transparently evaluate the scientific risks and advise the community in a trustworthy manner.

There was an interesting variation in different European multi-stakeholder dialogues regarding trust drivers. In Poland[11] the feeling was that trust could be better gained by stakeholder dialogue, in France[12] by having a stronger role for civil society and SMEs while in Sweden[13], trust was seen emanating from better labelling. In the European

[9] See notes on this as the basis of David Zaruk’s presentation at the Society for Risk Analysis meeting in Arlington, VA, USA on 13 December 2017: https://risk-monger.com/2017/12/11/evolutions-in-trust-part-1-blockchain-trust/
[10] http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20multistakeholder%20dialogue%20France.pdf
[11]http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20Multi-stakeholder%20dialogue%20in%20Poland.pdf
[12] http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20multistakeholder%20dialogue%20France.pdf
[13] http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20citizen%20dialogue%20in%20Sweden.pdf

stakeholder dialogue[14], the feeling was that trust would come from a public more engaged in the developmental process (a co-production of knowledge), with better unbiased communications transparently engaging different perspectives.

2. Public Engagement and Citizen Buy-In

Engagement and buy-in are crucial factors for developing public trust in emerging technologies (agency) and ensuring that innovations are welcomed in the market. But who, when and how should the public be involved in the research process? Not everyone is an expert in complex chemical technologies (and a little Google is a dangerous thing). Nor is everyone interested in advances of technologies (some people are technophobic).

The Brussels stakeholder dialogue[15] expressed the need for 'trustworthy intermediaries' who should be given a mandate to facilitate interactions between different actors in the long term. Would this be along the line of citizen science committees meeting regularly as part of a risk assessment process or more of a community involvement organisation?

The Italian multi-stakeholder dialogue proposed another approach. There would be a need to identify and involve a new group of actors: "those citizens who are better informed about technologies and aware of the magnitude of the phenomenon of nanotechnology, or who represent specific societal needs. Labelled as "competent agents", they would mediate between citizens and policy-makers, industry and researchers."[16] These competent agents could be likened to role of a trade union at a bargaining table.

The multi-stakeholder dialogue in Spain[17] proposed a greater role for science communicators as such mediators to improve dissemination making nanotech science comprehensible to society. Some Spanish participants added that scientists themselves should also engage more extensively in communication activities, calling for specific training activities for researchers to develop communications skills.

[14]http://www.nano2all.eu/wp-content/uploads/files/NANO2ALL%20-%20685931%20-%20D3.4%20Responsible%20Innovation%20Agenda%20at%20European%20level-submitted.pdf
[15]http://www.nano2all.eu/wp-content/uploads/files/NANO2ALL%20-%20685931%20-%20D3.4%20Responsible%20Innovation%20Agenda%20at%20European%20level-submitted.pdf
[16] http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20multi-stakeholder%20dialogue%20Italy.pdf
[17] http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20citizen%20dialogue%20spain.pdf

While the Brussels stakeholder dialogue spoke of co-production of knowledge, none of the other events brought up this subject (a common theme in the REA's RRI strategy). That begs the question whether and when non-scientists should be permitted to influence or potentially obstruct research objectives. Is it necessary for the public to buy into the process by determining the process and does that create a dangerous situation where research options are restrictive and less than optimal? If the public decides only natural-based nanomaterials should be used, are they then interfering with the European research opportunities?

The Italian multi-stakeholder dialogue recognised this potential problem and reported back: "Last but not least, the group stressed the importance to respect the freedom of research and to support 'research free from constraints', whose application should be regulated when leaving the laboratory and entering in everyday lives."[18]

Finding the right time for co-production of knowledge is important with a consultation at the beginning of the research process and when innovative products are proposed for the market. But prudence should be considered at the idea of citizens looking over the researchers' shoulders in the lab or getting politically involved. The memories of UK animal rights activists shutting down pharmaceutical labs or French reapers destroying GMO test fields might create the opposite of the REA's RRI objectives.

3. Privacy and Data Protection

Nanotechnologies are often linked to futuristic scenarios as their potential seeks to unlock many of the mysteries inside the human body, create new beneficial wearables and advances in communications technologies. In all of these cases, personal data might be put at risk whether it is via more easily accessible private health information, personal location tracking or AI technologies being able to predict and control decision-making processes. A common public fear is that the benefits will come at a cost of further erosion of privacy and personal data protection.

Regarding nanotextiles, the Nano2All dialogues[19] recorded public concerns about nanotextiles that can monitor bodily functions or environmental conditions, data that can

[18] http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20citizen%20dialogue%20Italy.pdf

[19] http://www.nano2all.eu/wp-content/uploads/files/NANO2ALL%20-%20685931%20-%20D3.3%20Responsible%20Innovation%20Agenda%20at%20national%20level.pdf

lead to the exclusion and discrimination of certain groups, people possibly losing personal control and the ability to think for themselves. This is already the case given how algorithms are controlling our online search outcomes but perhaps it is more personally felt when it might affect people physically. Even more troubling, concerning nano-enabled brain computer interfaces (BCIs),[20] it was clear the technology was capable of recording more personal data than the subject could ever be aware of.

In a curious contradiction, people were also concerned over what would happen if the technology fails or breaks down. It seems the fear of over-dependence on data and technology is matched by the fear of losing the technology.

During the multi-stakeholder dialogue in Israel,[21] participants felt that if new methods for assuring patient privacy were developed, there would be an increase in public confidence in new healthcare innovations. The French multi-stakeholder dialogue[22] expressed how whistleblowers could play a role in protecting researchers from ethical transgressions, but that they would need more protection.

It seems ironic, but ethical issues around data protection may not only be restricted to preserving privacy and releasing sensitive personal data. A fear about having too much data was expressed regarding the amount nano-medicine and medical devices[23] can provide. Knowing too much about the state of our bodies and health might just make us feel sicker than we truly are and there was a concern about limiting the infobesity the technology may burden us with.

Some of the ethical issues nanotechnology raises surrounding personal data protection and informed consent will challenge ethicists for generations to come. When a technology can get inside of our bodies, inside our brains, and record data about us we are not aware of, predict decisions or advise on and take courses of actions without even consulting us or having our consent, then we need to weigh the benefits of a technology with the loss of agency and control personal of data. It will have to be considered on a case-by-case basis since there are so many variations in the technological applications. A diabetes patient who has a chip that can measure and release insulin internally as

[20] http://www.nano2all.eu/wp-content/uploads/files/NANO2ALL%20-%20685931%20-%20D3.3%20Responsible%20Innovation%20Agenda%20at%20national%20level.pdf
[21] http://www.nano2all.eu/wp-content/uploads/files/Nano2All-multi-stakeholderd-alogue-Israel.pdf
[22] http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20multistakeholder%20dialogue%20France.pdf
[23] http://www.nano2all.eu/wp-content/uploads/files/NANO2ALL%20-%20685931%20-%20D3.3%20Responsible%20Innovation%20Agenda%20at%20national%20level.pdf

needed is a clear win with very little loss of agency whereas a device implanted in the brain to control moods is an entirely different question.

4. Social Equity and Access to Technology

Emerging technologies provide innovative products that often are expensive, limiting access to those who can afford them. Several citizen dialogues were concerned that nanotech medical products would help the wealthy and further exclusion and societal privilege gaps.

The Swedish dialogue[24] wanted nanotechnologies to be so cheap that anyone could have access to them. This would depend on legal frameworks and would apply to publicly-funded research. The dialogue agreed that technological development in general and nanotechnologies in particular should work for society, to provide people with a good and dignified life.

In the Israel dialogue[25], there was a concern that new technologies would improve natural abilities and address needs that only rich people were interested in or could afford. Personal responsibility for one's fate and individual freedom meant certain classes would be more aware of the nanomedical opportunities offered to them creating a social exclusivity to technology access.

Overall there was a general fear of further technological inequity, particularly with the development of nanomedical solutions.[26] There was an expectation of unequal access to medicine. From the professional perspective, participants shared a concern that developments in nanomedicine may even lead to certain jobs and professions disappearing.

Equity and access issues were even more challenging for nano-enabled brain computer interfaces (BCIs).[27] Brain implants that may strengthen or enhance intelligence will likely

[24] http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20citizen%20dialogue%20in%20Sweden.pdf
[25] http://www.nano2all.eu/wp-content/uploads/files/Citizen_Nanodialogue_in_Israel.pdf
[26] http://www.nano2all.eu/wp-content/uploads/files/NANO2ALL%20-%20685931%20-%20D3.3%20Responsible%20Innovation%20Agenda%20at%20national%20level.pdf
[27] http://www.nano2all.eu/wp-content/uploads/files/NANO2ALL%20-%20685931%20-%20D3.3%20Responsible%20Innovation%20Agenda%20at%20national%20level.pdf

not be equally accessible for some time to come, causing new social inequalities to emerge.

Technology has always led to societal divisions and inequity. It would be naïve to think that the benefits of nanotechnologies (especially in the fields of medicines and medical devices) would be freely accessible to all members of society in the early stages of innovative product launches. It is up to governments and authorities to ensure a rapid uptake and development to enable prices to become for democratic and accessible. Some of the innovations, however, may excite the ire of certain civil society groups whose actions to interfere with the technology may slow the product development and actually augment the inequity and exclusionary nature of the technology.

5. Threat of Dual-Use and Misuse

The value of any new technology is determined by its use and ethicists are charged with guiding and assessing the practitioners. Often society judges the technology (assuming the worst in its practitioners). Nanotechnology provides humanity with an enormous potential for benefits, improved quality of life and economic and social advances. It can also be misused to create unheard of and previously unimagined horrors.

The Spanish citizen's dialogue[28] seemed to have uncovered many of humanity's potential dark sides. The participants raised the potential for a sensation enhancement device (intended to aid learning and augment media experiences) being misappropriated for use in psychological torture. The idea of safety glasses designed to heighten the wearer's attention when operating dangerous machinery could potentially lead to workforce exploitation. Nanodevices that could recover lost cognitive and motor functions could also be packaged and sold by private companies as an intelligence or strength-enhancing device, compounding social inequalities. The Israeli citizen dialogue[29] noted that while nanomedicine can empower the individual, it can also strengthen social control of individuals.

Dual use or misuse is a question on the conduct of the user and should not imply that the technology itself should be placed under ethical scrutiny but there may be

[28] http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20citizen%20dialogue%20spain.pdf
[29] http://www.nano2all.eu/wp-content/uploads/files/Citizen_Nanodialogue_in_Israel.pdf

applications that are far too dangerous to fathom. The dialogues did not raise the potential for military or terrorist applications of nanotechnology. The idea of releasing nanobots carrying deadly pathogens into an environment occupied by adversaries creates scenarios demanding restrictive measures. Nanotechnology can redefine the very concept of a weapon of mass destruction and regulators will need to be vigilant to restrict such malevolent misuse.

The very notion of brain implants via nano-enabled brain computer interfaces as intelligence or strength enhancers rides on the boundary between “being human” and “being a machine”.[30] As artificial intelligence advances push this debate on the relationship between man and machine, it is not just a question about when a machine crosses into the boundary of human volition, the ability of technology to have humans function more like machines needs to equally be assessed for its ethical ramifications.

In societal concerns about potential dual use and misuse of nanotechnologies, there needs to be a clear role for watchdog organisations like certain civil society groups and whistleblowers, as emphasised in the French multi-stakeholder dialogue.[31] Codes like the European Commission’s Code of Conduct for Responsible Nanosciences and Nanotechnologies Research (mentioned above) are essential but for society to accept the values of the technology amidst risks of malevolent misuse such codes need to be strictly enforced and monitored by third parties.

[30] http://www.nano2all.eu/wp-content/uploads/files/NANO2ALL%20-%20685931%20-%20D3.3%20Responsible%20Innovation%20Agenda%20at%20national%20level.pdf
[31] http://www.nano2all.eu/wp-content/uploads/files/Nano2All%20-%20multistakeholder%20dialogue%20France.pdf

5.Conclusions

5. CONCLUSIONS

The Nano2All citizen and stakeholder dialogues, game theory and case study evaluations revealed some important measurements on the public understanding of nanotechnological innovations, providing a bridge between the research community and other stakeholders as envisioned in the EU Research Executive Agency's Responsible Research and Innovation strategy. Some of the key findings include:

- The building of trust through dialogue and engagement practices allowed nanotechnologies to avoid the threat of public moral outrage that has led to the exclusion of transgenic plant breeding technologies;
- The European Commission's Code of Conduct for Responsible Nanosciences and Nanotechnologies Research and the Responsible Research and Innovation outreach programmes have created a framework for a more participatory process in the societal debates on nanotechnology;
- There should be clear intermediaries, competent agents or science communicators bridging any gaps in understanding and issues between the research community and other stakeholders;
- Civil society groups, government authorities or whistle-blowers should be given the means to monitor and assess nanotech research in such cases where trust might be compromised (especially in cases of malevolent misuse of the technology).
- Should co-production of knowledge, essential for public buy-in, only enter into the nanotech research process at certain times (like at the beginning and end of the process) in order to ensure researchers have an optimal opportunity to develop and discover?
- Clear development of privacy and personal data protection measures are essential to ensure public confidence and trust of any nanotech applications;
- There is a real concern how nanotechnologies can go inside of our brains and bodies and determine and take actions without our consent, but that such issues would need to be considered on a case-by-case basis;
- There will inevitably be inequities and exclusion of access to emerging nanotech innovations in the initial developmental stages. It is up to regulators and stakeholders to ensure an expansion of implementation and financial support of new innovations, particularly in the nano-medical domain, in order to lower prices and accelerate the sharing of benefits and societal goods.