

Research Platform
Nano – Norms – Nature



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Project Report

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Nano-Norms-Nature

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Project Report

Angela Kallhoff and Elias Moser

Abstract

From 2015 to 2019 the interdisciplinary research platform Nano-Norms-Nature, funded by the University of Vienna, brought together scientists from ethics, law, and social sciences in order to explore and critically reflect upon developments in nanoscience. It worked according to interdisciplinary standards, specifically focusing on the nano-nature-interface. The research platform Nano-Norms-Nature investigated the prospects of nanotechnology in terms of enhancement (e.g. new procedures of environmental cleaning, new qualities of natural goods) and in terms of restoring the environment by means of nanotechnology. It also focused on the negative and dangerous side-effects (e.g. responses to risks, toxic accumulations of nanoparticles). The research included a reflection of normative concepts for responsible and precautionary strategies. The objective was a detailed assessment of the nano-nature-interface according to recent findings in ethics, law, and the social sciences.

Main Outcomes

- Discovery of novel methods in the field of Nano-Ethics
- Modelling of normative frameworks in techno-sciences
- Essential contributions to Nano-Ethics in the international academic discourse
- National and international Collaboration of ethicists, social scientists, and nano-scientists

Project Leader

Univ. Prof. Dr. Angela Kallhoff, Institute of Philosophy, University of Vienna

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1. Description of Platform

Nanotechnologies are amongst the most rapidly developing technologies of our days. Over the last two decades, nanotechnology has been considered a central means for fostering positive technological and economic developments in the European Union, the United States, and other industrialized countries. At the same time, it is widely recognized that nanomaterials could have potentially negative impacts for human health, animal health, and the environment.

Nanoparticles are to be found in our consumer products. They are in our food and in our cosmetics and during the life-cycle of these products nanomaterials also make their way into the natural environment. Due to their size, they cannot easily be tracked. In particular, these particles are melted into materials, they cluster with other chemicals, and once released into the environment they are hard to detect. This situation leaves researchers, policy-makers and ethicists with worries and fears about the causal impact of these particles. Yet, there are no final answers to the question how we should deal with the production and the distribution of nanotechnological products.

Various societal actors such as natural scientists, ethicists, policy makers, lawyers, social scientists, and Civil Society Organizations CSOs have conducted assessments and come up with governance proposals. Still there are unanswered questions of whether and under what conditions specific nanomaterials may include risks for humans, animals, and the environment. The development and refinement of ethical standards, legal regulation, and societal integration mechanisms for nanomaterials remains a work in progress.

The research platform Nano-Norms-Nature addressed this challenge in a novel way that includes a normative assessment of ethical, legal, and societal aspects of nano-technology based on a fundamentally interdisciplinary approach. As the heading of the platform suggests, the research project's primary focus was the interface of nano and nature—i.e. the question in which way the development and application of nano-particles has a detrimental effect on the environment, biospheres, human health, or animal health. The main objective was to establish normative guidelines for assessing this interaction.

In order to perform a normative assessment of the development and use of nano-materials based on ethical, legal, and sociological studies, reliable information on the current state of the arts in natural sciences was necessary. The platform, therefore, aimed at enabling an interdisciplinary exchange and to collect knowledge on the risk-potential from environmental sciences and chemistry. A descriptive inquiry into current research on nanotechnology first addressed the question of how nanomaterials are employed

in production processes. Furthermore, in order to properly evaluate the use of nanotechnology in industrial and consumer products, in-depth insights were needed of how nanomaterials disperse in the course of a product-cycle and it was necessary to achieve an overview over the different ways in which nanoparticles chemically interact with surrounding materials.

Based on a common interdisciplinary ground between the humanities, social sciences and the natural sciences, a scientifically well-informed investigation could be performed on how society, societal actors, and legal and governmental institutions should deal with the risks from nano-materials. Is there a duty to restrict, regulate, or standardize these materials? Or are we obliged to enable and foster research into and application of these materials?

Although, from an environmental ethical perspective, the development of new emerging technologies is often criticized, the platform explicitly defended an account that allows for openness with respect to possible outcomes and results of the investigation. Nanotechnology cannot be assumed to positive or negative altogether, and with all its aspects. Merits and potential threats needed to be weighed carefully in order to arrive at a deliberate judgment.

The intensive research on normative issues concerning nano-technology can be subsumed under four main questions:

1. What are current restrictions, regulations, standards, or self-regulatory mechanisms for nanomaterials?
2. What is their intended effect and how does their actual effect diverge from the intention?
3. Is the intention justified?
4. Is the effect desirable?

These questions were discussed in various internal, national, and international workgroups, workshops, and conferences. The results of these events and the individual contributions of researchers from different fields, were published in distinguished interdisciplinary series and journals. The results were communicated to the broader scientific community at numerous conferences and evening talks. Over the course of four years of thorough investigation, these above-mentioned questions could not be answered conclusively. Nevertheless, the outcome of Nano-Norms-Nature can be seen as an essential part of the international academic discourse on nano-technology and has made a major contribution to the debate.

2. Project Team

2.1. Members

The Platform was split in two branches in 2017. This report represents the normative branch. The geo-physical part was headed by Univ.-Prof. Dr. Thilo Hofmann, University of Environmental Geosciences at the University of Vienna.

a. Principal Investigator

- Univ. Prof. Dr. phil Angela Kallhoff

Professor for Ethics with a Special Focus on Applied Ethics at the Department of Philosophy, University of Vienna

b. Members of the Platform

- Univ. Prof. Dr. jur Iris Eisenberger

From 2015 to 2017 Assistant Professor at the Law Faculty, University of Vienna.

Now Full Professor at the Faculty of Economics and Social Sciences, University of Natural Resources and Life Sciences, Vienna.

c. Research Staff

- Dr. Claudia Schwarz-Plaschg

From 2015 to 2018 Post-Doc Assistant at the Department of Science and Technology Studies, University of Vienna.

Now Fellow in the Science and Technology Studies Program, Harvard University.

- Dr. Elias Moser

From 2018 to 2019 Post-Doc Researcher at the Platform Nano-Norms-Nature, University of Vienna.

Now Post-Doc Assistant at the Section Moral and Political Philosophy, Karl-Franzens University Graz.

d. Administrative Staff

- Mag. Linnea Kralik

Secretary at the Department of Philosophy, University of Vienna

2.2. Collaborations

a. International Cooperations

A small group of distinguished researches are specifically investigating in the field of ethical, legal, and societal aspects of nanotechnology. The aim of the platform was to strengthen the network of scholars and to establish international collaboration with scientists in the field. This objective was mainly pursued with the organization of interdisciplinary workshops. Partners participating on the events and research activities were (amongst other):

- | | |
|--|--------------------------------|
| • Bernadette Bensaude-Vincent | Université Paris Sorbonne |
| • Diana Bowman | Arizona State University |
| • Christopher Coenen und Torsten Fleischer | KIT Karlsruhe |
| • Juliane Filser | University of Bremen |
| • Mireille Hildebrandt | Vrije Universiteit Brussel |
| • Lotte Krabbenborg | Radboud University Nijmegen |
| • Hans Christian Lehmann | TEMAS AG Schweiz |
| • Ibo van de Poel | Delft University of Technology |

2.3. Individual Career Development

a. *Iris Eisenberger*

In 2016 Iris Eisenberger was awarded with the Full Professorship for Law at the Faculty of Economics and Social Sciences, University of Natural Resources and Life Sciences, Vienna.

She remained closely affiliated with the platform as a co-organizer of events and as editor of the volume “Nanotechnology: Regulation and Public Discourse”, published by Rowman & Littlefield in 2019.

b. *Claudia Schwarz-Plaschg*

During her time at the research platform, Claudia Schwarz-Plaschg was invited to join the School for the Future of Innovation in Society SFIS, Arizona State University, as a fellow. She visited the school, which is recognized for its international reputation for interdisciplinary accounts and for a large number of distinguished researchers in the field of social sciences.

Claudia Schwarz-Plaschg also participated at numerous international conferences, such as e.g. S.NET (The Society for the Studies of New and Emerging Technologies), where she could present the platform and her current research. She established and maintained an international record with her publications on societal aspects of nanotechnology.

Since early 2018, Claudia Schwarz-Plaschg, is a Research Fellow in the Science and Technology Studies Program at Harvard University.

c. *Elias Moser*

Elias Moser joined the platform at a late stage between Mai 2018 and September 2019. After his doctorate in the field of legal philosophy, the platform provided a unique chance to embark on a new field of research. He amplified his knowledge in ethics of new emerging technology with the editorial assistance in the edited volume “Nanotechnology: Regulation and Public Discourse” and he was able to profit from networking-effects by co-organizing the international workshop “Envisioning the Future”.

Since early 2019, Elias Moser is a Post-Doc Assistant and lecturer at the Section Moral and Political Philosophy at Karl-Franzens University, Graz.

3. Project-related Output by Person

3.1. Angela Kallhoff

a. Project-related publications

- Kallhoff, Angela/Moser, Elias (2019): Eco-Centric Evaluation of Nano-Release. In: *Nanotechnology: Regulation and Public Discourse*, 17–34. London: Rowman & Littlefield International.
- Kallhoff, Angela/Schwarz-Plaschg, Claudia/Moser, Elias (2019): Rethinking Ethical, Legal, and Societal Frameworks for Assessing and Governing Nanomaterials. In: *Nanotechnology: Regulation and Public Discourse*, 1–14. London: Rowman & Littlefield International.
- Kallhoff, Angela (2017): Safer by Design and Trump Rights of Citizens. *Nano Ethics* 11(3), 291–295.
- Kallhoff, Angela (2016): The Normative Limits of Consumer Citizenship. *Journal of Agricultural and Environmental Ethics* 29(1), 23–24.
- Kallhoff, Angela (2016): The Normative Limits of Consumer Citizenship. *Journal of Agricultural and Environmental Ethics* 29(1), 23–24.
- Kallhoff, Angela (2015): Water Ethics: Toward Ecological Cooperation. In: *Oxford Handbook of Environmental Ethics*, vol. 36, 416–426. Oxford: Oxford University Press.

b. Project-related talks and presentations

- “Enacting vs. Envisioning the Future: Do Scenarios help? Workshop: Evisioning the Future.” University of Vienna, 24 May 2019.
- “Standardization: Implicitly Normative Orders?” Workshop: Standardization in the Nano-Field: for the Common Good? University of Vienna, 19 May 2017.
- “Ecocentric Evaluation of Nano-release. Conference: Good Nano, Bad Nano: Who Decides?” University of Vienna, 1 December 2016.
- „Safety: A trump value?“ Workshop: Making Nano “Safer by Design”, University of Vienna, 18 May 2016.

- Presentation of Poster Nano-Norms-Nature (together with Antonia Prätorius). Workshop: Umweltwissenschaften – aus allen Richtungen, Vienna 10 June 2015.

3.2. Iris Eisenberger

a. Project-related publications

- Eisenberger, Iris/Bereuter, Franziska (2019): Nanotechnology and Fundamental Rights: Regulating Dual-Use Research. In: *Nanotechnology: Regulation and Public Discourse*, 135–146. London: Rowman & Littlefield International.
- Miernicki, Martin/Hofmann, Thilo/Eisenberger, Iris/von der Kammer, Frank/Praetorius, Antonia (2019). Legal and Practical Challenges in Classifying Nanomaterials According to Regulatory Definitions. *Nature nanotechnology* 14(3), 208–216.
- Eisenberger, Iris/Kallhoff, Angela/Schwarz-Plaschg, Claudia (eds.) (2019): *Nanotechnology: Regulation and Public Discourse*. London: Rowman & Littlefield International.

b. Project-related talks and presentations

- “Defining Nanomaterials. Roundtable: Good Nano, Bad Nano: Who Decides?” University of Vienna, 1 December 2016.
- “Design: Who gets to decide? Workshop: Making Nano ‘Safer by Design’.” University of Vienna, 18 May 2016.

3.3. Claudia Schwarz-Plaschg

a. Project-related publications

- Schwarz-Plaschg, Claudia (2019): The Politics and Public Imagination of Nano-Labeling in Europe. In: *Nanotechnology: Regulation and Public Discourse*, 179–210. London: Rowman & Littlefield International.
- Schwarz-Plaschg, Claudia (2018): Nanotechnology Is Like...The Rhetorical Roles of Analogies in Public Engagement. *Public Understanding of Science*. *Public Understanding of Science* 27(2), 153–167.

- Schwarz-Plaschg, Claudia (2018): The Power of Analogies for Imagining and Governing Emerging Technologies. *NanoEthics* 12(2), 139–153.
- Schwarz-Plaschg, Claudia/Kallhoff, Angela/Eisenberger, Iris (eds.) (2017): Special Section: Safer by Design in the Nano-Field. *NanoEthics* 11(3), 277–311.
- Schwarz-Plaschg, Claudia/Kallhoff, Angela/Eisenberger, Iris (2017): Making Nanomaterials Safer by Design? *Nano Ethics* 11(3), 277–281.

b. Project-related talks and presentations

- “Stakeholder and public engagement with and after nanotechnology.” Workshop: Prisma – Stakeholder Dialogue, Berlin, 20 November 2017.
- “The Politics of Nano Labeling: Public imagination meets regulatory reality.” Conference: 8th annual S.NET Conference, Bergen, 12 October 2017.
- “Collateral Effects of Technoscientific Buzzwords: Lessons from Nanotechnology and Personalized Medicine.” Conference: 9th annual S.NET Conference, ASU Phoenix, 9 October 2017.
- “Playing the Nano Game: The (Identity) Politics and Ethics of Doing Nanoscience” (together with Ulrike Felt and Simone Schumann). Workshop: Community and Identity in Contemporary Technosciences, IFF Vienna, 16 February 2017.
- “Nanotechnology is like...Analogy as framing device in public engagement.” Conference: 4s/EASST, CCIB Barcelona, 31 August 2016.
- “Imagining nanotechnology in public engagement: The power of analogies.” Conference: Third ISA Forum of Sociology, Vienna 10 July 2016.
- “Evaluating Nano labeling. Conference: Good Nano, Bad Nano: Who Decides?” University of Vienna, 2 December 2016.

3.4. Elias Moser

a. Project-related publications

- Moser, Elias (2018): Normative Letibilder in der Technikfolgenabschätzung. *ITA manu:scripte* 18–2.

b. Project-related talks and presentations

- “Ethical Challenges for Scenarios on New Emerging Technologies.” Workshop: Evisoning the Future, University of Vienna, 24 May 2019.
- „Responsible Research and Innovation RRI und das Problem zukünftiger Werteeinstellungen.“ Konferenz: TA18 –Technikfolgenabschätzung und Normativität, OEAW Vienna, 11 June 2018.

4. Organized Events

Chronological Overview

10/06/2015	First presentation of the research outline at the University of Vienna
18/05/2016	Workshop: "Making Nano 'Safer by Design'"
01/12/2016	Conference: "Good Nano, Bad Nano: Who Decides?"
19/05/2017	Workshop: "Standardization in the Nano-Field: For the Common Good?"
01/12/2017	Special Section: "Safer by Design in the Nano-Field", NanoEthics, Springer
01/05/2019	Edited Volume: "Nanotechnology: Regulation and Public Discourse", Rowman & Littlefield
24/05/2019	Workshop: "Envisioning the Future: Scenarios as Theoretical Tools"

4.1. Workshop: Making Nano "Safer by Design"

Date: 18 May 2016

Location: University of Vienna (main building), VAM2 Conference Room, Universitätsring 1, 1010 Vienna

a. Program

- Mireille Hildebrandt Vrije Universiteit Brussel
"Legal Protection by Design: Interfacing Legal Conditions and Technical Requirements"
- Erik Reimhult BOKU Vienna
"A Colloidal Scientist's Perspective on Nanosafety: The Challenge of Staying Nano and Seeing Nano in Complex Environments"
- Hans Christian Lehmann TEMAS AG Arbon
"The 'Safe-by-Design concept': Not a Panacea in Itself"
- Ibo van de Poel TU Delft

“Can Safer by Design Approaches to Nanotechnology deal with Uncertainty?”

- Torsten Fleischer KIT Karlsruhe

“Why the current Popularity of SxD Approaches in Nanomaterials-related Innovation Policy?”

- Angela Kallhoff University of Vienna

“Safety: A Trump Value?”

- Iris Eisenberger BOKU Vienna

“Design: Who gets to Decide?”

b. Report

In the interdisciplinary workshop “Making Nano ‘Safer by Design’”, in May 2016, the concept of “safer by design” in an interdisciplinary dialogue was explored as an approach towards material development, which includes knowledge of potential adverse effects and practices of evaluation into the process of product design. Chemists and material scientists are trained in toxicology to become aware of inherent characteristics of chemicals and materials increasing their hazard potential in order to choose between safer but functionally equivalent alternatives in product development. The proposal of a “safer by design” account has received increasing attention in the field of nanotechnology to proactively address potential risks and negative impacts emerging from this new technology.

In her presentation, Mireille Hildebrandt introduces her concept of Legal Protection by Design and, as an example, Data Protection by Design. She discusses the challenges of designing architectures that can achieve security in a way that safeguards our fundamental rights, instead of trading the one against the other. She concludes that we need to be transparent about (1) which problems are solved, (2) which issues are not solved and (3) what new problems may be created when implementing e.g. security by design.

After explaining technical difficulties of designing nanoparticles in the laboratory, Erik Reimhult from the Institute for Biologically inspired materials, Department of Nanobiotechnology at BOKU Vienna, asks whether the legal definition of an engineered nanomaterial is a meaningful concept. He introduces some of the current experimental techniques and shows how they fail to uniquely identify nanomaterials based on physical properties.

Hans Christian Lehmann observes that in the public discussion about nanomaterials, the idea of “safer by design” is often introduced as a way to reduce the (perceived) risks and hazards associated with nanomaterials. As he states in his presentation, there is no generally accepted definition of “safer by design” and the understanding is diffuse and may be misleading. In order to show this, Lehmann provides an

overview over the “safe-by-design” concept as developed in the EU research programs SINN, NanoReg, NanoReg2 and ProSafe.

Ibo van de Poel outlines the distinct advantages of a “safer by design” account in the field of nanotechnology. As he shows, the approach helps us to address safety pro-actively and early in the life cycle of products, and may help to avoid or diminish safety issues at later stages. In his defense of the account, van de Poel then discusses two possible challenges for safer-by-design approaches, namely (1) a focus on products and (2) a focus on known risks. He then indicates ways of dealing with them.

In a more sceptic vein, Torsten Fleischer asks why we should support “safer by design” research and warns that we should not exaggerate its potential merit. He discusses the current developments in nano-material-related innovation policy within the framework of the “promise-requirement”-cycles-model. He explores the potential and the limitations of the “safer by design” idea in regulation policy context. As he argues, the “safe-by-design”-rhetoric may induce political and public expectations that cannot be met in real life.

With reference to Ronald Dworkin, Angela Kallhoff introduces the conception of safety as a “trump right” of individuals. Based on that conception, she translates the notion of a “trump value” into the specific context of nano-research and nano-release. She then goes on to argue that, even though a reasonable constraint, “safety” needs to be contextualized within a frame that addresses more basic issues, in particular basic values that contribute to shifting the burdens of proof towards values of nano-products in the first place.

In the last contribution, Iris Eisenberger assigns academia and industry with the responsibility of incorporating norms and values into materials, products or processes. She observes that “safer by design” concepts mainly aim to circumvent hazards and risks for human beings and the environment. As a result, she argues, these concepts often neglect many other interests, such as freedom of choice, consumer sovereignty, equality or public engagement. In her opinion, this effectuates a shift of the normative power from democratically legitimized parliaments to academia and the private sector, that has to be assessed critically.

4.2. Conference: Good Nano, Bad Nano: Who Decides?

Date: 1–2 December 2016

Location: University of Vienna (main building), Marietta-Blau-Saal, Universitätsring 1, 1010 Vienna

a. Program

- Juliane Filser University of Bremen
“Pros and Cons of ENP Regulation and ways towards a Sustainable Use”
- Angela Kallhoff University of Vienna
“Ecocentric Evaluation of Nano-release”
- Bernadette Bensaude-Vincent Université la Sorbonne Paris
“Toward an Object-Centred Evaluation of Nanotechnology”
- Tsjalling Swiestra Maastricht University
“First and Third Person’s Perspectives on Morality”
- Lotte Krabbenborg Radboud University Nijmegen
“Nanotechnology and the Public Sphere”
- Franz Seifert Independent scholar, Vienna
“The Deliberative Turn in Nanotechnology Policy”
- Christopher Coenen KIT Karlsruhe
“Creating Objects of Deliberation and Governance”
- Diana Bowman Arizona State University
“Science – Democracy – Industry: Who is in Charge of Regulating Nanomaterials?”
- Iris Eisenberger, Andreas Huber, Claudia Schwarz-Plaschg
Roundtable: Regulation meets Public Opinion

b. Report

“Goodness” and “badness” are contested categories in the ongoing struggle over the assessment of nanomaterials and their potential impact on society, humans, and the environment. In this debate a variety of institutions and actors play a role, among them nano-researchers, (eco)toxicologists, policy and law makers, industry, ethicists, or civil society organizations. The interdisciplinary conference “Good Nano, Bad Nano: Who Decides?”, in December 2016, brought together international scholars who contribute to the evaluation of nanotechnology and analyze the positions of societal actors as well as the processes in which the goodness or badness of nanomaterials is negotiated and established.

In the opening talk, Juliane Filser criticizes formal regulations, such as REACH and other guidelines, as not sufficiently nano-specific. Furthermore, she identifies various pressure groups—i.e. scientists, media, environmentalists, or industry lobbyists—, whose intentions are often contradictory, and she points at the scientific difficulties related to the complexity of processes in the environment. She illustrates some of those problems with the help of examples from her own research and sketches potential solutions towards a transparent and fair development for sustainable applications of nanotechnology.

In her contribution, Angela Kallhoff explores a so-called “ecocentric evaluation” of nano-release as a method to evaluate effects of nano-materials with respect to non-human nature. Her investigation is based on the assumption that nano-materials can both be beneficial and harmful to the environment. She discusses proposals to distinguish between both forms of evaluation in the context of environmental ethics and outlines major objections against an ecocentric evaluation. She concludes with a defense of an integrative approach to assess nano-release that prioritizes environmental concern.

Bernadette Bensaude-Vincent introduces the account of ELSI research to deal with ethical, legal and societal issues of nanotechnology. This prevailing approach has been the target of a number of criticisms. In her talk, Bensaude-Vincent outlines them and considers some more relevant concerns for a moral evaluation of nanotechnology. Based on that critique, she proposes a research focus on the cultural meanings of nanotechnological objects in a broad anthropological perspective, taking into account the interdependence of human societies and technological objects. Her account is introduced as “object-centered evaluation” of nanotechnology.

Tsjalling Swierstra outlines the methodological differences between academic fields. The social scientist, he argues, tend to privilege the 3rd-person perspective of the outsider, uncovering patterns and environmental constraints that the agent may not be aware of. The ethicist, in his opinion, sides with the agent’s phenomenological 1st-person perspective. He admits that both perspectives might offer important insights and concludes with the open question whether they can be reconciliated.

In her presentation, Lotte Krabbenborg stresses out the important role of non-governmental organizations NGOs for societal evaluation processes around emerging technologies. She describes them as “voices of civil society”: knowledgeable in giving voice to concerns and wishes of society. However, she identifies two problems with the NGO’s role. First, they do not always see themselves as representatives of civil society. Second, such a positioning underestimates the socio-technical complexity that is involved. She then argues that the challenge is not how to involve more NGOs, but how to create an active public sphere that includes emerging technologies as topic for deliberation and negotiation.

Franz Seifert raises the question why a so-called “deliberative turn” in nanotechnology has come to pass. He gives an overview over the analytic premises of his own project which focuses on the conceptual framework for the analysis of the process of a deliberative turn in three countries—France, Germany and the UK—over an observation period of 15 years. His concept of policy-oriented learning describes the deliberative turn as a learning process from past collective experiences such as public controversies.

Christopher Coenen argues that, for researchers in the fields of Technology Assessment and Science and Technology Studies, the rise of nanotechnology has led to new dynamics of emerging techno-sciences. Based on this interpretation, he draws lessons concerning the role of normative evaluations and new stakeholder interactions in the nano discourse by taking a closer look at how nanotechnology emerged in the last century and how it was politically materialized in the course of the 2000s.

In the last talk, Diana Bowman focuses on nano-regulation. She observes that hundreds of consumer products contain nanomaterials of one kind or another—e.g. sunscreens, deodorants, anti-aging and moisturizing creams, or dendrimer-based drug delivery systems. She then explores regulatory regimes that control the entry of nano-based products into the market. The focus is set on the roles and power of different actors within these frameworks, including industry and individuals. She asks the rhetorical question: “Who is in charge of regulating nanomaterials?” and sharply criticizes nowadays’ legal norms.

The regulatory issues for nano-materials in consumer products are also an important topic in the roundtable discussion at the end of the conference. Iris Eisenberger provides some insights into the European Union’s regulatory framework and elucidates some problems for proper definition of nano-materials. Following up on this, Andreas Huber presents the mandatory labeling requirements and their different purposes, namely, consumer information, hazard control, and risk management. Finally, Claudia Schwarz-Plaschg illustrates how members of the Austrian public perceive and imagine nano-labeling. She identifies a gap between labeling regulation and public opinion.

4.3. Workshop: Standardization in the Nano-Field: For the Common Good?

Date: 19 May 2017

Location: University of Vienna, NIG, Seminar Room 3B, third floor, Universitätsstraße 7, 1010 Vienna

a. Program

- Angela Kallhoff University of Vienna
“Standardization: Implicitly Normative Orders?”
- Henk de Vries Rotterdam School of Management
“Standardization: Enabler for Innovation”
- Knut Blind TU Berlin
“Research and Standardization in Nanotechnology”
- Fern Wickson SIVA Tromsø
“Are International Standards for Nanosafety Research Responsible?”
- Thomas Jäger University of Vienna
“Standardization as a Necessary Nuisance: Functioning and Pitfalls from a Legal Perspective”
- Karsten Fischer LMU Munich
“Common Good and Civic Spirit: Political Key Concepts in Past and Present”

b. Report

New materials and products, such as e.g. products containing manufactured nano-materials, do not enter the market without processes of standardization. Standardization procedures are set up to guarantee the safety and quality of new products. They facilitate innovation and trade, and enable efficiency and compatibility. They likewise contribute to shaping research, production, and the release of materials into the environment in a significant way.

The workshop “Standardization in the Nano-Field: For the Common Good?”, in May 2017, aimed at exploring in how far and in which ways standardization may contribute to the common good. This includes a discussion of the goals and mechanisms of standardization, of standards as either facilitating or restricting tools. The workshop provided an interdisciplinary setting in which scholars from economics, ethics, law, and social and political sciences could investigate these issues.

Angela Kallhoff, from the University of Vienna, opens the workshop by questioning whether standardization leads to implicit normative orders. First, she proposes definitions for the terms ‘standards’ and ‘standardization’. She claims that standards and standardization are not neutral. As she argues, standards can

be used for control, rationalization, facilitation, socio-economic development, sustainability, the prevention and reduction of risks etc. Nevertheless, she asks who is to decide what is good and what is not. Must a standard be justified or legitimate? Do we need democratic procedures?

Henk de Vries, president of the European Academy for Standardisation EURAS, gives a talk with the title 'Standardization: Enabler for Innovation'. He asks whether standardization is hindering or enabling innovation. He shows the role taken by standards in the innovation process and touches upon topics such as the terminology of standardization, conformity assessment, standardization for science-based health, safety and environmental practices, and material specifications.

Knut Blind shows that standards are to be found in all market sectors, and that they function as a kind of infrastructure. Standards and innovation, he claims, are the major source of growth and welfare of economies. He provides an overview of four types of standards, and classifies their positive and negative economic effects: standard compatibility/interoperability, minimum quality/safety, variety reduction and information. The illustration shows the recursive interdependence between research and standardization.

Fern Wickson, Senior Scientist at GenØk, Centre for Biosafety, University of Norway, asks whether international standards for nano-safety are suitable. In ecotoxicology research, she shows, many choices have to be made on which organisms should be the focus of tests and what endpoints should be measured by what measures and timeframe. Wickson points out that there are scientific tensions within nano-ecotoxicology, e.g. between basic and applied science, between biology and chemistry, and between realism and control. There is a so-called "triple double bind" effect. A double bind describes a situation where two choices are in tension and success in one creates unavoidable problems in the other. The first double bind is a temporal one—standardization comes both too early and too late. The second double bind concerns how choices in standardization inevitably increases the attention given to specific aspects and, therefore, leads to neglecting others. The third double bind relates to the regulatory dilemma. There are tensions between pursuing tests under real environmental conditions and using well-controlled experimental setups. For responsible research and innovation, she argues, all involved parties should work together during the whole research and innovation process in order to achieve a better alignment of the process and its outcome. Research should be anticipatory, reflective, deliberative and responsive.

Functioning and pitfalls of standardization from a legal perspective were introduced by Thomas Jaeger. The European Lawyer Professor from the University of Vienna speaks about the effects of standards and about how patents can create a so-called "bottleneck" for competition. Patents and standards can aggravate the bottleneck, lead to overprotection and limit innovation. Jaeger divides nano-technology patents

into two categories: those with top-down and those with bottom-up approaches. He points out the importance of developing a common and cross-disciplinary vocabulary.

Karsten Fischer closes the workshop with the presentation titled “Common Good and Civic Spirit: Political Key Concepts in Past and Present”. He takes a closer look at the conceptual history of the common good and civic spirit, and introduces philosophical accounts by Aristotle, Machiavelli, Rousseau and Robespierre. He shows how the common good has shifted from virtue to self-interest. He then demonstrates the demands of standardization and the ethical postulations. Using Niklas Luhmann’s theory, he describes different functional systems: politics, law, religion and economy, seeking a place for ethics in this system.

In sum, the workshop revealed that the goals and mechanisms of standardization need to be made explicit. Participants agreed that, in order to find answers to the questions raised, an interdisciplinary approach is indispensable.

4.4. Workshop: Envisioning the Future: Scenarios as Theoretical Tools?

Date: 24 May 2019

Location: University of Vienna, NIG, Seminarraum 3A, third floor, Universitätsstraße 7, 1010 Wien

a. Program

- Angela Kallhoff University of Vienna
“Enacting vs. Envisioning the Future: Do Scenarios Help?”
- Petra Schaper-Rinkel AIT Vienna
„Drei epistemische Praktiken zur Antizipation von Zukunft Scenarios, Visionen und politische Utopien“
- Arie Rip University of Twente
“Constructive Technology Assessment and the Methodology of Insertion”
- Alexandra Hausstein KIT Karlsruhe
“Vision Assessment as Tool for Understanding Technology Futures”
- Elias Moser Universities of Vienna
“Ethical Challenges for Scenarios on New Emerging Technologies”
- Christopher Coenen KIT Karlsruhe

“Scientific Prophecy”

b. Report

Scenarios of new emerging technologies describe social, political, and economic change due to the application of new technological developments. They play an integral part in discussions on how to handle, control, or regulate these developments. They are not only important for technology assessment institutions but also for the public to bring possible outcomes of scientific developments to mind and to outline in which way these developments can affect our daily lives. The one-day workshop “Envisioning the Future: Scenarios as Theoretical Tools”, in May 2019, on the one hand, investigated the nature of technoscientific scenarios and the role they play as visions of the future. On the other hand, the broader question was raised if the design of scenarios should be guided by certain moral constraints.

In the opening presentation Angela Kallhoff describes scenarios as theoretical tools, which should support decisions on future affairs. She points at their functions of reducing complexities, highlighting important information, and proposing paths into the future. In particular, she shows that scenarios are used against the background of theories that rest on a distinct philosophical interpretation of decisions, including a dogma of neutrality. In her contribution, Kallhoff confronts this theoretical model with theories of social philosophy on “joint action”. Theories of joint action highlight shared objectives of a collective, a common ethos of partners in cooperative action, and a commitment to bring about a desirable state of affairs.

Petra Schaper Rinkel distinguishes three epistemic practices for anticipating the future: scenarios, visions and political utopias. She observes that there is a variety of envisioned futures. As she shows, they are designed and analyzed as scenarios and visions in a participatory and transdisciplinary way in order to summarize possible future developments and to support policymaking. On her account, especially in the field of future research, technology, and innovation, scenario and vision design are used to support political decision-making. In contrast, political utopias are described as outside the spectrum of methods in foresight processes.

Arie Rip is generally known for his expertise in so-called “Constructive Technology Assessment”. In his talk, he outlines his methodology of socio-technical scenarios, starting with a diagnosis of the dynamics (tensions, and dilemmas) of developments, and possible responses to them. In order to illustrate the approach, he gives examples of futures of research funding organizations at research universities, and of their being “imprisoned in the race for excellence”.

Alexandra Hausstein introduces the cutting-edge research account of the Institute for Vision Assessment at KIT. She argues that our anticipation of the development of society due to technological progress most

likely relates to our past and present experiences and knowledge. As she shows, it is difficult to arrive at an empirically supported understanding of the future. In her opinion, both Risk Assessment and Scenario Analysis are faced with the challenge of lack of knowledge and with high probability of fallacies in reasoning. However, given the power of visions as action-guiding principles, she opts for developing a normative framework and evaluating scenarios according to scientific standards.

Elias Moser starts his talk with the observation that, in social science, predictions have an influence on the outcome and that, therefore, the object of study is not independent of its description. He points out that the formulation, communication, and implementation of scenarios in political decision processes have an inherently normative character. Based on this theoretical challenge, he asks whether we should include some moral standards for a proper design of scenarios. He then reflects on different ethical side-constraints for scenarios and develops procedural ethical standards for scenario-making.

In analogy to quasi-religious convictions of early transhumanist movements, Christopher Coenen describes some scenarios as mere prophecies. Outlining the congruencies between societal debates in the 19th century and nowadays' techno-sciences, he hopes to better understand the motivations behind, the constructional principles and the functions of visions.

In the concluding discussion, participants reflected on some of the most recent visions of scientists and product developers. A common denominator of the different accounts can be found in the urge for a more cautious application of scenarios and a consideration of implicit normative propositions in descriptions of possible futures.

5. Scientific Output

5.1. Special Section: “Safer by Design in the Nano-Field”

The controversial discussion on “safer by design” concepts to approach challenges of nanotechnology in industrial and consumer products at the workshop “Making Nano ‘Safer by Design’” in May 2017 evoked the idea to collect original essays of the contributors in order to publish them in a special section of a widely recognized journal in the field. Christopher Coenen invited the platform to edit a section in Nano-Ethics and to collect and prepare the papers for blind-review. The section was published in late 2017.

- Editors: Claudia Schwarz-Plaschg, Angela Kallhoff, and Iris Eisenberger
- Journal: NanoEthics, Springer
- Volume/Issue: 11 (3)
- Pages: 277–311

a. Summary of Content

The common idea behind different “safer by design” terms is to integrate knowledge of nanomaterials’ potential adverse effects on human health, animal health, and the environment into the process of designing nanomaterials and nanoproducts. The objective is to engineer these undesirable effects out of the respective materials or products. This entails that functionality and safety be considered in an integrated way, right from the earliest phases of the research and innovation process. The Special Section “Safer by Design in the Nano-Field” comprises four original papers on the topic from scholars with a different academic background.

1. Erik Reimhult: “Nanoparticle Risks and Identification in a World Where Small Things Do Not Survive”

In a discussion note, Erik Reimult argues that physical laws intrinsic to the behavior of nanoparticles both lead to limits on the risks to which we are likely exposed and to our technological ability to verify compliance with new regulations. He concludes that governmental actors should be careful not to overreact in their response to a technological revolution that only in few areas is likely to lead to increased public exposure.

2. Angela Kallhoff: “Safer by Design and Trump Rights of Citizens”

Angela Kallhoff’s article focuses on basic legal rights of citizens. She argues that the reference to “trump rights” is helpful in highlighting two normative claims: First, products that are “safer by design” are suitable instruments to protect the bodily integrity and health of potential users. From this perspective, “safer by design” strategies can guarantee some most basic rights of citizens. Second, the debate on trump rights also suggests that safety needs to be regarded as part of a more comprehensive normative framework. A final section gives evidence that both claims are congruent with recent insights from the debate on the so-called “precautionary principle”.

3. Ibo van de Poel and Zoë Robaey: “Safe-by-Design: from Safety to Responsibility”

In their article, Ibo van de Poel and Zoë Robaey ask to what extent “safer by design” approaches can deal with uncertainty, in particular with indeterminacy. They argue that while indeterminacy may be approached by designing out users in attaining safety, this is often not a good strategy. It will not only make it more difficult to deal with unexpected risks; it also misses out on the resources that users (and others) can bring for achieving safety, and it is undemocratic. They argue that rather than directly designing for safety, it is better to design for the responsibility for safety—i.e. designers should think where the responsibility for safety is best situated and design technologies accordingly.

4. Mireille Hildebrandt: “Saved by Design? The Case of Legal Protection by Design”

In her discussion note, Mireille Hildebrandt follows three different assignments: First, she explains the notion of “legal protection by design” in relation to data-driven infrastructures that form the backbone of our new “onlife world”. Second, referring to the work of James Gibson, she explains how the notion of “by design” relates to the relational nature of what an environment affords its inhabitants. Third, she explains how this affects our understanding of human capabilities in relation to the affordances of changing environments. Finally, Hildebrandt argues that in the case of nanotechnology “safer by design” will require legal protection by design to ensure that human capabilities are reinvented and sustained in nanotechnical environments.

5.2. Edited Volume: “Nanotechnology: Regulation and Public Discourse”

The interdisciplinary conferences organized by the platform in collaboration with the BOKU, Vienna revealed the need for a comprehensive academic work collecting the opinions from different academics in the field of nanotechnology. In 2018 the members of the platform decided to launch a publication project

to address societal, legal, and ethical challenges in the nano-field. Contributing scholars to the platform's events were asked to submit original papers, in order to create an edited volume. Sven Ove Hansson, editor in chief, welcomed the project as a major contribution to the distinguished series "Philosophy, Technology, and Society" at Rowman and Littlefield. The book was published in May 2019.

- Editors: Iris Eisenberger, Angela Kallhoff, and Claudia Schwarz-Plaschg
- Publisher: Rowman & Littlefield International, London
- Series: "Philosophy, Technology, and Society"
- Series Editor: Sven Ove Hansson

a. Summary of Content

The book comprises three parts, which address different aspects of nanotechnology: the ethical, the social, and the legal concerns.

The first part titled "Evaluation and Standardisation" is edited by Angela Kallhoff. It encompasses four chapters which present and engage with evaluation and standardization practices of ethical, legal, and economic backgrounds.

1. Angela Kallhoff and Elias Moser: "Ecocentric Evaluation of Nano-Release: Risk, Precaution, and Imagination"

In the first contribution, Angela Kallhoff and Elias Moser outline different ethical approaches of relevance for a normative assessment of nano-release. They elaborate on traditional risk assessment and the notion of a "precautionary principle" in order to demonstrate that these accounts need to be complemented with an ethical guidance considering the environmental influence of emerging technologies. They conclude that it is necessary to engage in what they call an "eco-centric evaluation" of nano-release.

2. Fern Wickson and Ellen-Marie Forsberg: "Standardising Responsibility? The Significance of Interstitial Spaces"

Fern Wickson and Ellen-Marie Forsberg draw attention to an aspect that is only implicit to current discussions on Responsible Research and Innovation RRI, but which has a highly significant impact on scientific research, innovation, and policy—namely, the interstitial space of international standardization. They argue that although current models for RRI provide a promising attempt to make research and innovation

more responsive to societal needs, ethical values, and environmental challenges, such approaches will need to encompass and address a greater diversity of innovation-system agents.

3. Henk de Vries: “Standardisation and Patenting in Nanotechnology: Better Balancing for a Necessary Nuisance”

Henk de Vries’ contribution proposes voluntary standardization as an instrument to mitigate risks while enabling innovation rather than hindering it. He describes the current efforts of developing international standards for terminology, measurements, health, safety and environment, and material specifications. Additionally, he discusses how legislation and standardization can be used in combination, thus avoiding the danger obstructing innovation by legislation.

4. Thomas Jaeger: “Standardisation: Enabler for Nanotechnology Innovation”

Thomas Jaeger explores the effects of patenting in nanotechnology on innovation and competition. Some of these effects may be seen as positive in terms of stimulating investments and enabling inter-operability and comparability. Yet, some effects run counter to the aims of protection and standardization, namely, where “bottlenecks” are created for competition in downstream markets or when patenting leads to obstacles for follow-on innovation. Jaeger seeks to pinpoint the positive and negative effects of standardization and patenting in the nanotech field and assess tools for better balancing and avoiding over-protection.

The second part of the volume, edited by Iris Eisenberger, focusses on “Norms and Regulation”. It comprises chapters which analyze and assess existing regulatory frameworks in different national contexts.

5. Diana Bowman and Lucille Tournas: “Science, Democracy, Industry: Who Is in Charge of Regulating Nanomaterials?”

Diana Bowman and Lucille Tournas explore the question of who is in charge of regulating nanomaterials. They adopt a more comprehensive account of thinking about regulation and argue that all sectors of society are currently “regulating” nanotechnologies—insurance markets as well as consumers. They conclude that nanotechnology serves as a powerful illustration of how emerging technologies may be regulated in future. In their opinion, the multifaceted regulatory framework captures the complexity of the technology.

6. Juliane Filser: “Pros and Cons of Nano-Regulation and Ways toward a Sustainable Use”

Juliane Filser, in her highly critical examination, observes that, historically, risk assessment procedures have been developed for conventional chemicals and they do not account for the fact that nanoparticles (because of their size) behave and react differently in the natural environment. She suggests that current regulatory practices for nanomaterials do not sufficiently protect the environment, and that they significantly differ from one country to another. Furthermore, Filser argues that standardized guidelines for environmental hazard assessment underestimate the potential risks of engineered nanomaterials by not accounting for biotic interactions.

7. Iris Eisenberger and Franziska Bereuter: “Nanotechnology and Fundamental Rights: Regulating Dual-Use Research”

Iris Eisenberger and Franziska Bereuter analyze nanotechnology research as a phenomenon with dual use potential—it can be used for the good or the bad. The conflict between promises of beneficial innovation, on the one hand, and concerns about possibly harmful consequences, on the other hand, makes nanotechnology research an object of regulation. Its twofold character, however, makes this difficult. Regulation needs to balance freedom of research with other fundamental norms such as the right to life, physical integrity, or health. Thus, fundamental rights both limit and oblige the legislator in the context of dual-use research. According to Eisenberger and Bereuter, regulation is best placed between law and science, where tools such as “safety by design” combine legal and scientific strategies.

8. Emad Yaghmaei, Andrea Porcari, Elivio Mantovani, and Steven Flipse: “Monitoring the Value of Responsible Research and Innovation in Industrial Nanotechnology Innovation Projects”

The contribution of Emad Yaghmaei, Andrea Porcari, Elivio Mantovani, and Steven Flipse describes and discusses a possible method to quantitatively assess the value of RRI strategies in commercial, industrial innovation departments. They outline their experience within the EU-funded project PRISMA, which aims at helping industries implement RRI strategies in their innovation processes. Moreover, they attempt to provide evidence on how the RRI approach and its explicit attention to the gender dimension can improve the innovation process and its outcomes.

Social scientist Claudia Schwarz-Plaschg edited the third and final part of the volume. Under the heading “Publics and Politics”, it comprises contributions that investigate the role of political actors, institutions, publics, and civil society in the ongoing societal debate about nanomaterials.

9. Schwarz-Plaschg: “The Politics and Public Imagination of Nano-Labeling in Europe”

Schwarz-Plaschg scrutinizes whether nano-labelling and the concomitant shifting of decision-making responsibility onto consumers represents an adequate governance mechanism under uncertain epistemic conditions. In order to provide an answer, she explores the current state of nano-labelling regulation in Europe and contrasts this with imaginations of members of the Austrian public about ideal nano-labelling scenarios. Based on a detailed discourse analysis, she diagnoses that nano-labels are often not very meaningful and sometimes even produce a dilemma for consumers. To countersteer such confusion, she calls for an epistemic transparency—in combination to the material transparency that a nano-label purports to provide—that openly communicates the limits of existing (scientific) knowledge and institutional processes for guaranteeing certainty and safety with regard to the application of nanomaterials in consumer products.

10. Lotte Krabbenborg: “Emerging Technologies and the Problem of Representation”

Lotte Krabbenborg studies the important role of Civil Society Organizations CSOs in the evaluation processes surrounding emerging technologies. She argues that two problems arise when CSOs are positioned as “voices of civil society”. First, these organizations do not always see themselves as representatives of civil society. Second, such positioning underestimates the socio-technical complexity involved when emerging technologies become a topic for deliberation and negotiation. Building upon the work of philosopher John Dewey, Krabbenborg shows that in order to attain a societal evaluation of emerging technologies, the challenge is not to involve more CSOs (even though they could play a valuable role), but rather to properly enquire the indeterminate situations that arise, both on a small and large scale.

11. Franz Seifert: “Nanotechnology: Democratising a Hyped-Up Technology?”

Franz Seifert begins his contribution with the observation that there is general hype around nanotechnology, that not only promotes discourse and rhetorical hyperbole, but also has substantial financial, scientific, and innovative influence. He provides some explanation for the structure of public discourse on nanotechnology and explores the discussion on nanotechnology in EU technology policy from a critical viewpoint. Finally, he proposes certain lessons to be learnt from the nanotechnology field in terms of emerging technologies and their accompanying social-science research.

b. Reviews

- Sven Ove Hansson, Editor in Chief KTH Stockholm

“This is a well-organized and highly informative book that provides a very good summary and discussion of the social and ethical issues related to nanotechnology.”

- Rostam Neuwirth University of Macau

“Nanotechnology: Regulation and Public Discourse offers important insights into how, paradoxically, the smallest things seem capable of posing the biggest challenges to the world. Taking a comprehensive and multidisciplinary perspective, it integrates governance within and beyond the law, thus, deriving regulatory solutions from the micro-level for the macro-level. A highly instructive book for everyone interested in innovation and shaping a forward-looking normative frame for emerging technologies.”

- Joakim Juhl University of Aalborg

“The book Nanotechnology: Regulation and Public Discourse skillfully investigates society’s normative practices for adopting new technologies. By probing the subject of nanotechnology, this important book breaks new ground within our understanding of contemporary mechanisms for assessment and definition of new technological advances. Taking matters further, this volume proposes methodological and normative guidelines that aid our preparation for better nanotechnological futures.”

6. Scientific Outcomes

- Discovery of novel methods in the field of Nano-Ethics
- Modelling of normative frameworks in techno-sciences
- Essential contributions to Nano-Ethics in the international academic discourse
- National and international Collaboration of ethicists, social scientists, and nano-scientists

Some of the most important findings of the project are summarized in this section. However, the list is not exclusive and cannot cover all topics that have been touched upon in the course of four years of intensive research.

6.1. European Regulation

One focal point of the project team was the study and critique of the European regulatory framework for nano-materials. The three major EU-regulation texts concerning the use of nano-material were investigated: Registration, Evaluation, Authorisation and Restriction of Chemicals REACH [EC No 1907/2006], the Cosmetics Regulation [EC No 1223/2009], the Regulation of Novel Foods [EU 2015/2283], and the Regulation of Biocides [EU No 528/2012]. Not all norms in these documents have the character of binding law. Nevertheless, they have a significant impact on the behavior of participants in markets for products including nano-material.

The normative study of the EU regulatory framework revealed three major shortcomings:

- The potential threat for health and the environment is made dependent upon the mass of nano-material in a product and does not account for the specific molecular structure of the material and its behavior.
- A unified and universally applied definition of “nano-material” cannot be identified. The legal texts apply different concepts that might be contrary. This leads to uncertainty for market participants but also loop holes for producers who want to circumvent restrictions.

- From an ethical perspective, it is not clear which justificatory standards are applied. The regulatory framework lacks a coherent theoretical framework for its normative judgements.

6.2. Governance Accounts

Several interdisciplinary working-groups consisting of scholars in the fields of law, social sciences, technology assessment, ecology, and ethics have been formed to discuss governance options for the development, use, and potential release of nano-materials. The working-groups culminated in the conference „Good Nano, Bad Nano: Who Decides?“, in December 2016.

A common denominator of participants was found in the conviction that, instead of a mono-causal protection mechanism, we should be developing a governance account that allows for participation of different stakeholders of nano-technology. This includes the accommodation of different value-standards from various interest-groups in society.

From this perspective, a promising account on Nano-Governance can only be built upon four pillars:

- *Priority* towards a protection of legal entitlements (e.g. freedom of research, protection of life and health, or the protection of our natural heritage)
- *Transparency* in communicating the interests of the industry, the civil society, and governmental institutions
- *Governance* accounting for the interests of both the industry and the civil society in accordance with the rule of law

6.3. Assessment of „Safer by Design“

A broadly discussed option to answer current uncertainties for the regulation of nano-materials is the so-called “safer by design” approach. The international workshop „Making Nano Safer by Design“ in May 2016 addressed this new approach and invited leading scholars in the field to reflect its merits.

“Safer by design” strongly refers to already existing accounts, such as “green chemistry” or “privacy by design”. It is an attempt to incorporate and reflect existing social norms and values in the process of designing a new product. The account, however, has to be assessed with careful scrutiny.

On the one hand, what is needed, is in-depth knowledge about the behavior of nano-particles, once released into the natural environment. Furthermore, models of possible interactions on a molecular basis need to be designed in order to assess a product’s hazardous potential. We simply do not possess sufficient knowledge on these issues. More empirical findings need to be generated in order to support and defend the normative claims of “safer by design” approaches.

On the other hand, from a normative—i.e. ethical or legal—perspective, the potential benefits of safety enhancing procedures in the process of a product design have to be weighed against potential losses with regard to other fundamental values, such as freedom of information or freedoms of consumers. The special section “Making Nano Safer by Design” in the distinguished journal *NanoEthics* in 2017 addresses these issues and summarizes the findings from the conference.

6.4. Standardization

Although almost invisible to consumers, standards and standardization of procedures have a decisive impact on the safety and quality of new products. The way new technologies are implemented in the development and production and applied as parts of new products is heavily dependent upon standards.

On the one hand, standards have desirable effects with regard to economic efficiency. They enable innovation and trade. On the other hand, they are a suitable tool to avoid the worst possible outcomes of developing, producing, and distributing products. They can be used to shape research, production, and the release of materials into the environment in a significant way.

The platform investigated in the role, the merits, and the potential of standards and standardization in its workshop “Standardisation in the Nano-Field: For the Common Good?”, in May 2017. The workshop provided a setting in which scholars from economics, law, social and political sciences could further reflect the important role of standards for nanotechnological products. Two major shortcomings of nowadays’ regime of standardization have been uncovered.

First, standards and the way they influence the behavior of market-participants are often implicit. Most consumers do not possess insights and overviews of how different standards are shaping products and

markets. They are not able to participate in a public discourse in order to have an impact on standardization. From a democratic perspective, more information needs to be made available.

Second, some scholarly opinions are not acknowledged in the process of decision-making on standardizing new products. Especially, social sciences and humanities are not able to make suggestions based on societal and ethical concerns. Standardization should be more interdisciplinary and include experts from different fields.

6.5. Scenario Assessment

Scenarios, which describe social, political, and economic change initiated by the development and application of technologies, play an integral part in discussions on how to control, and regulate these technologies. They are important for technology assessment institutions, for political institutions, and the public to reflect possible outcomes of scientific developments and to outline possible futures. With regard to nanotechnology, the concept of a scenario is crucial: We imagine possible futures and define which steps need to be taken in order to avoid the worst outcomes.

In this sense, a scenario cannot be conceptualized as a mere description of a possible future. From an ethical, legal, societal perspective, it is necessary to reflect on the specific nature and the role scenarios play in society. National and international scholars in the field of Science and Technology Studies and Technology Assessment, were invited by the platform to share their interpretation of the roles of scenarios from their specific standpoint.

First, it was acknowledged by the participants that scenarios are action-guiding: They include implicit or explicit advice on how to act as developers of new technologies or as companies producing goods by the means of new technologies and, in doing so, visions of the future exert a normative function.

Second, a scenario necessarily includes value-statements on the envisioned future. Based on that observation, we need to ask whether the use of scenarios as a strategic means for achieving certain political objectives is justified. Considering the fact that visions of the future can be used to manipulate people into convincing them of either negative or positive outcomes of the application of technologies, a normative framework should be developed to provide conditions for the legitimate use of scenarios.