FORESIGHT AND SOCIAL EPISTEMOLOGY

AN INQUIRY INTO THE EPISTEMIC VERSATILITY OF FUTURES RESEARCH AND THE POTENTIAL OF A SOCIOEPISTEMIC APPROACH

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There comes a time in the growth of any intellectual endeavor when further progress depends on knowing the philosophical foundations on which it stands.

(Bell and Olick 1989: 116)

Abstract

In this work, I examine the potential of social epistemology to serve as a foundation for foresight. I firstly describe the history of ideas that led to foresight and clarify the specific characteristics of foresight in contrast to other futures research activities. To develop an epistemological classification of foresight, or rather to show the impossibility of such a classification, I sketch the development of main strands of philosophy of science and the most prominent approaches of futures research and foresight theory. I argue that foresight is best grasped on the basis of socio-epistemic approaches that recognize the importance of values in science. On this basis I propose a socio-epistemic foresight framework that includes rules for scientific criticism, operates in close connection with scientific practice, and accommodates both the role of values and forms of objectivity. The work shows that Longino's claim that "science is social knowledge" (Longino 1990) can be adapted to foresight as "foresight is science as social knowledge".

Zusammenfassung

Die vorliegende Arbeit überprüft, inwiefern ein sozialepistemologischer Ansatz als Grundlage für Foresight tauglich ist. Hierzu wird zunächst die Ideengeschichte des Denkens über die Zukunft skizziert, die letztlich in der Herausbildung der Zukunftsforschung und in praktischen Ansätzen wie Foresight mündete. Anschließend wird eine Definition der Charakteristika von Foresight und dessen Abgrenzung zu anderen Ansätzen der Zukunftsforschung vorgenommen. Um Foresight wissenschaftstheoretisch einordnen zu können – bzw. um die Unmöglichkeit dieses Unterfangens aufzuzeigen – werden die maßgeblichen Strömungen der Wissenschaftsphilosophie umrissen, sowie gängige Theorien zur Zukunftsforschung und zu Foresight. Hierauf aufbauend, sowie auf Ansätzen der sozialen Erkenntnistheorie, welche die Rolle von Werten in wissenschaftlichen Prozessen berücksichtigen, wird ein Konzept für ein *socio-epistemic foresight framework* entwickelt. Dieses Framework ermöglicht es, Theorie und Praxis in Foresight einer wissenschaftlichen Kritik zu unterziehen, welche auch den geregelten Einfluss von Werten und verschiedene Objektivitiätsbegriffe berücksichtigt. Longinos These Wissenschaft sei soziales Wissen folgend (Longino 1990), ließe sich demnach Foresight als seine auf sozialem Wissen basierende Wissenschaft begründen.

Danksagung

Die vorliegende Arbeit habe ich als Promovierende des Karlsruher Institut für Technologie, Institut für Philosophie, angefertigt. Fast zeitgleich war ich, bis Ende 2016, am Fraunhofer Institut für System- und Innovationsforschung ISI am Competence Center Foresight als wissenschaftliche Mitarbeiterin und Doktorandin tätig.

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Die Promotion selbst ist nun Vergangenheit – was bleibt, sind Erinnerungen an eine intensive und bereichernde Zeit, sowie verschiedene denkbare Zukünfte, wie die Erkenntnisse aus dieser Arbeit sich weitertragen werden.

Contents

Abbreviations

EHS	Environment, Health and Safety (research)
ELSI	Ethical, Legal and Societal Implications
EFFLA	European Forum on Forward Looking Activities
EU	European Union
FTA	Future Technology Analysis
KAM	Knowledge Assessment Methodologies
R&D	Research and Development
RRI	Responsible Research and Innovation
S&T	Science and Technology
STOA	Science and Technology Options Assessment (operates for the European Parliament)
STS	Science, Technology and Society
STEEPV	Science, Technology, Economy, Environment and Values
SNV	Stiftung Neue Verantwortung
TA	Technology Assessment
TFA	Technology Futures Analysis

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1. Introduction

Where foresight and science meet

Foresight has an ambivalent status. While there is an ever more urgent need for future orientation and decision making in policy, technology, business, and R&D, the theoretical foundations and scientific character of foresight are still highly contested.

In their second edition of *Thinking about the future*, Hines and Bishop, two well-known foresight theorists and practitioners, express the commonplace that “[t]here has perhaps never been a time in human history where strategic foresight is more needed” (2006/2015: 1). They argue that foresight offers tools that help us structure debates and sketch multiple futures for today’s decision making in diverse areas of society. Foresight can be applied to any thematic issue or topic where future orientation is needed, be it technology, education, environmental issues, or concerns of NGOs or governments. These application fields, also known as environmental issues of foresight activities, are summed up as STEEPV[1] (Loveridge 2009b). In contrast to short-term consultancy and forecasts, foresight enables a long-term view into the future. With the use of a wide range of tools for scanning, forecasting and visioning, alternative futures are created which are possible, plausible and probable (Slaughter 2006). With regard to its methods and areas of application, foresight is in many ways similar to other strategic futures research concepts like forecasting and technology assessment.

Cuhls points out, however, that foresight differs from these concepts in its debate-oriented and systematic character, its focus on communication, long-term planning, coordination, consensus, commitment and comprehension (Cuhls 2003; see also Martin 1995). Another important characteristic is the emphasis on group work and participatory processes to promote joint actions and democratic procedures (FOREN 2001; Amanatidou 2011). Amantidou (2017) even highlights the potential of participative foresight activities to foster transparency in policy processes and to increase public awareness about policy concerns in science, technology and innovation.[2] Over the past two decades

[1] STEEPV is an abbreviation for science, technology, economy, environment and values. In foresight, STEEPV is also used as a term for brainstorming and structuring influential factors of a topic.

[2] Amanatidou refers to her evaluation of the project eFORESEE Malta (Amanatidou (2017). Note that this is only one of several examples in the EU context and from other regional foresight activities. For further examples concerning the use of participatory approaches and projects, see Cuhls (2004); Jaspers and Banthien (2004); Faucheux and Hue (2001). For the FUTURIUM, a foresight platform for evidence-based and participatory policy making that has also been installed in an EU context, see Accordino (2013). For examples in technological and other application fields, see Bas and Guillo (2015); Addison and Ibrahim (2013).

especially in the foresight activities of the EU and in different institutional and governmental foresight communities, the influence of participatory approaches has risen. Participation refers, on the one hand, to the involvement of different parties and stakeholders in the process and, on the other, to the inter- and transdisciplinary work within foresight activities, which requires the involvement of researchers from different disciplines (due to the need to address STEEPV conditions). Furthermore, in EU foresight projects cooperation within consortia also requires the involvement of researchers from different countries. Foresight activities in European countries are driven mainly by established foresight institutions (Georghiou, ed. 2008),[3] to which EU research programs like Horizon 2020 and formerly FP7 have also been an important impetus (Duckworth et al. 2016). Besides research institutions, today there are also various futures journals and conferences where exchanges within the community takes place.[4]

Research institutions represent authority, reliability and credibility, and these in turn can lend credibility to foresight. Such credibility is needed in order to distinguish foresight from simple trends, prophecies or science fiction. The European Parliament, for example, insists that it builds upon scientific foresight within STOA, that is, on the expertise of scientists in foresight activities.[5] However, a simple transmission of authority and credibility is not evidence of the validity of procedures and methods from an epistemic point of view. For foresight to be scientific, it is essential that the procedures and methods in foresight are valid, reliable and credible. But how can foresight be validated scientifically? In reference to its purposes and outcomes? Its methods? Is it even scientific at all?

Recently, interest in such questions in the field of futures studies has been growing. On the one hand, a new wave of theoretical analyses and investigations have been carried out since the early 2000s. This includes historical as well as philosophical inquiries, for example, Wendell Bell's *Foundations of futures studies* (2003, 2004). The ever more widespread application of foresight in policy making has also provoked new interest in critically examining the theoretic foundation of futures studies, especially its credibility and reliability (Grunwald 2009; Gerhold et al., eds. 2015; Kunseler et al. 2015). On the

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[3] Georghiou (ed. 2008) and other European futures researchers provide comprehensive overviews of foresight activities in different countries such as the UK, France, Germany, the Nordic countries, Japan and the USA.

[4] This point will be discussed in greater detail in chapters 2 and 7.

[5] STOA is the panel for the science and technology options assessment in the European Parliament. It encompasses TA activities and also foresight. The function of scientific foresight projects is described as follows: "The Scientific Foresight Unit (STOA) executes the decisions of the STOA Panel, mostly with the assistance of external contractors who are selected on the basis of the expertise needed by STOA". The projects are conducted by "expert consortia covering the delivery of technological and scientific expertise in a broad range of areas" (European Parliament (2016). See also http://www.europarl.europa.eu/stoa/.

other hand, attempts have been made to use evaluations and experience from past activities and projects to establish quality criteria (Kuusi et al. 2015a; acatech, ed. 2015b; Guimarães Pereira et al. 2007).

Foresight still faces, however, various deficiencies and challenges, which account for its ambivalent status. Although most foresight practitioners have scientific backgrounds, it is still not settled whether future studies in general is better seen as an art or a science (Bell 2003; Loveridge 2009b). Foresight also faces delimitation problems concerning the definitions of basic concepts of futures studies as a result of thematic and methodological overlap with other related fields. There is, for example, futures research, forecasting and foresight, and even technology assessment (Sardar 2010; Marien 2010).[6]

There are several reasons foresight has not been classified among the scientific disciplines. Foresight practice is committed to selecting approaches and tools in accordance with the project in question and the customer's needs (cf. Bingley 2014: 8; Kuusi et al. 2015a), rather than discovering truths about the natural world. In dealing with the long-term future, foresight activities expose the fuzziness and uncertainties that we face. And then there is the vicious circle of predictions in futures research: Because the future is influenced by foresight, assessment and planning, it is impossible to properly foresee a future event objectively, for future events may be prevented or enforced by decisions made today and how the future is perceived. Finally, there are methodological challenges, which arise in part because both quantitative and qualitative methods are used.[7] Foresight allows the creation of narrative scenarios and alternative futures, which we anticipate as more or less possible. Desired futures are also affected by personal judgments and assumptions. These do not come from experts alone, but also from laymen and other stakeholders who may be affected by the particular future subject matter. Thus foresight is not truth-oriented like traditional sciences but rather, to a certain extent, subjective and value-laden – it is in this regard incompatible with classical epistemology.

From an epistemic point of view, however, the question whether foresight is a science or at least scientific cannot be answered so easily. No existing account of science or of the scientific method can be applied to all sciences equally (Chalmers 1999: 247). When assessing the scientific foundation of foresight, three issues have to be taken into consideration: (1) scientific methodology, (2) scientific goals and (3) scientific practices.

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[6] Some authors even subsume all these concepts as activities with different foci for future technology analysis (FTA) (sometimes also future-oriented technology analysis), a term that is also used in place of concrete differentiations – see, for example, Eerola and Miles (2011); Haegeman et al. (2013); Cagnin et al. (2008).

[7] See chapter 3.

In classical philosophy of science, scientific methods range from positivist approaches to relativist approaches. Which scientific method is used reflects the prevailing definition of knowledge. The main scientific methods to justify scientific knowledge are ei-based on the logic of induction and falsification, or on the attempt "to locate scientific rationality in large-scale theory change" (Mayo 2000).[8]

According to the positivist account of science, knowledge is derived from experimental facts that we arrive at through observation.[9] Questions are raised, on the one hand, concerning the nature of those facts and the ways scientists access them, and on the other hand, concerning "how the laws and theories that constitute our knowledge are derived from the facts once they have been obtained" (Chalmers 1999: 3). By contrast, there are theory-laden holistic accounts, which maintain that "elements of a theory, including its supporting data, can only be understood in the context of the whole" (Longino 1990: 27). In the past century, two notable works argued that scientific method is connected to fundamental changes to theory, namely, Thomas Kuhn's *The structure of scientific revolutions* (1962/2012) and Paul Feyerabend's *Against method* (1975/2010). Regardless of the methodological approach chosen to explain the development of scientific knowledge, there are different understandings of the goal of scientific inquiry. For some the goal is "the construction of comprehensive accounts of the natural world" (Longino 1990: 32)[10]. For others the goal is to discover truths about the observable and unobservable world – even if one remains skeptical about the possibility of reaching this goal.[11]

In the 20th century, philosophy of science promoted the value-free ideal of autonomous science, circling between realism and relativism, despite the increasing importance of science-supported decision making in policy making, companies and the public. In philosophy of science of the past decades, there has been disagreement concerning the aims and methods of science, as scientific practice has also changed (Fuller 1994). This has led not only to the Science Wars of the 1990s, which disclosed the misuse of scientific method in certain disciplines, but also to new approaches in philosophy of science, which regard the aims and methods of scientific practice in the context of their role in

[8] In *What is this thing called science*, Chalmers also follows this vague classification. He dedicates the first three chapters to "inductivism" and three further chapters to falsification, in its classical form introduced by Karl Popper. He then summarizes the alternative propositions of Imre Lakatos (1978) and Thomas Kuhn . Finally, for all of the theories that are not based on inductivism or falsification, such as Feyerabend's "anti-methodology of epistemic anarchy", Chalmers introduces the position of "radical instrumentalism (pluralistic realism)" Fetzer (1979: 393).

[9] This tradition is initiated by the empiricists of the 17th century, especially John Locke and David Hume; Auguste Comte extended this tradition in the form of positivism in the 19th century. The logical positivists of the Vienna Circle (1920) focused on the "logical form of the relationship between scientific knowledge and the facts" Chalmers (1999: 3).

[10] Exemplary work for this position is Hempel (1965/1968) and Kuhn (1962/2012).

[11] This position is held, for example, by Popper (2005, 1992, 1975) and Feyerabend (1975/2010).

society. Since the late 1980s, an increasing number of scholars have been pushing for a socially responsible science (Kourany 2013) and for scientists to become ethically more sensitive (Ziman 1998b). In addition to this focus on values and the impact of society on science, there has been greater awareness of the political and discursive impact of science on society.

The focus on the social impact has been an important incentive for futures research ever since – be it in technology assessment or early scenario-based futures research (Helmer 1966; Slaughter 2006). In reflecting upon the epistemic base of foresight, it is important to take into consideration not only that the way we look into the future has changed, that is, the way futures research is conducted, but also how we view scientific theory and practice in philosophy of science. Contemporary philosophical theories, which take into consideration the social aspect of knowledge acquisition in foresight, may therefore be useful.

In recent years, numerous scholars have argued that science is credible only if it is built upon a pluralist and social practice (Longino 1990, 2002; Kitcher 2001). Douglas, for example, emphasizes that authority and reliability make science relevant to policy making (Douglas 2009: 3). Such claims on the social dimension of knowledge are also known as social epistemology (Goldman 2012). Socio-epistemic theories ask what impact social practices have on knowledge acquisition and rationality (Goldman 2004). Some socio-epistemic approaches maintain that knowledge is defined as true belief – but the focus does not lie on internal knowledge-producing methods (which relate to personal perception, memory, reasoning), but rather on external issues, for example, testimony and discourse (Goldman 2004). Hence, epistemic differences between group work and group rationality are also a crucial topic in socio-epistemic considerations (List 2011). On the basis of a scientific realist account of science, proponents of social epistemology evaluate the different forms of objectivity in science and the role of values throughout the research process (Douglas 2009: 88).

Purpose and research questions

The challenge in foresight – and futures studies more generally – is to formulate a theoretical framework that is valid methodologically and that at the same time encompasses the practical orientation and social dimension. Social epistemology is a contemporary approach that fulfils this demand. Social epistemology does not only encompass all forms of scientific practice, but also emphasizes the social character of knowledge production. One of the aims of the present work is to determine whether foresight may be conducted in such a way that it can meet the goals of socio-epistemic theories and follow the principles of social epistemology. If this is case, there is good reason to claim that foresight is a scientific practice. And this may, in turn, contribute to the theoretical foundation of foresight. Socio-epistemic criteria may then be used when searching for new methods in foresight or when assessing them.

In the following chapters, the first task is to clarify what foresight is and why it does not qualify as a classical scientific discipline. Then, I will offer a detailed account of social epistemology in order to determine if it is applicable to foresight, and if so, in what sense. For this purpose, I will focus on the theories of Helen Longino (1990, 1994, 1996, 2002, 2004, 2015) and Heather Douglas (2000, 2008, 2009, 2013), who present comprehensive and convincing accounts of objectivity and values. Longino provides a useful framework for the concept of scientific criticism, which may be adopted for criticism in foresight. These insights will serve as a base to draft a socio-epistemic foresight framework and to discuss three examples of quality criteria. The reader may now have gained a first view of the general structure of this work: On the basis of contemporary science and the philosophy of science, it employs a combination of historical-comparative and epistemic approaches to analyze the development of the scientific foundation of foresight.

The brief review in chapter 2 describes the historical and cultural tradition of looking into the future. The aim is to show how perceptions about the future have changed over time and that the meaning of the future has always been strongly shaped by the prevailing conception of the world and the state of scientific knowledge. In ancient and medieval times, the future belonged to a divine eternity. This perception started to change in the Renaissance, and leading up to the industrialization era, the future was associated with scientific progress, perfectibility and innovation. In modern times, in the course of technological and scientific progress, the future becomes a field of forecasting, planning and change. Due to setbacks in planning and forecasting, the perception of the future has recently shifted to a multiple-futures perspective, which requires anticipating various possible and desirable futures for today's decision making. Despite their differences, today's foresight approaches in the US and Europe have the same roots.[12] In chapter 3 I clarify what foresight is, firstly, by showing points of similarity and difference between forecasting and foresight: these points concern the purpose, methodological advances, the multiple futures approach and new time spans, and the fields of application. Secondly, I describe the conceptual design of foresight according to its typical stages, and the interrelation of quantitative and qualitative methods.

Different scientific disciplines have different theories concerning what science is, including its method, means and aim. This has important implications for two epistemic questions: Which scientific method does foresight use? If foresight should be designated

[12] Even though foresight activities are on the increase in Asia – for example, Japan has conducted foresight activities since the early 1990s, see Cuhls (1998) – it will not be possible in the present work to offer a historical review of future thinking and foresight activities in Asia.

as a science, then what kind of science is it? Chapter 4 offers an insight into the discourse on scientific knowledge and practice. I describe the main accounts of science from realist to relativist positions, especially those of Popper, Kuhn and Feyerabend. The general differences between scientific disciplines, which also impede the scientific debate on foresight, are shown alongside the so-called Science Wars. My aim is to show why foresight cannot be described with classical epistemological approaches.

Futurists[13] and futures researchers have tried, since the beginning of futures studies and foresight, to provide its theoretical foundation. Instead of rethinking its role and impact on decision making within a changing relationship between science and society, foresight (formerly also forecasting) theorists have tried to support their field of work within existing accounts of science. Chapter 5 describes the variety of epistemic discussions in foresight and futures research: the art-or-science debate; Rescher‘s conceptual, epistemic and ontological considerations; foresight as a social science; and attempts to take up contemporary theories of science. There are still no systematic works on the potential of social epistemology to provide a theoretical framework to foresight and to substantiate it as a scientific practice. In chapter 6, after describing social epistemology in general, I will discuss crucial scientific issues appearing both in foresight and social epistemology, for example, objectivity and values in science, the role of experts and reliability. To show how foresight may qualify as a scientific practice, I will discuss the theories of Longino (contextual criticism) and Douglas (forms of objectivity and values in science).

Based upon the findings in chapters 3 to 6, a socio-epistemic foresight framework is proposed in chapter 7. It encompasses the features essential to foresight theory and practice: truth and knowledge, objectivity, credibility and reliability, possibility and probability, validity, methodological diversity, customer orientation of rules and frameworks, and value judgments. Such a framework may guide debates on quality and validity of foresight while satisfying rules of contemporary scientific practice. The value of this approach is then discussed in chapter 8 alongside three different cases of quality criteria.

What will be left out

I will not go into detail about the case of prophecy, which has its roots in Antiquity and finds support to this day in its different forms. In fact, describing the difference between mere prophecy and reliable future images that may be useful for today’s decision making is challenging. One reason is that books are constantly being published by scientists who deal with future issues. Prominent are, for example, Alvin Toffler’s *Future shock* (1970/1990) and *The third wave* (1980/1990), Naisbit’s chronicle of *Megatrends*

[13] The terms “futurist” and “futurology” have been shaped by Alvin Toffler. He became famous with books like *Future shock* (1970/1990) and *The third wave* (1980/1990) where he discusses the future of digital revolution and technological singularity.

(Naisbitt 1984), and more recently, Michio Kaku's *Physics of the future* has also been very successful (Kaku 2011).[14] The present work aims to show, however, that robust and reliable foresight that is useful for decision and policy making builds upon group work. Future prognoses like Kaku's and Naisbit's are personal, expertise-based projections which do not reflect a deliberative approach to the future by the affected target audience. I will also leave out the development of science fiction in literature, film and arts as a reaction to scientific progress.[15] These are parallel developments to dominant scientific theories or concepts, which have had a major impact on future thinking. In line with the aim to explain the epistemological value of foresight, I will focus on the latter. It is nevertheless worth mentioning that H.G. Wells, who is known especially for his works of science fiction, is also the first to claim the need for "professors of foresight". In a radio broadcast aired by the BBC on 19 November 1932 he presents the following argument:[16]

> It seems an odd thing to me that though we have thousands and thousands of professors and hundreds of thousands of students of history working upon the records of the past, there is not a single person anywhere who makes a whole-time job of estimating the future consequences of new inventions and new devices. There is not a single Professor of Foresight in the world. But why shouldn't there be? All these new things, these new inventions and new powers, come crowding along; everyone is fraught with consequences, and yet it is only after something has hit us hard that we set about dealing with it. (Wells 1932, in: Slaughter 1989: 3)

The discussion of social epistemology in the present work will also be oriented to foresight. I will describe social epistemology in a comprehensive manner and discuss specific theories in greater detail that are relevant to the impact of values in science and the social impetus in scientific practice. Critical discussions about the different strands and particular points of view, for example, the critical analyses between Longino and Kitcher, cannot be given in the present work.[17]

It should be noted that the socio-epistemic foresight framework that I propose in chapter 7 is a conceptual draft based upon the findings in chapters 3 to 6. In order to meet socio-epistemic requirements, this framework draft will have to become itself object of scientific criticism. Finally, it should also be emphasized that, due to the terminological defi-

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[14] Kaku explains the future development of today's technologies, such as the future of AI, medicine, nanotechnology, energy and space travel. He even dedicates two chapters to the future of wealth and humanity. However, the book market is steadily flooded with new literature on future trends and projections.

[15] Futurist Karlheinz Steinmüller provides different studies on science fiction and its use for futures thinking, including scenarios. See, for example, Steinmüller (ed. 1995); Steinmüller (2010).

[16] The text is published in Slaughter (1989: 3–4).

[17] See, for example, Kitcher (2002). Leuschner (2012), in her inquiry on credibility in climate research, goes into greater detail on the differences between the theoretic approaches of Longino and Kitcher.

ciencies in the futures field, the present work discusses literature dealing with a broad range of subjects: futures studies, futures research, forecasting, foresight, technology assessment, and also methods and tools like scenario techniques.

2. A Short History of Future Thinking

Today, in politics, business and industry, activities that look into the future are used for strategic purposes to anticipate different futures and derive recommendations and plans for action. The possibility of actively designing the future, however, and the awareness that humans' actions significantly influence future developments, or may even cause some of them, was not taken seriously until modern times. In ancient times, by contrast, looking into the future was seen as an attempt to foresee a future which was already predetermined by a cosmic system, fate or God. Future concepts change over time. Future thinking as an anthropological constant is pre-formed in large part by the prevailing perception of time. Roughly summarized, the definition of the future has shifted over the course of history from being a part of divine eternity to a sphere of progress and perfectibility, and finally to a field of active planning and change. In part responsible for this shift is the way people look into the future and understand the cause and effect of events. The historical summary in this chapter sketches some of these shifts to the concept of the future, touching upon the concept of *futura contingentia*, the impact of progress, and the emergence of futures research.

2.1 Perceptions of time and the future since Antiquity

Up to the Enlightenment in Europe, the concepts of the past, present and future were used to contrast points in time with eternity. In ancient thought, the seer, who appears in several ancient myths, is a literary representative of someone who can foresee the future. The seer has the ability to see the past (what is no longer), the present and the future at the same time and thus perceive eternity. This is also known as the Homeric formula of eternity. In fact, it is not merely a literary construction. It is also adopted from the ancient philosophical conception of time presented by Heraclitus, Empedocles, Anaxagoras and Plato (see Picht 1996: 44, 64). Ancient philosophical thought about the future is guided by the polarity of time and eternity. Generally, the ancient concept of time distinguishes the eternal present from the past and the future, which respectively stand for mortality and the hereafter (Link 2004: 1426).[18] Variations of this concept of time can be found in Plato's and Aristotle's works. In the *Timaeus*, Plato claims that the

[18] In contrast to the Homeric formula, which defines eternity as the sum of each possible present (the past, the present and the future), the poet Hesiod opposes the eternal everlasting and divine present to the past and future.

world soul is constitutive of the order of the universe, and hence inexpugnable and eternal (Link 2004: 1426). Time itself is a changing and moving copy of this eternity, or, as Cornford translates it, “the moving likeness of Eternity” (Plato and Cornford 1971: 97).

> Now the nature of that Living Being [cf. the world’s body fitted to its soul, E. S.] was eternal, and this character it was impossible to confer in full completeness on the generated thing. But he took thought to make, as it were, a moving likeness of eternity; and, at the same time that he ordered the Heaven, he made, of eternity that abides in unity, an everlasting likeness moving according to number—that to which we have given the name Time.
> For there were no days and nights, months and years, before the Heaven came into being; but he planned that they should now come to be at the same time that the Heaven was framed. (Timaeus 37D/E; Plato and Cornford 1971: 97f)
> But that which is for ever in the same state immovably cannot be becoming older or younger by lapse of time . . . and in general nothing belongs to it of all that Becoming attaches to the moving things of sense; but these have come into being as forms of time, which images eternity and revolves according to number. (Plato and Cornford 1971: 98)

Cornford summarizes Plato’s concept of time with the statement that “[time] cannot exist apart from the heavenly clock whose movements are the measure of Time” (Plato and Cornford 1971: 97). The eternal universe can be measured by time only in reference to its copy, which is the heavens, the planets and stars. Since their movements can be counted with numbers, these are like tools for measuring time. According to Plato, heaven, which arose together with time and therefore was, is and always will be being, follows the example of the eternal nature. In this regard, time describes the observation of natural phenomena and the calculation of changes that take place.[19]

In general, ancient philosophers do not discuss present and future as abstract concepts. They are used merely to describe changes and movements in the universe, which is seen as the computable copy of eternity. This ancient concept is also taken up by Christian scholars such as Augustine. But the ancient polarity of time and eternity is not equivalent to the Christian concept of eternity. The ancient argument for a world’s soul that creates the universe, eternity and its copy, which is measurable by time, is transferred to an argument for the creation of the universe and time by the Christian god. Augustine, for example, starting from an Aristotelian point of view, argues in his *Confessiones* that time is created by God and time as enduring present seeks not to be; rather, it seeks eternity (Augustinus 2003).[20] Augustine interprets time as the experience of the duration of an event. It can be divided into parts that have already passed or still will be, and

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[19] Nomoi 680a – 682d. The Aristotelian view is also based on Plato’s theory and was later adopted by the Stoics (see Politeia 1269a12-14). Aristotle defines time as a measure for the constant change with regard to the “before” and the “after” of an event. He also takes for granted that the measure for determining time is the everlasting circular movement of the highest heaven (see Link (2004: 1427) “die ewige Kreisbewegung des obersten Himmels”).

[20] See also Link (2004: 1427–8).

therefore do not exist. Janich summarizes Augustine's main argument as follows: "as long as the present has extension, it can be divided and can be classed among parts of the past or future; thus, strictly taken, it is not present" (Janich 1985: 200). He concludes that the present tends not to be, as it exists only now but can be divided into past and future. Strictly speaking, Augustine's reflections would have remained contradictory had he not arrived at the conclusion that the present seeks not to be.[21] But the crucial point is that this argument is needed to emphasize that humans long not for the future, but rather for eternity. The modes of past, present and future are merely imprinted on the soul. The soul does not focus on the future, but on eternity. For Augustine, the future is just a mode, "expectatio", which follows the modes of present "contuitus" and past "memoria" (cf. Link 2004: 1429). Past, present and future are equivalent in their content of reality, since they are perceived as events, and will eventually become historical at a later point in time. This is connected to the thought that the future is determined by God.[22] The discussion of *futura contingentia*, that is, the discussion whether God preforms time or not, connects the discourse on the future from Augustine, to Thomas Aquinas to Edmund Husserl.[23]

A remarkable change in the perception of time and the future does not take place until modern times. With the Renaissance, the arts and sciences pave the way for a new definition of the future. Again, it is the perception of time that makes the difference: While the medieval age is committed to the world construction of historical continuity since ancient times with regard to the Christian doctrine of salvation, the Renaissance marks the epochal transition to the idea that history may be divided into concluded epochs (cf. Shala 2011). Segmenting time into historical world phases is a decisive factor in the development of a new view of the future. Increasingly, the future is no longer seen as belonging to God, but instead as something humans have to take responsibility for (cf. Link 2004: 1429). By separating the future from its religious sense of the hereafter, it is recognized that there is also a future in this world. It is now possible to distinguish between divine providence and human forecasting and anticipation. Also important is the progress in the natural sciences, and here Isaac Newton in particular should be mentioned. His discovery of the "absolute" reality of time marked an epochal change in our view of time and the future: since Newton, we actively approach the future, and not vice versa (cf. Link 2004: 1430).

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[21] Janich discusses Augustine's theory of time in detail in his publication *Protophysics of Time* (1985).

[22] Cf. Link (2004: 1429). Comparable to Plato's twofold construction of eternity and time, for Augustine, and Christian belief in general, future events are already preformed in eternity: "Es liegt in der Ewigkeit inhaltsgleich und fertig vor".

[23] According to Link, Boethius linked the discussion of time to the topic of predestination: Does god's necessary foreknowledge undermine human freedom of the will? The discussion of 'futura contingentia' also contains the question whether God knows at all about future events Link (2004: 1429).

As a matter of fact, the etymological roots of the different terms for the future in European languages indicate differences in our perceptions of the future. The French term ‘avenir’, Spanish ‘porvenir’ or Italian ‘avvenire’ (from Latin *adventus* = arrival, in the sense of a future event to arrive and as a synonym for *futurum = event to be*) indicate that the future comes to us, and not vice versa. At the same time, the English word ‘future’, French ‘futur’, Spanish and Italian ‘futuro’ are synonyms and they are used without semantic difference. In German, there is only the one word ‘Zukunft’ for both, which etymologically means that a future event comes to the observer who is resting in the present (cf. Link 2004: 1430).

Thus in modern times the future becomes a subject of analysis for different disciplines. Newton marks only the starting point in physics; in the late Renaissance there are already isolated cases of scholars and philosophers proposing new concepts of time and the future. One such example is Thomas More’s *Utopia* from 1516. This text may be seen as one of the first pieces of literature to draw a positive, alternative concept of a society.[24] More describes the political, religious and social customs of an isolated society on a fictional island. It is a society with a basic democratic order, exhibiting some early communist thoughts concerning property rights. It is therefore seen as an alternative draft of the political system that More was living in. The term ‘utopia’, used to designate a positive, desirable future scenario, may be traced back to More’s fictional work.[25] The gradual detachment of philosophy from a pure divine concept of the future and groundbreaking insights in the natural sciences have shaped not only new scientific paradigms but also a new form of future thinking. Since there are numerous detailed investigations on the history of future thinking,[26] in the following I will outline one specific phenomenon in this new paradigm that has played a central role in future thinking: the idea of progress.

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[24] Thomas Morus, also Sir Thomas More (1478–1535) was an English Renaissance humanist, social philosopher and lawyer. The original title of his book is *De optimo rei publicae statu deque nova insula Utopia* (“Of a republic's best state and of the new island Utopia”), Nisbet (1980: 89–91).

[25] Other classics of utopian and futuristic thinking of that time are Bacon’s *New Atlantis* (1627) and Neville’s *The Isle of Pines* (1668).

[26] See, for example, Ortega y Gasset’s essay *The revolt of the Mases (La rebelión de las masas, (1930)) and other essays* Ortega y Gasset (1952). In his book *Histoire de l’avenir (1996) (History of the future),* Minois outlines the impact of the church on future thinking, as well as the rise of astrology and utopiasMinois (1996/1998, see chapter VI). Uerz (2006) also provides a detailed historical analysis of the various approaches driven by progressive thinking. See especially chapter 3.

2.2 The impact of the idea of progress on future thinking

The idea of progress had a major impact on our perception of time and the future in modernity. I will briefly highlight some examples to show how scientific progress enabled philosophers to overcome the prevailing concept of *futura contingentia*.

Theories of progress arose especially in the 18th century and remained important also in the 19th. In general, these theories claim that the human condition improved throughout history and will continue to improve in the future. In the words of Meek Lange, "writings on progress tend to bear a close relationship to the environment in which they were produced" (Meek Lange 2011). This environment is characterized by scientific progress on the one hand, and historical events on the other. Theories of progress aim at dissolving questions concerning human well-being, for example, how concepts of human well-being are shaped, whether there are laws of long-term improvement and whether the concept of progress has an epistemic foundation.[27] For example, human well-being is identified as a core value that ought to be protected and constantly improved upon over time. The overall aim of theories of progress is to develop "a causal story to explain the improvement in the human condition" (Meek Lange 2011). Meek Lange describes the development of the idea of the historical improvement of the human condition into a universal theory as follows:

> Universal historians aspired to surpass ordinary historians in breadth and depth and aimed to penetrate the surface play of events to discover fundamental laws of historical development. These laws would not only explain the past, but could be used to predict the future. (Meek Lange 2011)

This approach led to various competing theories that were supported by political events and scientific advancement, which varied in accordance with different places and different times. Moreover, concepts of progress that emerged during the Enlightenment mainly in the 18th century are not established quantitatively or empirically, but aim instead at constructing philosophical *a priori* theories. Nevertheless, theories of progress that arose in the Enlightenment differ from ancient or medieval and Christian theories of human history. In antiquity, for example, the cyclic conception of progress and regress was predominant. To mention simply the two most influential proponents of this view, according to Meek Lange (2011), Plato and Aristotle believe "that certain developments occur spontaneously, but [they] also see disaster and decline as inevitable."[28] One of the first to express the thought that progress is a state of improvement of the human condi-

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[27] Cf. Meek Lange (2011). In addition, there has always been the opposite standpoint, claiming that history proves not the improvement but rather the deterioration of the human condition, especially after WW II. Cf. also Meek Lange (2011).

[28] Meek Lange (2011), Plato, Nomoi (680a-682d) / Platon and Horn (2013), Aristotle, Politeia, (1252a24–1253a4), (1269a12–14) / Aristoteles (2012).

tion is Lucretius.[29] His didactic poem *De rerum natura* (ca. 55 BC) contains references to Epicurean philosophy of nature, dealing especially with physics and psychology. The main claim of Lucretius's poem is that physical principles are guided by chance and not by Roman deities. Lucretius holds that the experiences of the human mind are constantly progressing. He shows this by outlining that human history is a history of progress which, by means of the human mind or spirit, results in the creation of the arts.[30] In light of the way Lucretius explains the evolution of the arts and political systems and progress while analyzing the laws of nature down to their atomic level, his didactic poem may be seen as a precursor to modern theories of progress. But in his work, human progress is still a part of the cosmic circulation, and therefore it is still not the central theme that it becomes in the thought of the Enlightenment (cf. Ritter 2004: 1037).

Modern theories of progress are driven especially by the progress of science. One of the first academics to follow this path was Francis Bacon,[31] who claims that ancient and medieval scholars did not consider human progress in general to be geared principally by scientific progress. By means of inventions and scientific discoveries, the present has access to knowledge that was simply not available to the past. Accordingly, the achievements of scientific knowledge cannot be deduced from ancient philosophy (Bacon 1620/1990: I.84).[32] The tradition of belief in authorities must be overcome by open scientific progress. Bacon recalls a proverb which may serve as a guiding principle of progress: "Recte enim Veritas Temporis filia dicitur, non Authoritatis"[33] (Bacon 1620/1990: I.84). Bacon argues that authorities inhibit the productive capabilities of

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[29] Titus Lucretius Carus, ca. 99 BC – ca. 55 BC, Roman poet and philosopher.

[30] At the end of the fifth book, he concludes: Navigia atque agri culturas, moenia, leges, / arma, vias, vestes <et> cetera de genere horum, / praemia, delicias quoque vitae funditus omnis, / carmina, picturas et daedalasigna polita / usus et impigrae simul experientia mentis / paulatim docuit pedetemptim progredientis. / sic unum quicquid paulatim protrahitaetas / in medium ratioque in luminis erigit oras, / namque alid ex alio clarescere corde vidembant, / artibus ad summum donec venere cacumen. Titus Lucrecius Carus (1973: 5.1448–57) This quotation shows exemplarily how Lucretius perceived progress as evidence based upon historic achievements that build upon each other; he repeatedly illustrates examples following the "alid ex alio" principle. Clay (2007) analyzes Lucretius' concept of natural events "springing up from another" in more detail in his essay *The Sources of Lucrecius' Inspiration.*

[31] Francis Bacon (1561-1626), English philosopher, statesman, scientist and author. With his scientific work, he made major contributions to the empiricist methods and the use of experiments. His main work *Novum Organon (New Organon)*, published in 1620, challenged the predominance of Aristotle's science; see Kenny (1998: 123).

[32] See aphorism 84.

[33] Bacon (1620/1990: I.84) (NO a 84) The proverb can be translated as follows: Indeed, they say truth is a daughter of time, not of authorities.

humans and are thus an obstacle to progress.[34] Truth is not determined by authorities, but rather worked out scientifically over the course of time.[35] A central aim of Bacon's *New Organon* is the renewal of scientific inquiry by concentrating on natural philosophy and science and on experimental methods.[36] On the one hand, his intention is to set new scientific pathways for the religion, which legitimates humans' capacity to dominate nature.[37] On the other hand, his work expresses the vision that the reform of the sciences may enable a reform of society, too. In contrast to political systems, which generally rely on violence to reform society, inventions and discoveries are not harmful. On the contrary, they are generally beneficial to humans:

> Meta autem scientiarum vera et legitima non alia est, quam ut dotetur vita humana novis inventis et copiis. (NO I.81)
> (The true and legitimate goal of the sciences is to endow human life with new discoveries and resources.) (Bacon 2000: NO I.81)
> Etenim inventorum beneficia ad univerum genus humanum pertinere possunt . . . Atque status emendatio in civilibus non sine vi et perturbatione plerumque procedit: ad inventa beant, at beneficium deferent absque alicujus injuria aut tristitia. (NO I 129)
> (For the benefits of discoveries may extend to the whole human race, political benefits only to specific areas; and political benefits last no more than a few years, the benefits of discoveries for virtually all time. The improvement of a political condition usually entails violence and disturbance; but discoveries make men happy, and bring benefit without hurt or sorrow to anyone.) (Bacon 2000: NO I.129)

In this quotation, material welfare is presented as a motivating force of science and invention. Nisbet outlines how this new attitude towards science has also influenced the works of Descartes, Locke, Leibniz, Montesquieu and others (1980: 208; see also Kenny, ed. 1994/1998). A further step in the history of progress is its connection to the idea of freedom. Nisbet explains the interrelation of this development incisively as follows:

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34 In aphorism 88 (NO 1 88), Bacon accuses authorities in arts and sciences of inhibiting progress by claiming that there is no exploration of new knowledge possible in the future, as everything has already been explored: "gloriae vanissimae et perditissimae dantes operam, scilicet ut quicquid adhuc inventum et comprehensum non sit, id omnino nec inveniri nec comprehendi posse in futurum credatur." Also cf. Ritter (2004: 1038).

35 A contrasting picture is presented by Fontenelle, who is best known from the "querelle des anciens et des modernes", the intellectual literary debate in France at the end of the16th and beginning of the 17th century. As Ritter describes, in *Digression sur les Anciens et les Modernes* (1688)he claims that progress rejects the authority of tradition, as later periods surpass previous periods by integrating greater experience and knowledge, cf. Ritter (2004: 1038).

36 NO I.116, 117. In NO II he shows how to logically explore the nature of 27 cases; however, in NO I 116 he says that his theory is still not universal and flawless, but will have to be proven in the future.

37 See e.g. Bacon (1620/1990) NO I 129: "Recuperet modo genus humanum jus suum in naturam quod ei ex dotatione divina competit, et detur ei copia".

> The reality of progress was attested to by the manifest gains in human knowledge and in man's command of the natural world, but such gains were only possible when all possible limits were removed from the individual's freedom to think, work and create. (Nisbet 1980: 179)

In this light one can see that the rise of moral philosophy, which assumes the possibility of moral perfection, is also essential for progress. One of the most influential representatives of this view, Immanuel Kant (1724-1804), claims that moral perfection is only possible under consideration of pure practical reason.[38]

The impact that these different ideas and concepts of progress – which were put forth by scientists, philosophers, artists and scholars – had on the attitude towards the future, is summarized succinctly in the following quotation by Condorcet (1743-1794) in *Esquisse d'un tableau historique des progrès de l'esprit humain*:

> Si l'homme peut prédire, avec une assurance presque entière les phénomènes dont il connait les lois, si, lors même qu'elles lui sont inconnues, il peut, d'après l'expérience du passé, prévoir, avec une grande probabilité, les événements de l'avenir; pourquoi regarderait-on comme une entreprise chimérique, celle de tracer, avec quelque vraisemblance, le tableau des destinées futures de l'espèce humaine, d'après les résultats de son histoire? (Condorcet 1794/1963: 344)

Condorcet claims that, because we can – with the help of past experience, historical knowledge and the knowledge of laws of nature – predict natural phenomena, we can also predict the future very reliably.[39] The credibility of natural sciences is premised on the necessity and constancy of natural laws. In this sense, in the 18th and 19th centuries the idea of progress acquires a political and ideological function. Hegel, Comte and Marx, for example, each follow in their own way the concept of deriving regularities of progress out of philosophical history and theories of history (cf. Giedion, ed. 1994: 772).

An adequate contextualization of the differing concepts can be found in von Wrights essay *Progress: Fact and Fiction* from 1997. Wright distinguishes the modern concept of progress into three different kinds and explains the correlation between them as follows:

> One is progress in science and technology. Another is the improvement of the material well-being of individuals and societies. A third is moral perfection. The Great Idea of Progress was the thought that the first type of progress has an instrumental role in promoting

[38] Kant (1788/2003) / cf. KpV 58, 220.

[39] As a matter of fact, Bell (2004: 320) even names Condorcet "The First Futurist", as he is the first one to locate his utopia in the future, rather than simply transposing a specific society into another geographical setting.

> the two other types – the accumulative and linear nature of the first being a warrant of life becoming progressively easier and manners more civilized. (Wright 1997: 7)

Wright explains the "The Great Idea of Progress" in reference to the roots and interdependencies of beliefs in progress. What theories of progress have in common is the claim that ongoing progress means the improvement of human affairs. Progress has a twofold character, that is, a "hedonic and moral aspect" (Wright 1997: 9f). The future marks a state of perfectibility, driven by scientific progress and the gradual charting of all laws of nature. Due to historical circumstances, for example, the state of scientific technological progress during Industrialization, which improved life conditions significantly, "The Great Idea of Progress" seems to come true. Concerning this point, Wright notes: "[t]he ideological link between science and progress is *technology* [sic!]." (Wright 1997: 3). With reference to Sigfried Giedion, technology may also be defined as a result of science (cf. Giedion, ed. 1994: 772).

However, the belief in a steady, linear technological progress and better living conditions led to a significant increase in revolutionary inventions and to the advancement of mechanization (like the steam machine, electricity, the automobile and telecommunication, etc.). At the beginning of the 20th century, scientific technology was joined by scientific management. Industrialists and entrepreneurs discovered scientific management as a tool for planning that leads to greater productivity and prosperity and at the same time to reduced costs. For instance, the main inventions that advanced scientific management were the time clock and the assembly line (cf. Giedion, ed. 1994: 120). The introduction of scientific management into industries and production during the 19th century marks the early beginning of future planning in economic contexts. Harold Linstone, one of the early futurists of the past century, claims that technological forecasting too has its roots in this period (Linstone 2011: 69).

The first half of the 20th century is marked by an increase in advancement and technology research, paired with a widespread enthusiasm in technology and technological determinism. In 1910, for example, German journalist Arthur Bremer edited a bestseller with texts by scientists and experts on future scenarios for 2010.[40] In these scenarios, technologies – based on energy and radium – are expected to solve problems and to

[40]The turn of the century was also the time of booming science fiction, not only literary but also in daily culture, e.g. with pictures of future scenarios sold by chocolate makers or by the world fair in Paris (1900). In this way the enthusiasm for technology spread throughout society; Ruppelt (2012).

make life easier and more comfortable.[41] The scenario *Das drahtlose Jahrhundert* (the wireless century) by Robert Sloss even alludes to the innovation of the smartphone – "das Telephon in der Westentasche" (Sloss 2012: 35).

By contrast, Giedion's diagnosis is that in his time "mechanization takes command". This is also the title of his book, in which he argues that we are living in times of constant change, and that this circumstance is due to deficiencies of theories of progress: On the one hand, the idea of progress presumes a final state of perfectibility, which at the same time implies a condition of static balance. But on the other hand, this contradicts the scientific discovery that movement and constant change are fundamental to natural laws. According to Giedion, the waning belief in progress is a consequence of the many revolutions, and the loss of a mechanistic world perception due to discoveries in the nuclear sciences. A side-effect of progress is the loss of the centuries-old mechanistic world view, based on experimental research on natural phenomena, objects and matter. Giedion claims that, since effects of nuclear research impinged upon daily life and other research areas within a very short time, discoveries and inventions must be brought into harmony with the societal impact they may have (Giedion, ed. 1994: 772–6). Today, Giedion's statement may be supported by further scientific discoveries, which have had a major impact on changing paradigms. During the past century, other forms of technological progress besides nuclear power brought about new paradigms, for example, a changing perception of the relation between humans and machines and the dimension of virtuality due to progresses in information technologies and cybernetics. Biotechnology and materials sciences are two other fields where significant technological change and progress has been made (cf. Coates et al. 2001: 26).

In this sense, there seems to be a need for future thinking with regard to the inevitable impact of progress and scientific and technological achievements on society. Yet surprisingly this retrospective view on progress is not congruent with the actual treatment of progress in the past century. Technological forecasting, for example, has existed

[41] In various scenarios, electricity is expected to improve life conditions significantly, and radium shall cure all diseases, even cancer ("Es besteht aber gar kein Zweifel darüber, daß wir zu der Annahme berechtigt sind, die Zukunft werde dem Radium ein Zeitalter völliger Krankheitslosigkeit danken" Hustler (2012)). Besides scenarios on sciences and technology, there are also future images for politics, and for society and culture. Most notable are the two scenarios on war and freedom. Martin (2012) for example prognoses the "United States of Europe" with a joint parliament, where no wars take place due to economic and technological dependencies. Instead, he states, the only probable serious world war would take place between the "United States of Europe" and the allies of China and Japan. It is remarkable that this scenario of a European Union has been developed only four years before the first world war. In von Suttner's scenario about the "peace regime", world wars are impossible due to the existence of weapons of mass destruction – which would be like dual suicide ("Wir sind im Besitze von so gewaltigen Vernichtungskräften, dass jeder von zwei Gegnern geführte Kampf nur Doppelmord wäre" Suttner (2012)).

since the 1950s. Despite the early call for conscious technology development by Giedion and others, the guiding principle up to the 1970s had been 'handling progress with regard to growth' or 'pushing progress as Cold War competition'. For this reason it is not surprising that forecasting tools were mainly developed and applied in reference to the military (see Jantsch 1967; Wills 1972).

2.3 The rise of futures research

The different streams of progressive thinking outlined in the previous section have diverging underlying future concepts, and not all of them are relevant for future planning and future thinking tools, or even foresight. As Bell states, "[a] major goal of futurists is to contribute to human betterment", which suggests the main claim of the idea of progress is still present (2004: 1). From the end of the 18th century up to the 1960s, the future is mostly considered foreseeable with the use of specific scientific tools. Since then, different theories, concepts and methodological approaches have been launched, applying philosophy, the natural and social sciences to the future of human existence. Driving forces have been political circumstances and technological progress (Steinmüller 2012: 8). To sum up, belief in progress, actual scientific progress and industrial revolutions led to different forms and aims in future thinking:[42]

a) future thinking as an element of strategic management in industries and economy, as well as military, with a strong focus on planning and change
b) future thinking related to future models of society using social sciences, or by developing philosophical theories, including utopian thinking
c) futures studies approaches to future thinking, methodologically located between a) and b), concerned with the future impact of progress and change in technology and society. This also marks the beginning of *futures studies and futures research.*

[42] To classify the different approaches of progress with regard to their future concepts, one may refer to Hans Jonas. In *Das Prinzip Verantwortung*, he differs between prediction as a result of analytical, causal knowledge and prediction by speculative theories (Jonas 2003, 206). The former represents the basis of forecasting methods, whereas the latter summarizes different attempts at explaining progress and change theoretically, as e.g. Marxism does. Hence, along with the different sciences, different approaches to future thinking appear. Against this background, one may locate the roots of foresight in the strand of prediction by forecasting as a result of analytical, causal knowledge. Nevertheless, Jonas's two-part categorization lacks the placement of many other strands that emerged from the idea of progress.

The detailed history of future thinking is too complex to be summed up briefly, in part due to the many methods, the differing schools and the diverse applications.[43] Son (2015) provides a comprehensive three-phase periodization of the development of futures:[44]

(1) "The scientific inquiry and rationalization of the futures: 1945 – the 1960s"
(2) "The global institution and industrialization of the futures: the 1970s – the 1980s"
(3) "The neoliberal view and fragmentation of the futures: The 1990s – the present"

(1) The rapid development of futures research especially since the Second World War was mainly due to the political and socio-economic situation. The post-war period required specific forms of planning to bring about peace, yet the start of the Cold War meant that tools for handling future developments and changes in military and technological contexts were required, too (Uerz 2006: 260; Steinmüller 2012: 12–3).

The first futurologist and futures research institutions founded in the USA after the Second World War had a military focus, most notably RAND, which was a military research department (named RAND-Corporation since 1948). Up to the 1960s further think tanks were established, not only in the USA but also in Europe (Uerz 2006: 260–1). Uerz argues that the professionalization of futures research at that time passed mostly unnoticed since military futures research had to be kept secret – the same applies to the establishment of strategic management and consulting in the private sector. Nevertheless, with the increase of projects with civil purposes, public awareness of futures research increased and there was even a boom in futuristic literature, including methodological and project reports. Some prominent examples are the reports on the Delphi method (Helmer-Hirschberg 1966; Helmer and Rescher 1958), Kahn's future scenarios (Kahn and Wiener 1967/1967), and also on the general need for futures research (Flechtheim 1969, 1970; Jouvenel 1964/1967; Helmer 1966). It is during this period that the terms 'futures' (futuribles) and 'futurology' were first coined.

In fact, it was Ossip K. Flechtheim who first introduced the term 'futurology' in the 1940s in several publications (see Flechtheim 1969, 1970). Sardar points out, however, that Flechtheim did not primarily intend to promote a new discipline with this term, as he was uncertain about its status, for example, whether it is a scientific discipline or some "'prescientific' branch of knowledge" (2010: 178). Instead, he is mainly concerned with what this discipline can contribute to futures orientation. Malaska similarly

[43] Detailed discussions on the historic development of futures studies in the post-war era up to today are provided by Bell (2003); Masini (2006); Uerz (2006); Steinmüller (1997, 2012, 2013, 2014); Son (2015); Martin (2010).

[44] There are different ways to explain the rise of foresight. Following Linstone (2011), it appears with the "4th K-wave".

argues that "[h]e also outlined what may be regarded as a humanistic futures programme" (Malaska 2000: 238).[45]

The term 'futuribles', by contrast, which was introduced by Jouvenel in the 1960s, designates the phenomenon of anticipating alternative possible futures – 'futuribles', a compound of 'future' and 'possible', are alternative future images that are only possible if rooted in the present (1964/1967). For this reason, the concept of futuribles is also common in scenario technique. But even though scenarios were used during that period, as I will outline in more detail, the term 'futures' in the plural was not used systematically in the way it is in the foresight era to build alternative future paths. Even Kahn and Wiener (1967/1967), who introduced scenario writing, and Jungk, ed. (1969), who edited a book on possible futures, believed to be able to identify a single future that would apply for a given topic. Futurists in that period were also encouraged to believe that they are able to anticipate "the right" future path out of the different possibilities because they trusted their forecasting methods (see also Cuhls 2003: 94).

(2) During the 1970s and 80s, futures research, tools, methods and approaches were further developed and discussed in the futures community. Methods of futures thinking were implemented in companies, for instance, in strategic planning. For Son, this is also the phase of the "global institution and industrialization of the futures" (2015: 126). During this period, many methodological advances took place, mainly in the field of scenario planning (Bradfield et al. 2005), and normative futures were developed. Increasing demand for futures research and the establishment of new methods correlates with contemporary events and some influential futurist reports. Son summarizes the rise of futures studies as follows:

> The rise of futures studies as global institutional norms was driven by two main events: (a) the pessimistic message of *The Limits to Growth*, and (b) the 1973 oil crisis. (Son 2015: 126)

In their well-known report from 1972, called *The limits to growth,* Meadows et al. (1972) provide scenarios of the future global economy and environment based on computer models. Its main conclusions are that unlimited economic and population growth will cause economic collapses and have a negative environmental impact, including scarcity of natural resources and malnutrition. Only one year later, the oil crisis shook the futures community. The forecasting paradigm of predicting, planning and controlling, which had guided the futures community till then, was suddenly put into question (Son 2015: 127; see also Cuhls 2003; van der Heijden et al. 2009). A new way of thinking about the future began – more specifically, a paradigm shift took place favoring the

[45] Malaska's conclusion is based upon Flechtheim's claim that the discipline of futurology should help to eliminate war and institutionalize peace, abolish hunger and poverty, promote democracy, protect nature etc. See Flechtheim (1970: 9).

approach of multiple futures. This may also be characterized as the shift from forecasting to foresight.[46]

(3) Son describes the phase of futures research since the 1990s as a “neoliberal view and a fragmentation of the futures field” (Son 2015: 127). One may question whether the impact of neoliberalism on futures studies is as distinctive and influential as Son claims, especially in light of the growing impact of environmental and social foresight in recent years.[47] Nevertheless, since the 1990s the futures research community has had to respond to contemporary political and socio-technological changes: there was the end of the Cold War, and to this day there are the effects of globalization, rapid progress in the field of information technologies and environmental issues (Son 2015: 127–8), and also the global knowledge economy (Johnston 2008: 22). Since the 1990s, foresight has been increasingly applied to address these issues. Foresight has been important not only to the futures field but also to other domains, such as strategic policy intelligence (Salo and Cuhls 2003), corporate concerns, and for future technology analysis (Son 2015: 128; Cagnin and Keenan 2008; Johnston 2008).

Son observes a trend of fragmentation, the “lack of disciplinary consensus on futures studies as well as the diversity of futures studies” (Son 2015: 128). This lack of disciplinary consensus is evident in the various attempts over the past years to provide a theoretical foundation to the field (see chapter 5). The current phase of futures studies, defined to a large extent by foresight, is also characterized by various controversies about the status of the futures field per se. While there have been essential contributions to the epistemology of futures studies, for example, by Wendell Bell (2002, 2003, 2004), other scientists like Michael Marien (2010, 2002a, 2002b) offer convincing arguments against

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[46] The commonalities and differences between forecasting and foresight are discussed in more detail in chapter 3.

[47] See, for example, the series *Developments in Environmental Modelling*, published since 1981, especially volume 22, “Environmental Foresight and Models: A Manifesto” (Beck 2002). On social foresight, see especially Slaughter (1996, 2006). However, both Slaughter and Son see deficiencies in futures studies due to the rise of foresight, which Son captures with the concept of neoliberalism. Son states that “The dominance of foresight in futures practice somewhat reflects the impact of neoliberalism on the field. Foresight results in part from the politicization of the neoliberal values in futures studies for serving policy preferences and specific interests even though it is the response to the lack of the practical application of futures studies. Slaughter believes that futures methods are used superficially and limitedly and the emergence of strategic foresight suggests the need for an applied focus in futures studies” (2015, 128).

treating futures studies as a distinctive scientific field.[48] His critique is justified: for example, (a) there a still conceptual confusions concerning futures studies and the overlap between forecasting, foresight, future technology analysis and technology assessment; (b) there are parallel schools that use different methods for the same purposes, or vice versa; (c) there are concerns regarding the scientific and epistemic validity of the field; (d) there are epistemic concerns about forecasting that are still present in the foresight community; and (e) there is the "problem of weak and secondary identity" (Marien 2010: 192), since most scientists and researchers in the field have different scientific backgrounds, and 'futurist' is still not a protected term for a profession.[49]

That being said, the futures field is witnessing more foresight projects today than ever before: these involve public and private foresight institutions, and a variety of scientific journals and conferences (see chapter 7). At present, the discourse on foresight is shaped primarily by concerns about quality and validity standards (Gerhold et al., eds. 2015), participatory issues and forms of knowledge creation (Dufva 2015; Amanatidou 2011; Kaivo-oja 2016) and the use of new technologies in knowledge and information processing (Kayser 2016).

2.4 Foresight, TA and FTA – the fuzziness of futures terms

In the preceding section, I touched upon some of the unclear and ambiguous terminology. Today, the terms futures studies, futures research and foresight are often used synonymously. This is an indication not only of their vagueness, but also of their diverse discursive and disciplinary purposes (Sardar 2010). For example, Bell defines in a very general way that "[t]he purposes of the futures studies are to discover or invent, examine or evaluate, and propose possible, probable and preferable futures" (Bell 2003: 73). Kuusi et al. clarify the specific differences as follows:

[48] It should be noted that Marien not only holds a radical view on the field of futures studies, but also acknowledges that tools are needed to look into the future to help today's decision-making processes with regard to global problems: "Futures studies should be seen as the grossly underdeveloped multi-disciplinary clearinghouse for all futures-relevant Information on world and national problems, regardless of whether the 'f-word' is used, and it should be organized to fulfill this potential, similar to the continuously operating surmising forum proposed by Bertrand de Jouvenel in 1967 or the 'world brain' organization advocated by H. G. Wells in 1937" Marien (2010: 194). The 'f-word' means 'field' in this context. Sardar (2010) also questions the independence of futures studies as a scientific discipline.

[49] Marien points out that there are more "futurized specialists" than "specialized futurists" worldwide, with a ratio of 10-1 (2010: 192).

> *Futures studies* refers to all kinds of approaches studying the future or futures. The concept foresight has a similar broad content though the foresight stresses more the pragmatic side of the futures studies and is defined as a systematic debate about different futures . . . .
> We reserve the concept futures research for those futures studies that are looking for pragmatically valid knowledge concerning possible futures. (Kuusi et al. 2015a: 61)

Miles et al. emphasize the networking aspect of foresight:

> The term [foresight] refers to approaches to informing decision-making, by improving inputs concerning the longer-term future and by drawing on wider social networks than has been the case in much "futures studies" or long-range planning. (2002: 33)

According to these definitions, foresight in the field of futures studies is an approach that builds upon wider social networks, promotes systematic debates about the future and is conducted pragmatically. Futures research describes concrete activities that aim at creating futures on the basis of valid knowledge.

A parallel and related development, which has thus far gone unmentioned, is that of technology assessment (TA). The purpose of TA is to "assess the potential and implications of emerging future technologies" and it is basically used in the context of parliamentary activities (Johnston 2008: 21). Following Grunwald (2010: 87–91), the classical approach to TA discussed in TA literature is shaped essentially by six elements and purposes, which have either been further developed or rejected and abandoned:

(1) TA as policy advisory. The classical concept reserves TA for policy advisory; it is seen as a governmental task and competence to rule and organize society. Citizens, the public or the economy are not seen as potential addressees. In recent years, following the idea of deliberative democracies, TA has been developed further with participative processes (see Grunwald 2010: 91–9).

(2) Decisionism. Following the ideal of value-free science, TA was first understood as a task based upon pure factual knowledge about the impact of technology – decisions should be made by politics. However, it has been recognized that TA also raises ethical questions and cannot be treated in isolation from normative considerations.

(3) Expert-TA. Initially, TA was perceived as an area in which only technological and TA experts can make a meaningful contribution. The need for experts is still present, but also the need to open TA towards participative approaches in order to include all concerned parties.

(4) Systems view. Systems analysis is a crucial part of TA, as it reflects the interdependencies between technologies, users, the environment and other affected areas.

(5) Scientism. Similar to forecasting, in early TA it was believed that the future impact of technologies can be forecasted and calculated accurately. However, this

approach has been abandoned because the impact of technologies on society can hardly be described adequately by models and forecasts. TA also implies intervention and thus self-fulfilling prophecies. The strand of scientism has been developed further to a co-evolutionary theory of technological progress (see Grunwald 2010: 99–103).

(6) Technology determinism, to which the state may adapt by means of TA. This approach is no longer pursued since being rejected by research in the social sciences.

One should keep in mind that there have always been gaps between theory and practice of TA, as TA activities have never been conducted in strict accordance with the classical definitions (Grunwald 2010: 87). As can be seen in the six points, there has been a shift in TA – similar to developments in futures studies more generally – towards participatory approaches, which have put in question the notion of a value-free ideal and the role of experts. In the next chapter, I will argue that similar developments have taken place in the shift from forecasting to foresight and that the paths of TA and futures studies are intertwined. Since the 1970s, that is, since the establishment of the OTA (Office of Technology Assessment)[50] in the United States, TA has been rapidly adapted and institutionalized in other countries, too. In Germany, for example, TA is mainly repre-

[50] In a recent paper, Sadowski sketches the history and impact of the OTA (2015). The term 'technology assessment' was first used by the Science, Research and Development Subcommittee of the House of Representatives Committee on Science and Astronautics in the late 1960s. In 1968, Emilio Daddario, chair of that Committee, gave the following definition of TA: "Assessment is a form of policy research and is not technological forecasting or program planning. It is a balanced analysis of how a technological program could proceed with the benefits and risks of each policy alternative carefully described. It incorporates prediction and planning but only to expose the potential consequences of the program. Assessment is an aid to, and not a substitute for judgment. Technology assessment provides the decisionmaker with a list of future courses of action backed up by systemic analysis of the consequences" in: Pot (1985: 916).

sented by ITAS and TAB,[51] as well as an active community maintaining a network and sharing TA knowledge, for example, by the networks openTA and Netzwerk TA[52]. However, Johnston notes that, while technology assessment activities are still prominent in German-speaking countries,[53] and also institutionalized in several of European governments, the term itself has almost vanished. TA groups from different states are involved in developing a framework for TA for the European Parliament within STOA and EPTA, the European Parliamentary Technology Assessment (Johnston 2008: 21).[54]

The close relation between TA and futures studies is also visible in other recent approaches to the future: TFA, Technology Futures Analysis (Technology Futures Analysis Methods Working Group 2004), which later became FTA, Future-oriented Technology Analysis supported by literature, practice reports and conferences (Cagnin et al., eds. 2008, 2008; Loveridge and Saritas 2012; Marinelli et al. 2014). Technology Futures Analysis Methods Working Group (2004) aimed at presenting a concept that encompasses the many methods and practices used for technology-oriented forecasting.

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51 Institute for Technology Assessment and Systems Analysis (ITAS), founded in 1995 and now a research facility of the Karlsruhe Institute of Technology (KIT), is the largest German scientific institution dealing with TA (http://www.itas.kit.edu/english/institute.php). ITAS also runs the TAB, the Office of Technology Assessment at the German Bundestag, which is an "independent scientific institution created with the objective of advising the German Bundestag and its committees on matters relating to research and technology" (http://www.tab-beim-bundestag.de/en/index.html). Also involved in TAB are the Helmholtz Centre for Environmental Research GmbH (UFZ, http://www.ufz.de/index.php?en=34253), the Institute for Futures Studies and Technology Assessment GmbH (IZT, https://www.izt.de/en/), and the Innovation + Technik GmbH (VDI/VDE, https://vdivde-it.de/en). ITAS also publishes the scientific journal "Technikfolgenabschätzung – Theorie und Praxis" (TATuP) discussing TA projects and literature (https://www.tatup-journal.de/). Nevertheless, TA and FTA activities are also conducted by other German research institutions, such as the Fraunhofer Institute for Systems and Innovation Research (ISI) in Karlsruhe (http://www.isi.fraunhofer.de/isi-en/index.php), the IZT, and the EA European Academy of Technology and Innovation Assessment GmbH (http://www.ea-aw.org/).

52 OpenTA aims at fostering information, communication and cooperation within the TA community; see http://www.openta.net/home. NetzwerkTA, founded in 2004, is a network of TA researchers and practitioners from Germany, Switzerland and Austria. Their aim is to support cooperation and to foster TA in science, society, policy and economy; see http://www.openta.net/netzwerk-ta.

53 In Switzerland, TA is stipulated in the federal law; TA-SWISS, the Centre for Excellence of the Swiss Academies of Arts and Sciences, has been conducting TA activities since 1992. (See https://www.ta-swiss.ch/). In Austria, the Institut für Technikfolgenabschätzung (ITA) is the leading TA institution, founded in 1995. Precursor of ITA is ISET, a working group for TA founded 1985. On the history of Austrian TA, see Peissl and Nentwich (2005); see also http://www.oeaw.ac.at/ita/home/.

54 On its website, the EPTA describes its purpose as follows: "The currently 20 members of EPTA give advice to their parliaments on topical issues such as nanotechnology, brain research, road pricing or future energy systems. Their projects use various methods and draw on insights from citizen panels, stakeholders, workshops as well as the foremost experts in the relevant fields" (http://www.eptanetwork.org/).

Moreover, while various FTA methods are being actively employed with greater frequency, there is “little systematic attention to conceptual development, research on improved methods, methodological choice, or how best to merge empirical/analytical methods with stakeholder engagement processes” (Scapolo 2005: 1060). However, in a related seminar, a crucial shift took place, as ‘TFA’ became ‘FTA’ (Johnston 2008: 17). Scapolo explains the purpose of the FTA as a new collective term as follows:

> In addition, the idea was to analyse possible overlapping fields of practice among technology foresight, forecasting, intelligence, roadmapping, and assessment. The diversity among these disciplines reflects the complexity of demands for FTA relating to differences in scope (geographic scale and time horizon); relationship to decision making, the extent of participation; the purpose of the analysis (awareness raising, envisioning, consensus building, corporate technology planning, etc); the reliability of source information; and so on. (Scapolo 2005: 1060)

This description summarizes the purposes and methods used in TA and foresight. It also shows that certain points, like the reliability of sources and the degree of participation, are driving issues today for all FTA approaches. For this reason, I will not attempt in the subsequent chapters of the present work to clearly distinguish literature on foresight and epistemic considerations from other related work in the FTA field.

Finally, all contemporary forms of thinking about the future are tied to scientific and technological progress and thus reflect specific ways of dealing with the future. For example, Grunwald highlights that the systemic inquiry into the impact of scientific and technological developments lends support to TA, but also related fields such as ethics of science and technology, risk research, STS-studies, ELSI and EHS research (2015: 65). Foresight, however, has a more practical orientation. It aims at treating the future as an open space of alternative possibilities, which have to be debated in an open, discursive and transdisciplinary manner in order to devise plans of action that may be applied today and which satisfy the needs of those affected. In the next chapter I will discuss in more detail the specific characteristics of foresight, especially its differences with forecasting.

3. What is Foresight?

This chapter clarifies what foresight is, firstly, by showing the similarities and differences between forecasting and foresight. Secondly, I will outline the main characteristics of foresight, and then in section 3.3, I will examine foresight methodologies: the way foresight methods are selected, the relations between qualitative and quantitative methods, and finally the structure of typical processes in foresight exercises.

3.1 Forecasting as a precursor of foresight

While in section 2.3 I sketched the historical development of futures research, the aim of the present chapter is to show in greater detail how some basic aims of foresight are founded in the forecasting era, and how the crisis of futures research led to insights that motivated the transition from forecasting to foresight.

3.1.1 Forecasting technological change for planning and decision making

As indicated in the preceding chapter, the evolution of forecasting is closely related to the technological, socio-economic and political reality, on the one hand, and the prevailing concept of the future on the other. Initially the need for technological forecasting emerged from technological change.[55] The development of technological forecasting during the 1940s and 1950s is summarized in the following quotation by (Jantsch 1967):

> Technological forecasting emerged as a recognised management discipline around 1960; its modern form has gradually taken shape since the first attempts were made in the mid-1940's to attain "informed judgment" through systematic and comprehensive evaluation; it has been adopted on an increasingly wide scale in industry, research institutes and military environments since the late 1950's. (Jantsch 1967: 17)

Jantsch describes the development of technological forecasting as a tool for assessing technological change by exploring the future. In the 1960s and 1970s technological forecasting is used as an instrument to regulate technological change mainly in the context of industries, companies and national defense. Forecasting from that period has a

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[55] In this paper Schon describes the difference between forecasting per se and technological forecasting.

strong technocratic character, which is not surprising, considering that forecasting tools originally came from the military (Wills 1972: 11). Gordon Wills explains the need for technological forecasting in the private and economic sector as follows:

> Traditional products, skills, materials and production facilities may become obsolete within a short span of years, and in some cases just a few months, with the results that many thousands of businesses will rise or fall on their ability to respond effectively to an accelerating technological challenge, affording both threats and opportunities. (Wills 1972: 37–8)

In his 1967 paper, Donald Schon defines technological forecasting as “the forecasting of technological change” (1967: 759). Watts and Porter similarly define technological forecasting as an activity “to provide timely insight into the prospects for significant technological change” (Watts and Porter 1997: 25). According to Schon, in the strict sense, a technological forecast “is the forecast of the invention, innovation, or diffusion of some technology” (Schon 1967: 759). But he also stresses that technological forecasting entails forecasting various technology-related aspects, one of which is technological change.[56] Another position describing the need for technological forecasting due to technological change is given by Wills:

> The major significance of technology from the human standpoint is in its ability to make human effort more effective and harmonious. Accordingly, the firm must be able to assess the impact on society of technological progress. Progress that is incongruent with human values, as a result of a lack of technological foresight, is the outcome of a false sense of security about the effects of technological change. (Wills 1972: 38–9)

According to Wills’ argument, a technology of interest is primary in forecasting activities, whereas human and societal factors are secondary, considered in relation to the technology. Take as an example the forecasting activity of a company: Besides the societal impact, technological change may have a significant environmental impact. Besides technology, other factors that have to be taken into account by forecasting are domestic business, the world business climate, competitive action, customer characteristics, distribution, supplier behavior, the social and political climate, and government action (Wills 1972: 48). Forecasting should analyze these societal and environmental factors.[57]

However, technological forecasting can be applied to various areas and the experts and scientists who apply forecasting have different scientific backgrounds. Accordingly, it is characteristic for forecasting to be borrowing a variety of methodological tools and techniques from different scientific disciplines (Cuhls 2003: 94). Makridakis and

[56] According to Schon this includes, for instance, the forecasting of growth or employment in technology-related fields such as “industrial corporations, banks, investment firms, labor unions and government agencies” (1967: 760).

[57] Schon also notes that “technological change is so closely linked to social and economic factors that no prediction about the one can be made without assumptions, implicit or explicit, about the other.”

Wheelwright state that forecasting is “the domain of psychology, sociology, politics, management science, economics and other related sciences” (Makridakis, ed. 1982: 3). Hence, each of these disciplines contributes with its research methods in shaping forecasting tools and methods. Quantitative and qualitative approaches still characterize today’s future looking methods, but there has been a shift from a mere parallelism of methods to combinations and methodological mixes (Cf. Cuhls 2003: 94). Due to its methodological complexity, technological forecasting may assume different forms. For example, depending on the field of application and the purpose of a given forecasting activity, technological forecasting may be performed in either a normative or explorative way.

Also how the future is conceived plays a decisive role in forecasting. Progress is still believed to be linear and the future predictable. Wills, for example, admits that technological changes and innovations may have an adverse effect on society and business, but insists that in general innovations can be planned and managed by forecasting. He states:

> Planning the future involves predicting the decisions that policy makers must take. (Wills 1972: 37)
>
> None the less, only by forecasting expected future conditions can progress in the multifarious dimensions of modern life be effectively planned. (1972: 39)

And further:

> The alternatives from which management must choose for future development are largely technology-determined, and the choice between several types of logical futures and decisions is often subordinated to technological ends. (1972: 40)

These quotations capture in a nutshell the way forecasters conceive of the future: the future can be predicted by managerial tools of forecasting, which means the future can be planned. The planning credo is a result of a technocratic worldview. Up to the 1970s, forecasting methods were primarily developed and used in order to forecast one single future.[58] Even scientists using the scenario method at the end of the 1960s accepted the paradigm of the one single future that they believed to be able to correctly forecast (Cf. Cuhls 2003: 94). As Cuhls states, “a ‘correct’ prediction was the only criterion for forecasting and futures research” Cuhls (2003: 94). Their concept of the future has had a major impact on the way forecasting and futures research is conducted. Seen methodologically, this concept of the future has many limitations. For example, after the unforeseen oil shock in 1973, scientists started to realize that the future cannot be predicted entirely, as there will always be, alongside the events we can anticipate quite well with forecasting methods, also those that we cannot predict (Cuhls 2003: 94). In fact, already

[58] Cf. Cuhls (2003: 94). Cuhls describes these attempts as “single future approaches”.

in the 1960s, some authors recognized the need for multiple futures, for example, Jouvenel (1965) with his concept of futuribles. But it took almost another 25 years before the paradigm of multiple futures became established with the concept of foresight (Cornish 1969: 135).

3.1.2 The limits of forecasting

Different limitations to forecasting have been identified over the past decades, some of which have been resolved by the introduction of foresight – however, other limitations affect foresight, too. There are, for one, limitations which forecasting theorists and practitioners noted from the outset; but there are also limitations that were identified later by evaluations of forecasting practices. In their forecasting theories, authors point out numerous forecasting challenges and also propose solutions (Wills 1972; Martino 1983; Schon 1967; Makridakis and Wheelwright 1989). A central concern of forecasters is the fact that forecasts may turn out to be wrong. Wills sees forecasting to be limited for the following reasons (1972: 44):

a) discrete technological advances may lead to unpredictable interactions and thereby create unpredicted potentialities,
b) future conditions may cause unforeseeable demands,
c) the discovery of totally new phenomena may prove forecasts wrong as well as
d) the inadequacy of source data.

While Wills mainly focuses on factors that may evolve by unforeseeable future developments, Schon discovers methodological problems on an epistemic level (1967: 765–8):

a) “lack of appropriate, uniform, complete, credible and timely data”
b) no clear theoretical understanding of technological change, which means the field of research itself
c) probability and accuracy
d) danger of a “self-fulfilling prophecy”

Both Wills and Schon recognize the importance of data for the quality of forecasting activities. According to Wills, the limits of forecasting are determined by the unknowable factors that belong inherently to forecasting, whereas Schon emphasizes the impact of the methodology, indicating the need for a holistic theory that reflects the different views on technological change (Schon 1967: 766). The third point concerns the scientific basis of forecasting, and the fourth is directed at sociocultural constructions of the future (Schon 1967: 767). Despite its limitations, forecasting is needed in order to make decisions that will have a future impact on politics, business or industry. Schon recognizes that, in view of the complexity and impact on society of social, cultural and technological trends, forecasters are confronted with a volume of information that they can hardly handle alone. Schon notes:

> The complexity of interacting trends, the cultural spell that determines our sense of predictive relevance, the self-fulfilling character of public forecasts – all confront the forecaster with more information than he can handle. (Schon 1967: 770)

Further, he suggests that the possible solutions for this challenge

> may take the form of a new rationalism, a drive toward ever more complex simulations of real-world processes. Or it may take the form of increasing concern for skill in the *process* by which insights about the future can be used and unanticipated events responded to. (Schon 1967: 770)

There has indeed been a shift to more complex modeling in the historical evolution of technological forecasting, and in the shift to foresight the response to “the unanticipated events” has gained in importance. But one must also emphasize that these efforts of improvement were not adopted or invented by ‘the’ forecaster. Forecasting and especially foresight practices are conducted mainly by groups (see Karlsen and Karlsen 2007). In this context, the “self-fulfilling character of public forecasts” relates to the assumptions of a certain project team. Yet there is also need to take a closer look at the cultural environment of the people engaged in forecasting or foresight exercises, especially in view of the assumed self-fulfilling prophecy of forecasts. This prophecy may also be interpreted as an indication that today’s decision making can influence the future. The danger of self-fulfilling prophecies is converted to a methodological strength in the foresight era: If we can anticipate alternative futures, we can also choose the future we want and align our decisions and roadmaps in accordance with it.

Retrospectively, the results of the evaluation conducted by Coates et al. in 1994 show different methodological and practical limitations. In their *Project 2025* they summarize the shortcomings of forecasting by reviewing a series of 1500 forecasting exercises of 54 research areas in different countries.[59] By the mid-90s, Coates et al. state that forecasting is underdeveloped. The overall conclusion of their study is that forecasting “was better developed in the 1960s and has decayed in methodological quality and substan-

[59] Coates et al. (1994) The evaluation considers forecasts in 54 scientific and technological areas conducted since 1970. Its focus was global, and it was limited to formal forecasts developed in the context of research agendas and critical technology agendas. Corporate forecasting was not considered in this study.

tive content" (Coates et al. 1994: 23).[60] The findings of the study draw a very uneven picture of forecasting. There are methodological differences between different fields of research, but also in the different states where forecasting is used. The main observations, which may also be seen as limitations, are the following:[61]

- Too narrow view. Despite the claim in forecasting theories that environmental issues also have to be considered in order to forecast a technology, the study reveals that technology forecasts are generally too narrowly focused on specific aspects of a technology. Forecasts analyzing a whole field, or for example, social contexts, are rare.
- One-sidedness and consensus. Coates describes this dependency as follows: "In close-knit fields, forecasts show a great deal of consensus. . . . So there is some danger that a tightly-knit field misses the broader possibilities because they only read each other's work" (Coates et al. 1994: 24).
- Careless procedures. A frequent limitation of forecasting studies is that documentations are inaccurate or simply missing.
- Unclear labeling. Many studies and articles that discuss the future do not use forecasting methods (especially by with catch phrases like "past, present, future" or "yesterday, today, and tomorrow") (Coates et al. 1994: 24).
- Continuity before change. Some specialists favor a model of continuity over a model of potential change.
- Lack of future studies knowledge or methodological knowledge about forecasting. (Coates et al. 1994: 24)
- Visionaries' bias. This concerns especially technology enthusiasts, who "see their technology as the one that will be the hottest new thing in the years ahead" (Coates et al. 1994: 24).
- Different forecasting cultures. While the use of normative forecasting is limited in the U.S., it is commonplace in Japanese forecasts to set goals and directions by normative forecasts. This statement indicates that futures research cultures vary from country to country.
- Methodological misuse. The authors also found out that "Forecasting too often mixes technological and market forecasting" (Coates et al. 1994: 24). This is not necessarily a pitfall, since learning from other disciplines also enables the improvement of

[60] Other lessons learnt from forecasting can be found in Godet (1994: 29–37). The four fields where the deficiencies of foresight become visible are the following: a) the vague definitions in the futures field; b) the use of inaccurate data and models; c) the excessive use of quantification and extrapolation (the misuse of extrapolative tools for volatile topics, e.g. with a high socio-political impact); and d) "the future explained in terms of the past" (1994: 36), that is, the extrapolative way of focusing on one single future rather than using the multiple futures perspective.

[61] All these points are discussed in Coates et al. (1994: 24).

forecasting methods. Nonetheless, it fosters terminological confusions concerning methods and application fields.
- Differences in quality between research areas. According to the study, the quality of the forecasts is best in aerospace, information technology, manufacturing, and robotics, whereas forecasts in economics, social sciences, physics and basic mathematics show poor quality (Coates et al. 1994: 24).

Besides these observations up to 1994 on the status of forecasting and its limitations, the authors also came to the conclusion that forecasting activities declined during the 1970s and 1980s (Coates et al. 1994: 24). Because of failing forecasts, for example, about growing economic growth, energy demand or high-tech products, the various forms of future studies have lost their credibility (Cuhls 2003: 94; Steinmüller 2012: 15).

3.2 The characteristics of foresight

Following the decline in forecasting research in part due to the limits described in the previous section, the foresight approach was not launched as an entirely new concept. Grupp and Linstone, for example, emphasize the connection between foresight and previous futures studies: Foresight takes up strategies, methods and experiences from the field of future thinking, and attempts to improve upon the shortcomings of forecasting (Grupp and Linstone 1999: 87).[62] According to Slaughter, foresight is used for "opening to the future with every means at our disposal, developing views of future options, and then choosing between them" (Slaughter 1995: 1). Cuhls claims that foresight activities open and structure debates about the future, disclose needs, possibilities, opportunities and (un)desirable futures, and also enable long-term thinking and decision making (Cuhls 2015, 2012). Foresight differs from forecasting and other futures activities with regard to its distinct means and ends:

(1) a new definition of the purpose of its own field and new application areas
(2) the adoption and advancement of existing forecasting methods,
(3) a shift from a single to a multiple-futures-approach and, finally,
(4) the introduction of new time horizons in future thinking.

[62] Before examining these novelties in detail, one should take not that the seemingly smooth transition from forecasting to foresight and the actual differences between these two approaches were already worked out in a research project in 1983. Martin describes in detail how the Advisory for Applied Research and Development set up a study in 1983, finally known as Project Foresight, in order to evaluate commercial benefits of long-term and strategic research of the past 20 years in different countries, especially by examining the role of forecasts; Martin (2010: 1439). Martin admits that, despite its title, this exercise was rather a project in hindsight.

3.2.1 New purposes and application areas

During the 1980s, the futures research community understood that "the focus of planning has changed from forecasting accuracy to responsiveness to change" (Slaughter 1995: 82). The importance of this insight is twofold: first, the shift away from accuracy in forecasting makes room for multiple futures (see next section), and second, it emphasizes shifting the aim of the field to understanding the forces which shape decision making today and events in the distant future (Martin and Irvine 1989: 4). However, the task of understanding can only be achieved in a procedural way. Hence, as Cuhls argues, in contrast to forecasting, foresight emphasizes the process of understanding future options and providing a structured debate: "foresight is conducted in order to gain more knowledge about things to come so that today's decisions can be based more solidly on available expertise than before" (Cuhls 2003: 97).

Both foresight and forecasting aim at "changing the present to fit the image of the willed future" (Wills 1972: 40). But each pursues this aim differently. The forecasting era was strongly technocratic, whereas the foresight era places more emphasis on social and environmental factors, even when analyzing a specific domain based on technological progress. Foresight thus concentrates on specific areas in academia, business or policy. In each case, technologies may play a role, but they are not necessarily the key factor. Foresight is concerned with all STEEPV[63] issues, that is, with social, technological, economic, environmental, political and values-based issues (Loveridge 2009b: 49). Hence, the impact of STEEPV in futures research in general is twofold: As social and technological progress takes place in socio-cultural environments, STEEPV issues are needed not only in the present as a source of information; they also form the future frame for propositions, assumptions, scenarios and models (see also acatech 2012).

Accordingly, the foresight approach to futures thinking is also reflected in the different strands of foresight, for example, strategic and corporate foresight (Hines and Bishop 2006/2015; Müller and Müller-Stewens 2009; Kuosa 2012), regional foresight, national foresight and foresight for policymaking (Da Costa et al. 2008; Yoda 2011; Gertler and Wolfe 2004; FOREN 2001). In the literature on technology foresight, partly also technological foresight, the term is often used synonymously with foresight (Grupp and Linstone 1999; Linstone 2011; Martin 2010; JRC-IPTS, ed. 2004; Georghiou 2008; Porter 2010). Since technology foresight uses a systematic approach to a technological field and involves experts from technology fields, it exhibits similarities to technology assessment. But the concept of technology foresight differs from technology assessment, according to Kuosa, in that it is concerned with longer time ranges and the emphasis is

[63] In foresight practice, the acronym STEEPV is also used as a brainstorming method to initiate discussions about the future in a structured way.

on alternative futures rather than a systematic planning approach (Kuosa 2012: 6). Besides the application fields, other foresight approaches indicate the relation between their procedural and methodological focus and other disciplines such as social foresight (Slaughter 2006), participative foresight processes (Cuhls and Georghiou 2004; Cuhls 2004; Guillo 2013), foresight for research and innovation policies (Weber et al. 2016; Martin and Irvine 1989; Cassingena Harper and Georghiou 2005; Andersen and Andersen 2014) or foresight and systems thinking (Loveridge 2009b; Saritas 2004). However, the specifications of foresight styles only indicate differences in application fields and methodological approaches – the basic definition of foresight is the same.

3.2.2 Methodological advancement

Reasons for the emergence of foresight do not lie merely in the historical circumstances, which revealed the inadequacy of forecasting methods, but also in the research landscape, which was employing diverse methodological sets in futures research. Martino points out that during the 1990s “there have been some significant developments in technological forecasting methodology” (Martino 2003: 719). While the forecasting community lost credibility as it was failing to predict the future accurately, these methodological advancements were more successful when embedded in a foresight context. The methodological advancements are strongly linked to the newly defined purpose pursued by the foresight approach, namely, adequate decision making. Grupp and Linstone describe the need for methodological adjustment in order to meet the purpose of foresight as follows:

> [In foresight] [a]ttention is given to the feedback process between capability and need which must be linked in timely fashion for decision making. The traditional tools of forecasting, such as trend exploration, are appropriate during any stable phase but inherently fail in chaotic phases. The emphasis on communication phases [in foresight] increases our ability to respond capably to any anticipated situation and, in particular, to effective crisis management. (Grupp and Linstone 1999: 87)

In fact, foresight has no “clear-cut methodological repertoire” (Grupp and Linstone 1999: 87) but it has been profiting from new methodological advancements especially in the 1980s – called both forecasting or foresight methods – and combines available advancements. According to Grupp and Linstone, “[t]echnology foresight combines analysis and communication processes in which informed parties and stakeholders participate in a forward-looking exercise” (Grupp and Linstone 1999: 87). It is thus not suprising that foresight is mainly conducted by qualitative rather than quantitative methods. In the 1990s, the delphi-method is a preferred tool in foresight (Grupp and Linstone 1999: 87), but in the past decade, scenarios, expert panels and literature reviews have been playing an increasingly important role (Saritas et al. 2014: 6). In a recent paper, Saritas et al. analyze the evolution of foresight methods by using a bibliometric approach and conclude the following (Saritas et al. 2014: 15):

- Traditional methods remain reliable tools, but the way they are practiced has evolved: they are increasingly accompanied by other emerging tools, especially quantitative ones.
- There is a greater tendency towards the integration of qualitative and quantitative methods by employing participatory and creative aspects of qualitative methods, while exploiting the power of analysis, evidence generation and modeling of quantitative methods.
- The scope and focus of foresight exercises influence the method selection and integration. There are regional differences in foresight practices and variations in the use of methods due to different framework conditions such as policy making culture, priorities and visions.

This brief evaluation of the state of foresight methodology indicates that the field of foresight, is inherently dynamic as it responds to the domains in which it is applied.

3.2.3 Multiple futures

The multiple futures perspective is an essential characteristic of foresight. The plurality of futures was discussed in the late 1960s and 70s, for example, with Jouvenel's concept of 'futuribles" (Jouvenel 1964/1967) and Jungk, ed. (1969) with his overview of alternative futures.[64] However, up to the 1980s, futures research and forecasting projects did not make conceptual use of multiple futures. This changed with the transition from forecasting to foresight.

In section 3.1.1, it was suggested that the aim of forecasting is to acquire information about the future, to plan in light of this information and to shape technological change. Such an approach conjectures a linear view of the future. Increasing use of forecasting for futures research in areas with a high social, environmental or political impact show the deficiencies of the single-future approach (Masini 2010: 187). Masini puts this point as follows:

> [A]fter the impact of various historical events such as the oil crises, many alternative futures had to be considered, and not just one. The consequence was that futures derived only from trend extrapolation were not sufficient. (Masini 2010: 187)

[64] *Menschen im Jahr 2000*, published in 1969 by Jungk, provides 29 different futures scenarios written by scientists and futurists. Although using the term futures, the scenarios are self-contained future images without mutual references or joint action plans and recommendations.

When forecasting must go beyond the forecasting of calculable, mathematical events, results become vague and volatile. Forecasting methods have also been used for creating multiple futures (e.g. by using scenario techniques). But as Cuhls observes, “[f]orecasting normally ends with the identification of the possible futures” (2003: 95). In contrast, in foresight “networking and cooperation in identifying future options” is as important as the forecasting task itself (2003: 96).[65] The multiple futures perspective is a crucial part of foresight activities because it helps place different futures in relation to present needs. Hence, scenario techniques are the most commonly used methods in foresight activities (Mietzner 2009; Mietzner and Reger 2005).

3.2.4 The time span

During the period of extensive forecasting exercises, the foresight aspect of forecasting is seen as a lack of quality. Wills even states that this can be avoided by “extrapolative interpretations of the future with normative forecasts” (1972: 39–40). This emphasizes that the explorative function of foresight was seen to be a hindrance to effective forecasting. This perception changes with the methodological advancement and the multiple futures approach. In their forecasting study, Coates et al. state that from the 1970s to the 1990s there was an “increase in the time horizon in futures research” (1994: 29). There is no clear evaluation of the development of analyzed timeframes for recent years. Furthermore, the literature about time spans in foresight is not entirely consistent. According to Rader and Porter (2008: 28), the time horizon for foresight is “typically 30 or more years”, whereas Kuosa states that foresight pursues time ranges starting from at least 10 years away (2012: 6). Yet Cuhls’s analysis from 2008 of international technology foresight activities shows that in practice the time span ranges from 5 to 30 years, or even longer, depending on the subject, its relatedness to R&D or political questions. For example, foresight in the field of energy is more suitable for time spans of 30 years, as transformation processes take longer in this field; by contrast, in the field of ICT even a time horizon of 10 years is considered long term due to shorter innovation cycles (Cuhls 2008: 151).[66]

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[65] Cuhls argues further that this foresight approach including networking and cooperation is especially needed in European foresight networks, e.g. to set up research agendas, see Cuhls (2003: 95–6).

[66] See also Martin (1995: 159).

3.3 Using foresight

As remarked earlier, foresight tools may be considered advanced forecasting tools. There are two reliable sources which provide up-to-date descriptions of foresight methods: first, the European Foresight Platform EFP,[67] and second, the *Futures Research Methodology* by Glenn and Gordon, eds. (2009).[68] Both sources are being updated steadily by foresight researchers. For the purpose of the present work, emphasis will be placed on the interrelation and evolution of the different methods. In this way we can ses the epistemic difficulties of foresight, which are also rooted in the variety of scientific backgrounds of the methods.[69] A foresight exercise needs to be designed individually as it may be applied for different purposes and in different contexts. This relates to the level of application (organizational, regional, national), but also to the topic and expected outcome. The selection of foresight methods varies from case to case because of different requirements that need to be taken into account. In the following sections, I will describe the selection, interrelation and methods used in foresight.

3.3.1 Selection of foresight methods

The selection of foresight methods varies and depends to a large extent on the aims that are pursued. Based on an evaluation of international foresight activities, Cuhls (2008) has summed up the methodological framework of foresight in accordance with four polarities: a) the distinction between explorative and selective approaches, b) short-term versus long-term c) analytic versus participative methods and d) thematically comprehensive versus sectoral.

a) *The distinction between explorative and selective approaches*

Explorative approaches aim at finding alternative future options in an open manner, whereas selective approaches follow a strict set of priorities for outlining future paths by screening and evaluating. Cuhls sees a strong tendency in foresight projects to combine these two approaches. The more explorative the approach, the stronger the tendency is towards using creative approaches or scenarios. By contrast, selective approaches work with statistical analyses, roadmapping or matrices.

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[67] See http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/.

[68] This work is a result of the Millennium Project, an international futures research think tank; see http://millennium-project.org/millennium/overview.html.

[69] The most frequently used foresight methods are summed up in the glossary at the end of this work.

b) Short-term versus long-term

The second set of polarities for choosing the appropriate methodological mix depends on the time horizon chosen in the foresight exercise. Monitoring and trend analyses are helpful for short-term tasks, whereas modeling and simulations may deliver future assumptions for time frames of 30 years. But many methods can be applied to any time frame. This applies especially to those methods based on creativity or judgment, using interviews, expert opinions and workshops, panels, delphi techniques or scenarios.

c) Analytic versus participative methods

Foresight methods may also be selected based on their analytic or participatory character. Most methods are analytical and have their roots in forecasting, such as risk, causal or economic analyses, matrices, modeling and simulations or monitoring. They are best suited to tasks with a narrow thematic scope. By contrast, participative methods build upon expert and public opinions, and are thus used in participative TA projects in the form of workshops and panels. In general, participative methods can be defined as more qualitative, and analytic methods as more quantitative. But each type is seldom used alone. Roadmapping and scenario development, for example, can be assigned equally to analytic and participative methods. Developing roadmaps and scenarios allows a methodological flexibility within the single steps to integrate different methods like economic analyses and also workshops.

d) Thematically comprehensive versus sectoral

A final distinction can be made in relation to the scope of the topic. Methods like trend analysis and statistical analysis yield significant results for foresight tasks that focus on a specific sectoral topic. If the topic is thematically comprehensive and broad, surveys, scenarios, monitoring and creative approaches can help to bundle the topic and formulate assumptions about complex futures. These four polarities are depicted in Figure 1.[70] When designing a foresight exercise, an anchor is set on these four dimensions, depending on the project's objectives.

[70] This figure has also been presented in a poster at the conference PACITA, Berlin, 25 to 27 February 2015 (Shala, E. / Kayser, V. (2015): Rethinking the Information Base of Foresight: More Balance by new Tools?).

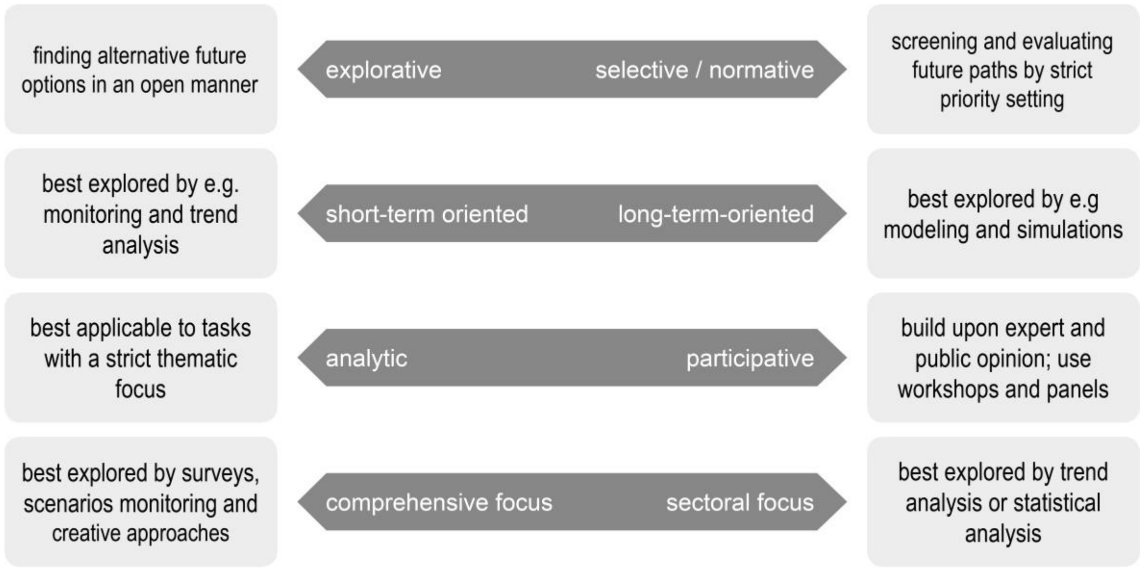

Figure 1: Polarities of foresight methods. Own illustration based on Cuhls (2008)

Cuhls's framework of foresight methods underlines the fact that there is no uniform answer to the question concerning where the information about the future is derived in foresight processes. The framework shows the many possibilities to combine quantitative and qualitative methods, depending on the objectives of the task and process. This description indicates that a closer look at the distribution and interrelation of qualitative and quantitative approaches is necessary in order to find out how additional data may improve the different project phases. In the following section, we will examine the interrelation of qualitative and quantitative approaches in more detail and focus on the problem of how to obtain insights into the future.

3.3.2 The interrelation of qualitative and quantitative approaches

In principle, foresight can encompass both qualitative and quantitative elements (Popper 2008b; Cuhls 2008; Karlsen 2014; Ciarli et al. 2013). Important is to find the right balance of methods. In an article, Popper gives a comprehensive overview of qualitative, quantitative and semi-quantitative foresight approaches (2008b). He classifies methods by their type as follows:

Qualitative: "Methods providing meaning to events and perceptions. Such interpretations tend to be based on subjectivity or creativity that is often difficult to corroborate (e.g. opinions, brainstorming sessions, interviews)".

Quantitative: "Methods measuring variables and applying statistical analyses, using or generating (hopefully) reliable and valid data (e.g. socio-economic indicators)".

Semi-quantitative: "Methods that apply mathematical principles to quantify subjectivity, rational judgments and viewpoints of experts and commentators (i.e. weighting opinions or probabilities)".

To be sure, this is a very simplified classification. The basis of the methods and tools is complex, as Popper's *Foresight Diamond* shows. He arranges the various quantitative and qualitative methods in an epistemic framework by classifying the approaches as creativity-based, expertise-based, interaction-based and evidence-based methods. In his classification, the quantitative methods are primarily evidence-based, for example, bibliometrics, benchmarking, extrapolation and modeling. All these methods can be improved by IT tools. Literature review is the qualitative approach used most frequently, also appearing in evidence-based methods (Popper 2008b).

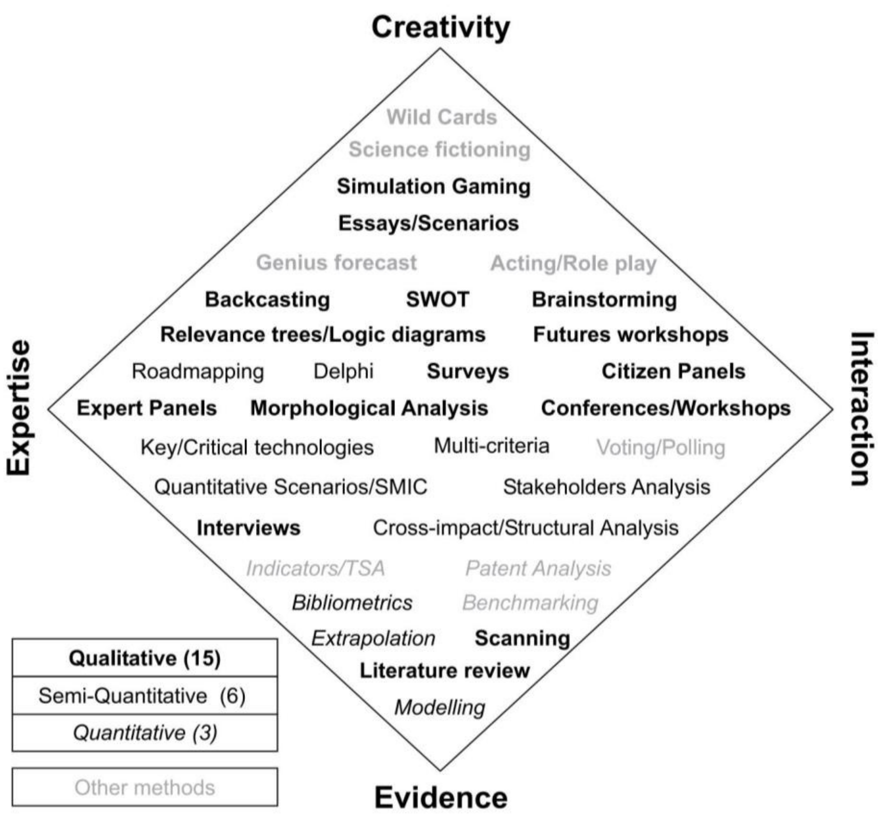

Figure 2: The foresight diamond (Popper 2008b: 66)

Of course, foresight methods and their classifications tend to leave a margin in their definition to accommodate a project's objectives, clients' aims and differing methodological schools. Despite the difficulty in drawing clear definitions of foresight methods, these classifications are helpful for describing at which point the different methods are needed. It is important to bear in mind that many concepts include both qualitative and quantitative methods as they are applied at different phases of a foresight process (Cuhls 2008).

Quantitative methods are particularly useful, for example, in phases when numeric data or simply huge data sets need to be analyzed. In these phases monitoring methods are applied. However, the results from such phases need to be evaluated or interpreted with regard to the overall objective of the foresight activity. Analytical results may turn out to be wrong, and so one cannot rely on them. Furthermore, quantitative methods focus only on shorter time frames. Therefore, further phases using qualitative methods that build strongly upon human judgments are needed. Motives for using qualitative approaches include stakeholder integration (Kunseler et al. 2015), the desire to make long-term predictions in foresight activities, or to provide a broad thematic overview. As mentioned before, the broad base of opinions resulting from delphi surveys or expert workshops can hardly be managed by qualitative methods alone.

Qualitative methods like some scenario techniques do not focus on predicting one future but consider a wide range of possibilities that originate from the imagination and that depend on the experiences and intuitions of experts (Mainzer 2014). More knowledge is created through the interaction in workshops (see e.g., Dufva and Ahlqvist 2014). But qualitative methods also have disadvantages. Experts may entirely overlook relevant issues, and judgmental future assumptions may be biased or simply wrong (Tetlock 2005; Henrich et al. 2010). Besides the bias resulting from the selection of experts, people also tend to describe their own "internally constructed version of reality" (van der Heijden 2005) based on mental models which determine how signals from the outside world, including changes to this world, are perceived by each individual. Also, the number of factors people can imagine, consider and combine is limited by their mental models (Brockhoff 1977).

3.4 How a foresight process works

Generally, foresight processes are conducted in three main phases: preparation of the field, realization of the process and implementation of the results. There are different approaches to structuring the process. For example, Martin calls the three phases (1) pre-foresight, (2) foresight, and (3) post-foresight (1995: 159–62). Horton (1999) calls these three steps (1) inputs, (2) foresight and (3) outputs and action. This basic structure serves as a point of orientation for the various foresight process concepts. For example, Voros (2003) subdivides the second step into three further steps – namely, into analysis, interpretation and prospection – while Andersen and Rasmussen (2014) include even more substeps.

More recent examples subdivide the processes into four or even five steps, for example, Da Costa et al. (2008): (1) diagnosis phase, (2) phase of exploration (3) phase of strategic orientation, (4) phase of public debate, (5) and the phase of implementation and coordination. But generally all processes follow a similar procedure. First the aim must be set, a project design has to be formed, and information needs to be collected about the subject matter. Second, the foresight methods are applied. Depending on the complexity of the topic, the stakeholders involved and the variety of methods used, this second phase may consist of several additional substeps. In more recent process designs, more steps are suggested for feedback loops and sense-making during the process. The third step consists in deriving action plans, recommendations, reports or further formats to communicate results and implement them.

Such a five-step approach is given by *Stiftung Neue Verantwortung*.[71] In their paper, *Government Foresight in Deutschland* (Buehler et al. 2013), they outline a five-step foresight process which differs from the others as follows: They split step 4, the output phase, into two steps: (4) Assessment and implications and (5) Communication (4. Bewertung & Implikation, 5. Kommunikation). Step 5, the strategy phase, is not described as part of strategic foresight, but rather as a downstream task, consisting of strategic planning and implementation (strategische Planung und Umsetzung). While their concept is suitable for practical purposes, for my work the most useful ideas concern the communication of the results and the strategy phase. My intention is to reach a clearer understanding of epistemic implications by means of a leaner process model.

There is even a foresight process suggested in the context of EU projects. In several briefs, the European Forum on Forward Looking Activities (EFFLA) consulted the European Commission regarding the application of foresight and other forward-looking activities in the context of R&D policies. Explicitly the policy briefs 11 and 14 demonstrate “the necessity of flexible, process-supportive, transparent and criteria-based standards”. This process consists of the four tasks (1) Strategic Intelligence, (2) Sense-making, (3) Selecting priorities and (4) Implementation. The EFFLA process model emphasizes sense-making. It thus highlights the need to select methods and processes that are both suitable for the task and that also respect the customers’ needs.

[71] Stiftung Neue Verantwortung (SNV) is an independent German think tank, focusing on foresight, policy advice and technological change.

The following figures show some of these examples of foresight processes – sometimes also called foresight frameworks. Some are more theoretic, such as Figure 3 (Horton 1999: 6), and others more specific, for example, when they are the result of a project or of a certain institution (see Figure 5 and Figure 16). However, while they are essentially comparable, they illustrate the variety of terminology in foresight and the possibility to adapt to specific concerns. Figure 4 isolates the foresight process per se, while Figure 5 emphasizes the connections to strategy building and implementation.

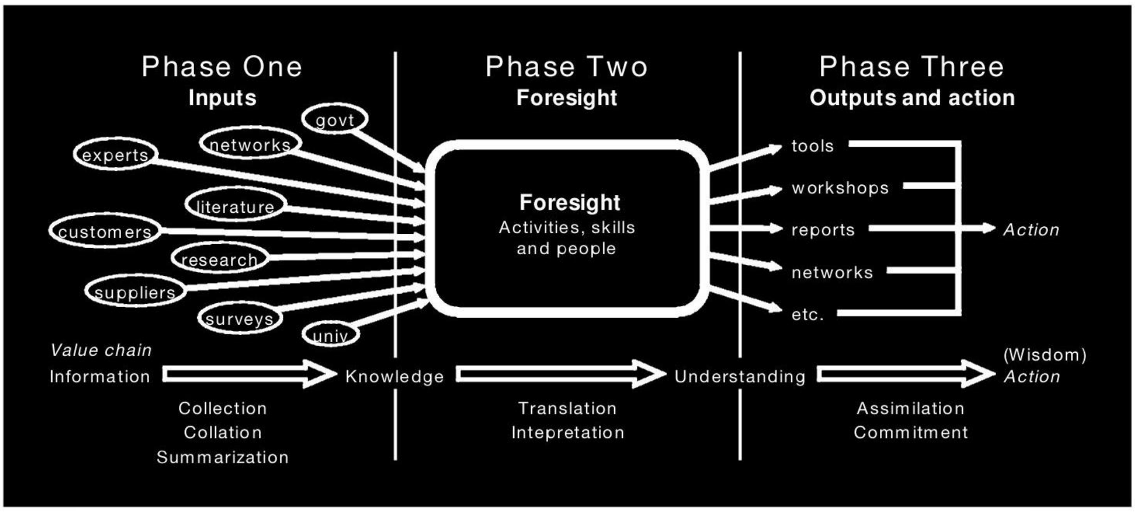

Figure 3: A successful foresight process (Horton 1999: 6)

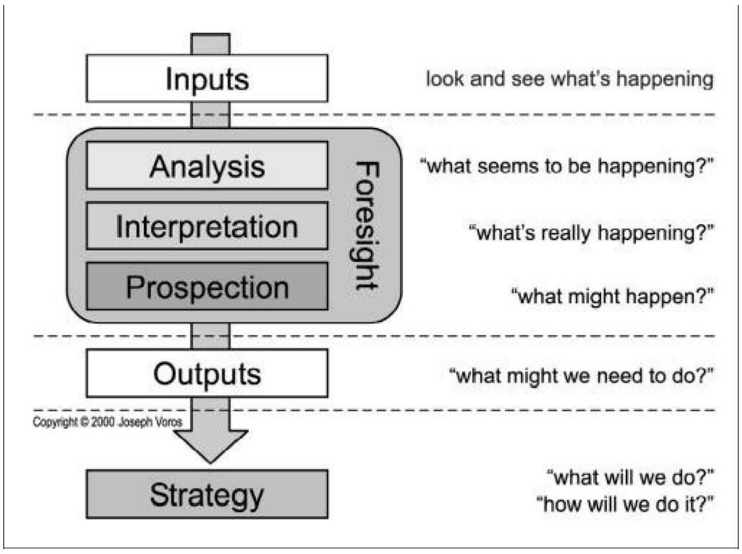

Figure 4: The foresight framework, in question form (Voros 2003: 14)

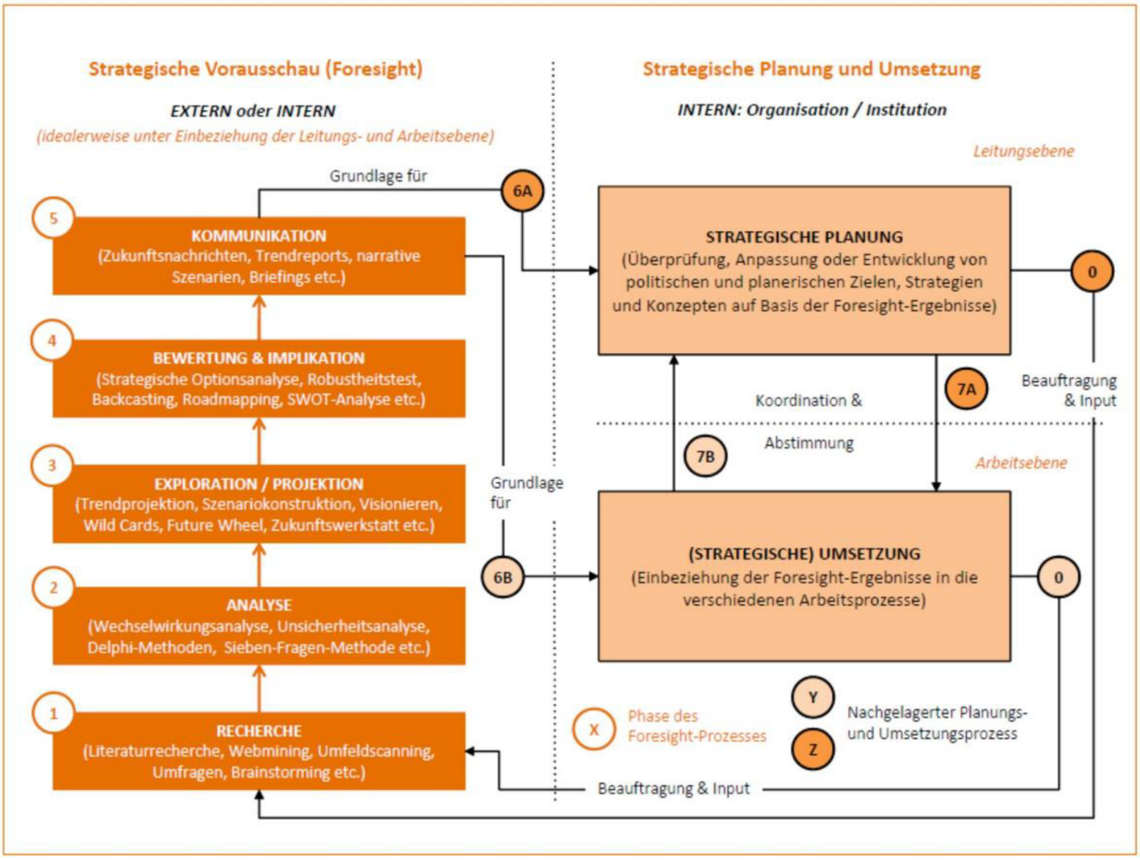

Figure 5: Government Foresight Prozessmodell (Buehler et al. 2013: 4)

3.5 Synopsis

Building upon the previous sections, forecasting and foresight can be briefly defined as follows:

Forecasting *consists of tools and methods that use knowledge about technology, science, environment and society in order to plan and predict the future for management and innovation in a field of interest, e.g. companies, industries or governments.*

Foresight *enables the creation of alternative futures for today's decision making by providing a variety of tools for creating possible, plausible and desirable futures of any social, technological, economic, political or environmental topic.*

Particularly important is the evolution from forecasting to foresight and its relation to the concepts of futures research and futures thinking. This transition is a paradigm shift, as foresight introduces the new thought of multiple futures.

Parallel to the development of future studies from forecasting to foresight, along with the shift from accurate planning of one single future to thinking in multiple futures, there have also been important texts on the theoretical underpinnings of the field. However, some limitations that have already affected forecasting still affect foresight, not only in practice, but also in its theoretical foundations. For example, while the ways of dealing with environmental factors that pose a challenge to forecasts were improved by introducing foresight, personal factors that affected forecasting still affect foresight (Cuhls 2003). As indicated in section 2.3, there are still many terminological uncertainties and overlaps in the use of the terms future(s) studies, future(s) research, forecasting and foresight. In some cases, for instance, in Coates et al. (2001), the difference between forecasting and foresight is even neglected. Also, methods used in future studies have changed only slightly over time. Mostly, they have merely been refined.

Thus, it is important to keep in mind that the epistemic questions concerning foresight face different issues, some of which were already addressed in section 3.2. The following statements may serve to introduce the discussion concerning the scientific basis of foresight:

S1 Foresight does not belong to a specific scientific field.

S2 In foresight, assumptions are made by researchers, scientists, practitioners and the public.

S3 Assumptions are made about various future states and STEEPV topics.

S4 Assumptions are structured and processed by a diverse set of tools and methods.

S5 The tools and methods evolved from scientific methods used in different scientific disciplines.

S6 Foresight opens up to alternative futures.

S7 In practice, the aims of foresight always depend on a client's aim.

The following chapters will argue that each of these statements undermine the thesis that foresight is a science in regard ofclassical epistemology. The driving question is the following: How is it possible that, since the emergence of futures studies and throughout its development from forecasting to foresight, there have been so many publications on its theoretical underpinnings, yet still no clear position on whether it is an art or a science? The variety of texts concerning the methods, the specific purposes of foresight, and also the issue of long-term and multiple futures cause epistemic uncertainties. On the other hand, philosophy of science has undergone significant developments during the same period, making it difficult to link foresight theory to philosophy of science. For this reason in the next chapter I will first outline the development of different scientific accounts that arose during the same time period that futures studies emerged, before describing in chapter 5 the different theoretical approaches in futures studies.

4. On Different Accounts of Science

The main objective of philosophy of science is to clarify and account for scientific methods (Chalmers 1999; Dascal and Boantza 2011). In philosophy of science, and also in history of science, there are different ways to argue, develop and evaluate the discourse on scientific methods (cf. Dascal and Boantza 2011). Within the scope of the present work, I will focus on some perspectives which help us highlight the epistemic problems of the field of scientific futures thinking. A further aim is to determine whether existing accounts of science may provide a theoretical foundation for a scientific account of foresight. For this task it is necessary from a philosophical point of view to ask in which strand of science foresight is located and if its methods can be justified as being scientific and capable of generating proper scientific knowledge.

In his book, *What is this thing called science?*, Chalmers raises a similar question with regard to the social and human sciences. He examines the success that experimental methods have enjoyed over the past 300 years as scientific methods[72] and asks if this success may be transformed to social and human sciences by learning and applying the underlying scientific method:

> [I]f the social and human sciences are to emulate the success of physics then that is to be achieved by first understanding and formulating this method and then applying it to the social and the human sciences. (Chalmers 1999: xx)

Chalmers's inquiry confirms that there is no universal account of science; hence, there is no universal account of science applicable to foresight, either. As a matter of fact, issues concerning validity, credibility and epistemic considerations are still present in foresight. In the following sections, I will sketch the most influential accounts of science, from positivist to relativist positions, in order to determine what they can contribute to a theory of foresight, and also to a scientific practice of foresight. At the same time I will also highlight the historical context of the philosophy of science in which futures thinking evolved.

[72] This refers to the epochal change in the scientific method initiated by Renaissance and humanist thinking, namely the revolution of the natural sciences, which means the transformation from scientific belief in authorities to scientific proof by experiment. Cf. Chalmers (1999: 2). This period of science has been explored thoroughly by Crombie in his work *Augustine to Galilei* (1959/1964b).

4.1 Positivist and realist accounts of science

Positivism is a strand of philosophy of science based on empiricism and which uses inductive approaches. Scientific inquiries that cannot be answered by empirical and inductive inquiry are rejected as speculative or simply unscientific (Schüll and Berner 2012: 187). Positivism gained popularity in the 20th century with the rise of logical empiricism, a philosophical movement of the early 1920s and 30s that arose in Germany (Berlin Circle) and Austria (Vienna Circle). It also had a major impact on philosophy of science during the 1940s and 50s, especially due to its ongoing popularity in Great Britain, the United States and Scandinavia. This strand of philosophy is also known as logical positivism.[73] Scholars of this movement do not agree on the best form of empiricism. The issues discussed range from empiricism, verificationism, analyticity to probability (Creath 2014). As a consequence of the positivist debates, new approaches were developed. In this light, Hempel and Oppenheim make the following o observation:

> [W]hile there is rather general agreement about this chief objective of science [of explaining why phenomena appear in the world of our experience, E.S.], there exists considerable difference of opinion as to the function and the essential characteristics of scientific explanation. (Hempel and Oppenheim 1948: 135)

So while there are different approaches to empiricism, all of its representatives shared an interest in developing an appropriate scientific methodology and fostering the role of science in reshaping society (Creath 2014). In the following, I will highlight inductivism, critical rationalism and the HO-model by Hempel and Oppenheim (1948).

4.1.1 The inductivist approach

Inductivism is the account of science which seeks to justify scientific knowledge by deriving it from facts.[74] Inductivism is based on the following argumentative principle:

> provided certain conditions are satisfied, it is legitimate to *generalize* from a finite list of singular observation statements to universal law. (Fetzer 1979: 393)

These facts can either be observed and justified by experience or by deductive logic. Theories can then be built upon these facts:

[73] However, some authors distanced themselves from these categorizations and introduced new names for their approaches. For example, Karl Popper introduced critical rationalism and claimed to have “killed” positivism; Creath (2014).

[74] The term ‘inductivism’ is introduced by Chalmers to justify scientific knowledge as being derived from facts. Accordingly, he calls all those following this principle ‘inductivists’; Chalmers (1999: 49).

> The laws and theories that make up scientific knowledge are derived by induction from a factual basis supplied by observation and experiment. Once such general knowledge is available, it can be drawn on to make predictions and offer explanations. (Chalmers 1999: 54)

According to this picture, science is based on observation, induction and deduction. Inductive logic became important in the 20th century especially in the effort to distinguish science from pseudoscience. Or, as Imre Lakatos remarks, "[i]nductive logic set out to define the probabilities of different theories according to the available total evidence" (Lakatos 1978: 3)[75]. Predictions and explanations of the inductivist account must not be confused with predictions in foresight: Predictions made by induction are based on laws of nature that can be explained by physical experiments, while the understanding in foresight allows for contradicting predictions. This is especially the case in scenario techniques where alternative scenarios are created by combining alternative future assumptions of key factors.

On the other hand, the notion that "science is derived from facts" is not appropriate as a theory of scientific knowledge for foresight due to its inherent difficulties. There are two main difficulties of the inductivist position: first, that the observed facts may be influenced "by the background and expectations of the observer" (Chalmers 1999: 17), and second, that new observations depend on theories that are already known, as they are the starting point of observation. This means that observed facts are derived from theories that are already known. As Chalmers points out, "the relationship between theory and experiment might involve a circular argument" (1999: 32), which means that any theory can be proven by a certain experiment, and vice versa. Moreover, experimental results are not at all reliable: with technological progress, observations are superseded by more precise observations and put in question by general advances in understanding. Plus, experiments may be based on errors.

Inductivism also has its limitations, which makes it obsolete for much of today's scientific practice. Inductivism is limited to the sphere of observable facts that can lead to generalizations about the observable world. As inductive reasoning cannot provide us justified scientific knowledge about the "unobservable world", it is hardly applicable to most of contemporary science that extends beyond observation (Chalmers 1999: 49). The same claim can be made with regard to foresight. It builds upon the current state of research in different scientific disciplines in order to ultimately anticipate alternative

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[75] Lakatos explains further: "If the mathematical probability of a theory is high, it qualifies as scientific; if it is low or even zero, it is not scientific. Thus the hallmark of scientific honesty would be never to say anything that is not at least highly probable. . . . But, in 1934, Karl Popper . . . argued that the mathematical probability of all theories, scientific or pseudoscientific, given any amount of evidence is zero" (1978: 3). As explained in chapter 4.1.2, Popper resolved this issue with the falsificationist approach.

futures. Also in cases where observable facts are not the object of analysis, for instance, in computer science, the scientific method has to reach beyond observation. This means that induction can serve as a scientific base for foresight only in cases where future projections are generalizations of the observable world. But more generally, given that any information used in foresight must be defined as observable facts, any extrapolation or future assumption based upon these facts would qualify as an induction. This means that foresight would struggle with the limitations of inductivism, too. A second limitation is pointed out by Chalmers:

> If scientific laws are inductive generalizations from observable facts it is difficult to see how one can escape the inexactness of the measurements that constitute the premises of the inductive arguments. (Chalmers 1999: 50)

If only inexact facts are available, then it is not possible to derive exact results. However, foresight neither creates scientific laws nor exact results.

A third limitation is the so-called problem of induction concerning how to justify the method of induction. This means that induction itself must be justified “either by an appeal to (deductive) logic or by deriving it from experience“ (Chalmers 1999: 50).[76] But according to Hume, who came up with the problem of induction,[77] conclusions based on induction are irrational, as they merely express our habituation with regard to past regularities, and our expectation that they will behave the same in the future. Goodman’s theory in *Fact, Fiction, Forecast* (Goodman 1988) also builds upon this claim: customs, habits and conventions are the foundation of rules for induction, justifying single inductive conclusions (cf. Kutschera ²1984).[78] These limitations have been themes in philosophy since the early times of Hume.[79] The inductivist approach to justifying scientific knowledge is one of the oldest that is still widespread today, going back 300 years. Real alternatives were not available until the 20th century, when Karl Popper introduced the falsificationist position.

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[76] A deduction follows the logic that an argument is true if it is valid, meaning that premises must lead to a valid, justifiable conclusion, regardless whether the premises can be proven wrong by experience.

[77] David Hume (1711–1796) was a Scottish philosopher, historian and economist. In his work *A Treatise of Human Nature (THN) I* (see section III, VI) (1739–40) he addresses the problem of induction and elaborates the problems further in the revision of THN called *An Enquiry Concerning Human Understanding* – albeit without explicitly noting the term. See Vickers (2016).

[78] In the third chapter of his book *Fact, Fiction, and Forecast* (1988), Goodman explains the “new” problem of induction by showing that certain conditions can lead to true and false inductions at the same time. He explains this circumstance by introducing the new term ‘grue’.

[79] The following works are also concerned with inductive risk: Hempel (1965/1968); Rudner (1953); Douglas (2000).

4.1.2 Critical Rationalism

Falsification is the most convincing alternative to the inductivist approach of deriving scientific claims from facts. Popper was in large part responsible for initiating this movement and remained its main representative. This scientific movement is also known as critical rationalism. While positivists aim to acquire knowledge empirically through observation and induction, critical rationalism takes up the notion of falsification.

The need for an alternative theory to inductivism follows from its logical insufficiencies described above. Popper also makes clear that inductivism cannot serve as a universal theory of science because it allows many disciplines to qualify as scientific if the inductivist approach is used in a vague and flexible enough manner. Popper was mainly concerned about disciplines based on human behavior or historical change. As Chalmers notices, "[i]t seemed to Popper that these [Freudian or Marxist] theories could never go wrong because they were sufficiently flexible to accommodate any instances of human behavior or historical change as compatible with their theory" (1999: 59). In comparison to logics of scientific advances in physics, the latter seemed to have much more potential for scientific progress. From these observations, Popper developed his main idea that scientific theories have to be falsifiable. The falsificationist position follows the principle that, in order to be provable and to qualify as scientific, a hypothesis has to be logically falsifiable. And the more falsifiable the premises of a theory are, the stronger the theory is. Here is the structure of a falsifiable argument:

Premise	A raven, which was not black, was at place x at time t.
Conclusion	Not all ravens are black. (Chalmers 1999: 61)

According to this account of science, laws and theories can only be informative if observation statements, which are logically possible, can be ruled out (Chalmers 1999: 63). This leads to two essential claims, the first of which concerns the degree of falsifiability:

> A very good theory will be one that makes very wide-ranging claims about the world, and which is consequently highly falsifiable, and is one that resists falsification whenever it is put to test. (Chalmers 1999: 65)

Secondly, as mentioned before, one main aim of this approach is to better justify and enable scientific progress:

> The greater the number of conjectured theories that are confronted by the realities of the world, and the more speculative those conjectures are, the greater will be the chances of major advances in science. (Chalmers 1999: 67)

As a consequence, falsified theories need to be rejected. Relevant for the present analysis is that these two falsificationist claims cannot be met by foresight. The aim of foresight is not to further scientific progress per se. It appeals to it occasionally in order to anticipate different futures. But if we regard the falsificationist position as a means for deriving alternative plausible futures, we will derive a weak epistemic argument in favor of foresight. For example, alternative futures have to be highly falsifiable to be scientifically robust from a falsificationist point of view. Here it becomes obvious that we cannot claim that foresight itself is scientific, but rather that it can use methods that satisfy scientific claims.

4.1.3 The HO model – an example for challenges to scientific explanations

Another important issue for foresight theory is the idea of structural equality of explanation and prediction. Here too it is clear that foresight has nothing to do with prediction in the sense of a scientific aim. Following Popper, with the use of side conditions, general propositions can be deduced to make predictions (cf. Popper 2005: 37). This idea is best known as the deductive-nomological model or HO-model, named after Hempel and Oppenheim, who elaborated this concept in more detail in their paper *Studies in the Logic of Explanation* from 1948. This paper had a major impact on the general understanding of science in the past century, and especially on the understanding of scientific prediction.

The deductive-nomological model by Hempel and Oppenheim triggered a general shift in the perception of scientific prediction, even though this model was later rejected.[80] Using physical cases, Hempel and Oppenheim show that a specific phenomenon under consideration is being explained by two kinds of statements: antecedent conditions and general laws. They formulated general characteristics of scientific explanation by dividing it into the two constituents "explanandum" and "explanans" (Hempel and Oppenheim 1948: 136). The following quotations refer to the definitions of "explanandum" and "explanans" as well as the "conditions of adaequacy" which should be satisfied by the constituents for proposing sound explanations:

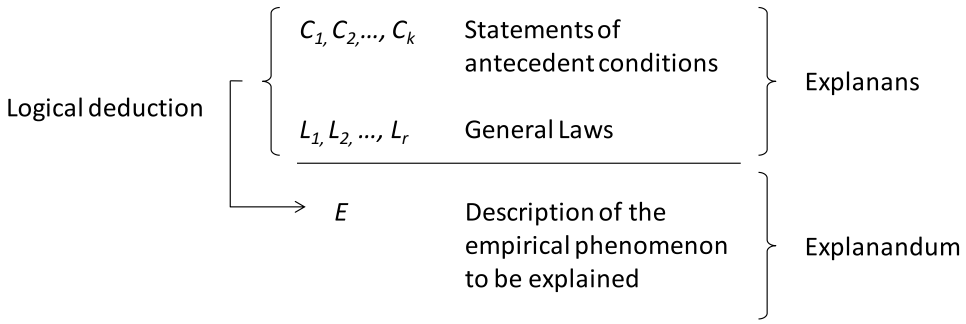
> By the explanandum, we understand the sentence describing the phenomenon to be explained (not the phenomenon itself); by the explanans, the class of those sentences which are adduced to count for the phenomenon. (Hempel and Oppenheim 1948: 136–7)

The conditions are divided in three logical conditions of adequacy (R1-3) and an empirical condition (R4):

[80] See Lenk (1986).

(R1) "The explanandum must be a logical consequence of the explanans".
(R2) "The explanans must contain general laws".
(R3) "The explanans must have empirical content; i.e., it must be capable, at least in principle, of test by experiment or observation."
(R4) "The sentences constituting the explanans must be true" (Hempel and Oppenheim 1948: 137)

R4 should be read in the sense that it is valid as long as it is not falsified by more recent empirical findings. The schema of a scientific explanation can be described as follows:



Based on this structure of scientific explanation, Helmer and Oppenheim claim to have proven that explanation and prediction can be explained in a structurally similar manner. The following quotation sums up the whole concept of explanation and prediction:

> [T]he same formal analysis, including the four necessary conditions, applies to scientific prediction as well as to explanation. The difference between the two is of a pragmatic character. If E is given, i.e. if we know that the phenomenon described by E has occurred, and a suitable set of statements C1, C2, … , Ck, L1, L2, … , Lr is provided afterwards, we speak of an explanation of the phenomenon in question. If the latter statements are given and E is derived prior the occurrence of the phenomenon it describes, we speak of a prediction. (Hempel and Oppenheim 1948: 138)

This characterization of scientific explanation has had a major impact on scientific debates in the past century, especially since Hempel and Oppenheim claimed that this structure refers not only to physical sciences but could easily be transferred to other sciences, too (cf. esp. Hempel and Oppenheim 1948: 142).[81] That is, they believed that their schema is universally applicable. They describe its strength in virtue of its predictive force as follows:

[81] There has also been much critique denying the structural similarity of prediction and explanation. See, e.g., Lenk (1986: 40–76).

> It is this predictive force which gives scientific explanation its importance: only to the extent that we are able to explain empirical facts can we attain the major objective of scientific research, namely not merely to record the phenomena of our experience, but to learn from them, by basing upon them theoretical generalizations which enable us to anticipate new occurrences and to control, at least to some extent, the changes in our environment. (Hempel and Oppenheim 1948: 138)

This quotation depicts the zeitgeist of science in the mid-20th century, which had a major impact on a technocratic view on research and development.[82] It also reflects the trust in forecasting of the following kind: If we are able to formulate theoretical generalizations from our experience by different sciences, the structural equality of explanation and prediction can help us to provide scientific forecasts.[83]

Although this may sounds like a reasonable epistemic base for foresight, the HO-model is not useful for the same reasons that make inductivism unsuitable. On the one side, the term prediction is focused to a certain kind of scientific explanation. Hempel and Oppenheim tried to adapt this to other sciences, and it seems it could also be adapted to foresight. But prediction in foresight, as mentioned before, is a vague construct because it allows for different predictions to be derived from the same facts (or explanations). Using a scenario technique, for example, one would derive a set of alternative future assumptions for one key factor. This shows the deficiencies of such an approach.

So what is the real problem with predictions? If foresight is best understood as science in the sense of Hempel and Oppenheim, one of its aims would be to produce accurate predictions. But predictions are not sufficient to account for the practical use of foresight. To see why, it is helpful to compare foresight with the use of predictions in the social sciences proposed, for example, by Betz (2011). Due to its relevance for rational decision making, prediction is widely accepted as a scientific goal. But, as Betz shows, prediction is not the only aim of scientific inquiry, particularly not for the social sciences. Here, "accurate descriptions and insightful explanations" (2011: 660), enabling judgments or evaluations, are used for successful decision making. Betz does not deny that predictions are to some extent possible in the social sciences, but he insists that, in this case, "[u]nderstanding and explaining complex social relationships, or identifying causal relationships" are also crucial in order to pursue the practical goal of general decision making (2011: 649). Hence, it is misleading to focus on the aim of a particular science without considering how this science is employed. We can see with the social

[82] The technocratic zeitgeist is also due to political circumstances: progress in physics and technical sciences mainly contributed to arms race during Cold War.

[83] But this view is misleading, as it ignores that prediction is not the only way to pursue scientific investigations that are epistemically valid. This point will be discussed in more detail in chapter 6.

sciences that deriving general laws from prediction by explanation may be important, but not necessary for a scientific investigation. It is not helpful to question whether Hempel and Oppenheim's claim that the HO-schema, which treats prediction as the only aim of science, is transferable to other sciences. But it is crucial to emphasize that depending on the application fields of scientific disciplines, the aims and methods may also vary.

With reference to the HO-model, it becomes evident that the pragmatic goal of foresight and its scientific aim are not identical. Foresight is not about predicting in the sense of explaining and deriving general theories, but about decision making. Nevertheless, the HO-model can be used as a scientific guideline in cases when foresight involves scientific methods that rely on this paradigm, for example, in physics – though this would constitute a very theoretical epistemology.

Following Lenk (1986), different forms of predictions can be distinguished in philosophy of science:

a) prognosis, projections, and technological or operational arguments and
b) non-scientific prophecies.

In the case of futures studies, it is of particular interest to take a closer look at predictions of the first kind as outlined by (Lenk 1986: 17–8).[84] With prognostic arguments, it is possible to forecast events (also historic ones) from prior historic facts and circumstances, for example, an astronomic fact about the year 1000 based on proven constellations of the year 900. Descriptive sciences, for example, historic or social, work in this way. This means there is an initial epistemic difference between prognosis relying on historical evidence and forecast from the present into the future. Predictions of the future may not only be forecasts of contemporary events but also hypothetic projections into the future. Likewise, there is an epistemic difference between predictions in the sense of a forecast and a backcasting from a hypothetical future event. Another differentiation can be made between

a) predictions on a theoretical level,
b) operational predictions, also known as operational or technological forecasts and
c) aim-adaptive predictions.

Theoretical predictions are not influenced by interventions by the person analyzing the situation; predictions of this kind can be found, for example, in all sciences that aim at

[84] Of course, there are different other sources for classifications of predictions. See, e.g., Brocke (1978) who analyses the use of technological prognoses in social sciences etc. But Lenk's classification is comprehensive enough to apply the different forms of predictions to different scientific disciplines, ad especially to emphasize the impact of operational and technological forecasts in the field of futures studies.

deriving theories from facts. The second kind corresponds to predictions in which the person analyzing the situation also intervenes with structured and planned manipulation of antecedent conditions, while aim-adaptive prognoses also encompass possible changes in the expected aims (circumstances) of antecedent conditions.[85]

Normally, different scientific disciplines are focused on one form of prediction. By contrast, in the methods used for foresight one can find all the different kinds of prediction. It is clear that the second and third forms of prediction, operational and aim-adaptive, are of special interest in the futures field, as they address the possibility of an active intervention in our orientation to future events. But the different approaches to predictions are also bound to different levels of reliability of those predictions (Lenk 1986: 18). Hence, it is more difficult to set up a useful foresight theory, since all these forms of predictions need to be taken into account and, at the same time, assessed in terms of their practicality and feasibility.

4.2 From post-positivism to relativism and back

In the preceding chapters I outlined the positivist accounts, which assume that science is derived from facts by focusing on one of the two following claims:

> One concerns the nature of these "facts" and how scientists are meant to have access to them. The second concerns how the laws and theories that constitute our knowledge are derived from the facts once they have been obtained. (Chalmers 1999: 3)

By contrast, the positions presented in this section describe science and scientific knowledge by "theoretical frameworks within which scientific work and argumentation take place" (Chalmers 1999: 107). Especially in the past century, philosophy of science has experienced many new approaches, some of which are based on the approaches described above, while others diverge more drastically. To be brief, I follow Longino (1990) and subsume them under the category of "wholism". While positivist and naturalist discourses focus mainly on scientific method, the wholist / post-positivist discourses focus instead on scientific practice. My aim is to outline some wholist alternatives to scientific method, in order to later show how such theories have been adopted, and also how they have shaped the epistemic discussions in the futures field.

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[85] As Lenk outlines in an earlier report on philosophy of science and futures research, this differentiation is based on Stachowiak's theory, which distinguishes between (1) theoretical, (2) operational, and (3) prospective predictions. In a work from 1970, Lenk added aim-adaptive prediction as a fourth type (1970: 126), in the publication referred to above from 1986, types 3 and 4 fall under the aim-adaptive type.

4.2.1 Thomas Kuhn

In 1962, Thomas Kuhn elaborated one of the most well-known critiques of the inductivist and falsificationist accounts of science in his book *The Structure of Scientific Revolutions* (Kuhn 1962/2012). In this work he shows examples from history of science that indicate that traditional accounts of science such as inductivism and falsification cannot be proven.[86] There are two crucial issues in Kuhn's theory: first, he emphasizes that scientific progress has a revolutionary character, meaning that an existing theoretical structure is replaced by a new, incompatible one. The other crucial issue is the social character of scientific communities (Chalmers 1999: 107). Both of these issues are not taken into consideration in the prevalent theories of critical rationalism and the HO-schema. As I will describe at a later point, both of these issues are of interest to a theory of foresight, especially since Kuhn's theory also had a major influence on Longino's work (Longino 1990). Kuhn is known especially for having elaborated a new understanding of scientific paradigms and having developed the notion of paradigm shifts. According to Kuhn, the main components of scientific revolutions are pre-science, normal science, crisis, revolution, new normal science and new crisis (Kuhn 1962/2012). Scientific revolutions occur when the paradigm of normal science is questioned, challenged or falsified, leading to crisis before it is eventually replaced by a new paradigm – which becomes the new normal science. Kuhn describes normal science as a steady procedure of puzzle-solving[87] within a field of knowledge, where only some "puzzles" are left open:

> 'normal science' means research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation of its further practice. Today, such achievements are recounted, though seldom in their original form, by science text books, elementary and advanced. (Kuhn 1962/2012: 10)

The achievements he refers to are also what he later calls 'paradigm'. They share the following characteristics:

> [The] achievement [is] sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity. Simultaneously, it [is] sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve. (Kuhn 1962/2012: 10–1)

[86] See also Bird (2002: 458–9). In SSR Kuhn makes the following remark about his work: "many of my generalizations are about the sociology or social psychology of scientists; yet at least a few of my conclusions belong traditionally to logic or epistemology" Kuhn (1962/2012: 8). For contemporary judgments on Kuhn's work, see Bird (2002); Achinstein (2001); Hoyningen-Huene and Kuhn (1989); Hoyningen-Huene (1990); Longino (1990).

[87] Actually, the terms normal science, puzzle-solving, paradigm / paradigm shift and revolution are now colloquial English, but in the sense used by Kuhn they were quite new in the 1960s; Kuhn (1962/2012: x).

In particular, a paradigm consists of fundamental laws, theoretical assumptions, and, as Chalmers summarizes, "[it] sets the standards for legitimate work within the science it governs" (Chalmers 1999: 108).[88] Hence, Kuhn regarded scientific practice per se as an important part of science. For instance, he notes that "the most striking feature of the normal research problems . . . is how little they aim to produce major novelties, conceptual or phenomenal" (Kuhn 1962/2012: 35). But what is the aim of all the puzzles and problem-solving in science, if not to achieve something new? Kuhn's answer to this question is twofold, and it reveals much about motivation in research:

> To scientists, at least, the results gained in normal research are significant because they add to the scope and precision with which the paradigm can be applied. . . .
> Bringing a normal research problem to a conclusion is achieving the anticipated in a new way, and it requires the solution of all sorts of complex instrumental, conceptual, and mathematical puzzles. The man [sic!] who succeeds proves himself an expert puzzle-solver, and the challenge of the puzzle is an important part of what usually drives him on. (Kuhn 1962/2012: 36)

In the first instance, normal science is occupied with contributing to completing the scientific aim of finding truth under a certain paradigm. Scientific progress, as indicated by Popper's falsificationist position, only occurs when there is a crisis in scientific practice, which means the detection of anomalies of the paradigm.[89] Kuhn explains scientific practice on a very different level: He focuses not on the structure of scientific explanations, like Hempel and Oppenheim, or on the very point of scientific progress, but instead on scientific practice in general. This allows him to detect that there is a mismatch in definitions and methodologies between the languages of the normal science und the upcoming "new" normal science that emerges following the new paradigm. Kuhn calls this effect "incommensurability" (Kuhn 1962/2012: 147–9). Bird describes the defining feature of incommensurability as follows:

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[88] According to Wilson (2014), Kuhn's picture of normal science is strongly influenced by Mill's concept of inductive method of inquiry. He states that "[w]hat Mill calls a law about laws, Kuhn calls a 'paradigm', but that is a terminological difference. For both, they are theories that guide research: they assert that there is a law, there to be discovered in a certain generically described area, and it is the task of the researcher to discover it" Wilson (2014).

[89] Kuhn explains anomalies and discoveries in normal science as follows: "Normal science, the puzzle-solving activity we have just examined, is a highly cumulative enterprise, eminently successful in its aim, the steady extension of the scope and precision of scientific knowledge. . . . Normal science does not aim at novelties of fact or theory and, when successful, finds none. New and unsuspected phenomena are, however, repeatedly uncovered by scientific research, and radical new theories have again and again been invented by scientists." And further: "Discovery commences with the awareness of anomaly, i.e., with the recognition that nature has somehow violated the paradigm-induced expectations that govern normal science" Kuhn (1962/2012: 52–3). Accordingly, he concludes that even the distinction between discovery and invention, but also between fact and theory, is strongly artificial.

> The root of incommensurability is the claim that perception and observation are not theory-independent but are influenced by the paradigm within which one is operating. (Bird 2002: 451)

One must be careful not to misunderstand Kuhn's point: The replacement of one paradigm by a new one does imply there is no communication between paradigms. Incommensurability means that parts of a scientific community change their conceptual structure, and this gives rise merely to problems in communication between the new group and the old community (cf. Andersen 1998: 4; Kuhn 1962/2012: xxxi).[90] We saw in chapter 4.1.2 on critical rationalism that the idea of replacing one theory by a more compatible one had already been introduced by Popper; the difference between the two positions may be emphasized as follows:

> But, whereas for Popper the replacement of one theory by another is simply the replacement of one set of claims by a different set, there is much more to a scientific revolution from Kuhn's point of view. A revolution involves not merely a change in the general laws but also a change in the way the world is perceived and a change in the standards that are brought to bear in appraising a theory. (Chalmers 1999: 121)

Accordingly, it makes sense that Kuhn distinguishes normal science from the stages of pre-science and crisis.[91] During the phase of pre-normal science, theory selection and the process of reaching a consensus regarding paradigms are still challenging. In the late phase, sufficient dissent concerning a formerly agreed-upon consensus leads to the crisis (cf. Hoyningen-Huene and Kuhn 1989: 167).

In rejecting the possibility of truth-related progress and introducing the thesis of incommensurability of scientific theories, Kuhn's theory also shows the impact of various social values on scientific practice. In the first place, Kuhn agrees to all five values of scientific rationality: "Theories should be accurate in their predictions, consistent, broad in scope, present phenomena in an orderly and coherent way, and be fruitful in suggest-

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[90] Andersen sums up this issue as follows: "Chancing the conceptual structure means that the relations of similarity and dissimilarity which constitute the categories are changed, and this entails changes in both the knowledge of ontology and the knowledge of how nature behaves. For those parts of the conceptual structure where the relations of similarity and dissimilarity have been changed, a translation between original and changed conceptual structures which preserves both reference and truth value is therefore is therefore impossible" Andersen (1998: 4). Kuhn clarifies this idea also in his later work: "Two theories are incommensurable if and only if they are articulated in languages that are not mutually translatable. But the concept of translation that is used in this definition is emphatically not the everyday concept of translation. Rather, a mechanically feasible translation is meant in which, according to fixed rules, words or groups of words from the source language are replaced by words or groups of words of the target language"; Hoyningen-Huene (1990: 487).

[91] It should be noted that the terms "pre-science" and "crisis" for the early and the later stage of science were not used by Kuhn himself but by Chalmers. Accordingly, in Hoyningen-Huene and Kuhn (1989: 167) these stages are called "'vornormale' Wissenschaft" and "ausserordentliche Wissenschaft" / "Wissenschaft im Krisenzustand".

ing new phenomena or relationships between phenomena" (Kuhn 1962/2012: xxxi).[92] Nevertheless, when it comes to paradigm shifts, Kuhn explains scientists' theory choice with the idea of a "gestalt switch", which means that there is no logical explanation for why a scientist should see one paradigm superior to another. This is because a variety of other factors – besides "the merits of a scientific theory" – play a deciding role in scientists' preferences for a specific theory. As Chalmers sums up, "[t]he factors will include such things as simplicity, the connection with some pressing social need, the ability to solve some specified kind of problem, and so on" (Chalmers 1999: 115).

As futures studies is a rather new field, one may be tempted to see the transition from forecasting to foresight as a kind of paradigm shift. The diversity of foresight styles and methodological approaches has beguiled many futures researchers, leading them to describe foresight with diverse paradigms. However, such approaches are doomed to fail as they misinterpret the Kuhnian concept of a scientific paradigm. Instead, they misuse the term paradigm to describe the different historical phases of futures studies.[93] One should bear in mind that, like Karl Popper's work, Kuhn's *Structure of Scientific Revolutions* focuses mainly on the natural sciences, supported by examples in physics. Both Popper and Kuhn base their work on theoretical concepts. Therefore, it is far-fetched to see in Kuhn's *Structure* a direct framework for foresight.

4.2.2 Against Method?

Kuhn's work has influenced many philosophers of science and evoked diverse discussions and responses. Starting in the late 1960s, different attempts appeared to improve the Kuhnian concept of scientific practice (Gholson and Barker 1985). For example, on the one side "new models of scientific methodology were proposed in a conscious attempt to improve upon Kuhnian ideas and, more specifically, to avoid both the problems associated with the incommensurability of paradigms and with irrationalism" (1985: 756). These include the models by Lakatos, Laudan and Stegmüller (1985: 756). Lakatos, for example, speaks of "research program" instead of "paradigm" (Lakatos

[92] In contemporary theories, like those of Longino (1990, 2002) and Douglas (2009), the values of scientific rationality are also cognitive values.

[93] In the futures studies field Kuhn's concept of paradigms has been taken into consideration for example by Mannermaa (1991) and Hideg (2002). However, Kuhn's concept of paradigms has often been mistaken, in futures studies also. Hideg for example describes the different developments in the field of futures research and futures studies by a strict division fist between the concepts of futures research and futures studies, but also by two new trends which she names "evolutionary futures studies" and "critical futures studies". Partly, she describes those trends as paradigms. However, such an understanding of paradigms does not correspond with the Kuhnian view.

1978). By contrast, Stephen Toulmin criticizes Kuhn's concept of scientific revolutions and introduces a evolutionary approach to science (Toulmin 1972).

There has also been much misunderstanding of Kuhn's theory, especially after Feyerabend enforced the motto that "the only principle that does not inhibit progress is: anything goes" (Feyerabend 1975/2010: xxvii). Feyerband's *Against Method* (AM) became famous as "the Woodstock of philosophy" (Hacking 2010). This was the case as his theory contains an even more radical attitude towards experimentalism, but especially against critical rationalism. Like Kuhn, Feyerabend underpins his claim with the fact that there is no evidence in history of science to show that science functions the way critical rationalists claim. He argues that scientific rules have always been violated, but this does not indicate paradigm shifts, but rather insufficient knowledge or lack of attention. Such violations do not undermine but rather reinforce the notion of progress:

> The liberal practice, I repeat, is not just a *fact* of the history of science. It is both reasonable and *absolutely necessary* for the growth of knowledge. More specifically, one can show the following: given any rule, however 'fundamental' or 'rational', there are always circumstances when it is advisable not only to ignore the rule, but to adopt its opposite. (Feyerabend 1975/2010: 7)

Feyerabend even claims that "[t]he consistency condition which demands that new hypotheses agree with accepted theories is unreasonable because it preserves the older theory, and not the better theory" (Feyerabend 1975/2010: 17). Furthermore, his main concern is that conducting science according to a strict logical empiricism or critical rationalism may hinder progress in science.[94] Feyerabend does not reject these methods per se, but instead emphasizes their limits, that is, the need to be aware that they cannot cover all possible knowledge. Empirical contents in particular cause "epistemological illusions" (Feyerabend 1975/2010: 158). This is depicted well by an illustration in AM:

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[94] In the 15^{th} chapter, Feyerabend sums up his critique of rationalists and logical positivists as follows: "wherever we look, whatever examples we consider, we see that the principles of critical rationalism (take falsification seriously; increase content; avoid *ad hoc* hypotheses; 'be honest' – whatever *that* means; and so on) and *a forteriori*, the principles of logical empircism (be precise; base your theories upon measurements; avoid vague and unstable ideas; and so on), though practiced in special areas, give an inadequate account of the past development of science as a whole and are liable to hinder it in future. [sic!] They give an inadequate account of science because science is much more 'sloppy' and 'irrational' than its methodological image. And they are liable to hinder it because the attempt to make science more 'rational' and more precise is bound to wipe it out, as we have seen [by historical examples, E.S.]. The difference between science and methodology which is such an obvious fact of history, therefore, indicates a weakness of the latter, and perhaps of the 'law of reason' as well. For what appears as 'sloppiness', 'chaos' or 'opportunism' when compared which such laws has the most important function in the development of those very theories which we today regard as essential parts of our knowledge of nature"; Feyerabend (1975/2010: 160).

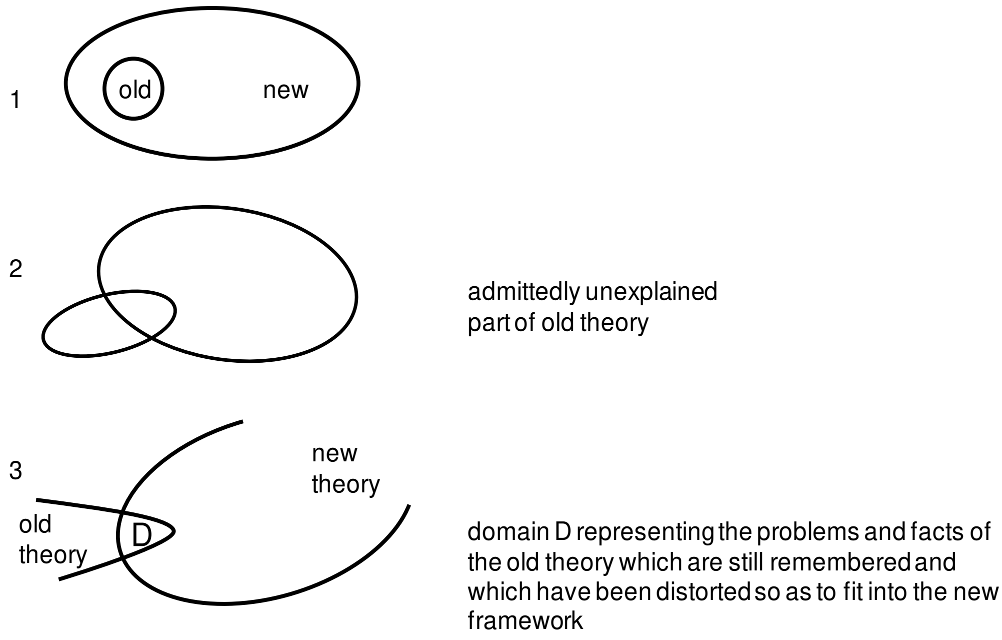

Figure 6: Theory domains, adopted from Feyerabend (1975/2010, 159)

Generally, the transition from one guiding scientific paradigm to another is perceived in terms of either illustration 1 or illustration 2. New knowledge is thought to extend much further than the old knowledge, either as an extension of the old (illustration 1) or as a new and much wider field than the intersection (illustration 2). By contrast, illustration 3 shows the real situation: our new paradigm with a new field of knowledge, whose limits that are accessible by the old paradigm cannot be demarked entirely. In this sense, Feyerabend also provides a differentiated consideration of incommensurability:

> I think that incommensurability *turns up* when we sharpen our concepts in the manner demanded by the logical positivists and their offspring, and that it *undermines* their ideas on explanation, reduction and progress. Incommensurability *disappears* when we use concepts as scientists use them, in an open, ambiguous and often counter-intuitive manner. Incommensurability is a problem for philosophers, not for scientists . . . .(Feyerabend 1975/2010: 218–9)

Again, this statement supports the claim that progress in science occurs when scientists challenge and modify existing concepts by breaking rules in order to achieve a scientific aim. In this light, one may use Feyerabend's theory, with its concept of 'sloppy' and 'irrational' procedures, to work out the epistemic foundation of futures research. Following Feyerabend, one may argue that there is a strict scientific methodology underlying futures thinking, but it is conducted in a way that uses 'sloppy' procedures. But how would we then measure scientific, methodological or procedural progress in futures research?

Authors such as Kuhn and Feyerabend were often misinterpreted and regarded as relativists in their views of science.[95] Kuhn's concept of scientific paradigms was taken as partial evidence that he believed scientific theories are social constructs. Feyerabend's aphorism "anything goes" was also often misunderstood as an anti-science claim. In fact, by "anything goes" Feyerabend never meant, as Hacking observes, that "anything *except* the scientific method (whatever it is) 'goes'. He meant that lots of ways of getting on, *including* the innumerable methods of the diverse sciences, 'go'" (Hacking 2010: xiii).

4.3 Realism vs. Relativism, or: Lessons from the Science Wars

Sections 4.1 and 4.2 describe divergent approaches to science. A central point of disagreement in philosophy of science – as indicated by the theories of Popper and Hempel or Kuhn and Feyerabend – concerned the scientific methods of the natural sciences.[96] But there is disagreement concerning not only what qualifies as the most suitable scientific method in natural sciences, but also between natural sciences, on the one hand, and arts and the humanities, especially social sciences, on the other. As indicated earlier, Popper's theory of critical rationalism is also motivated by the observation that inductivism had become too general in order to include disciplines that should not necessarily qualify as scientific. However, it is not only the scientific method per se that causes misunderstandings, but also the communication between different disciplines. For example, Kuhn's reflections on paradigms and incommensurability are also influenced by his observation and comparison of different scientific groups, such as social scientists, historians and natural scientists and the communication barriers between them:

[95] Feyerabend addresses this issue in the preface to the third edition of AM with the following statement: "Kuhn's main terms ('paradigm', 'revolution', 'normal science', 'anomaly', 'puzzle solving' etc.) turned up in various forms of pseudoscience while his general approach confused many writers: finding that science had been freed from the fetters of a dogmatic logic and epistemology they tried to tie it down again, this time with sociological ropes" Feyerabend (1975/2010: xxiii).

[96] Especially in philosophy of science, the past century is often described as the century of physics. In his *Introductory Essay* to the fourth edition of Kuhn's SSR (1962/2012), Ian Hacking says, in reference to the 1960s, that "[t]he queen of sciences, then, was physics" Kuhn (1962/2012: ix). This is due to the historical circumstances of the Cold War and the impact of the scientific progress of physics on current affairs and politics, but also on competing theories and cosmologies, e.g., steady state and big bang.

> Because the attention of different scientific communities is . . . focused on different matters, professional communication across group lines is sometimes arduous, often results in misunderstanding, and may, if pursued, evoke significant and previously unsuspected disagreement. (Kuhn 1962/2012: 176)

In contrast, the dominance of relativist positions in the social sciences and the humanities offered even more support of the differences between scientific communities detected by Kuhn. The discourse on supposedly anarchistic science or social constructivist science, on the one hand, and the positivist positions on the other, reached its climax with the "Science Wars" (Goldman 2006: 108).

To understand why the so-called Science Wars broke out and why they provide support for the thought that the scientific method and scientific aims of different disciplines are not entirely bridgeable, the two most divergent accounts of science should be recalled: the realist account on the one side, and the relativist on the other. The spectrum ranges from positivist, logical empiricist or rational criticist to post-positivist, wholist, postmodernist, social constructivist, etcetera. Of course, it is difficult to mark the differences. But one can at least make note that the radical distinction between the realist and relativist accounts lies in their attitude towards the way scientific truth is derived. As described in more detail in 4.1, realist accounts of science hold that "scientific knowledge reliably captures the structures of the world which is unaffected by all human conceptions and aspirations" (Carrier et al. 2004: 1). For this reason, unanimity characterizes sciences based on realism, in contrast to the arts and humanities. In the very extreme case, social and historical factors have no impact on scientific practice and the concept of scientific knowledge; the aim of science is to describe objects, phenomena, mechanisms, processes of the natural world, even those that cannot be perceived directly.

By contrast, in the relativist account non-cognitive influences have a major impact on the search for scientific truth. The justification of knowledge claims is strongly dependent on conditions which inhibit the universal validity of scientific laws: These conditions or principles have a social, cultural or historical origin. Furthermore, in the relativist account, observations are regarded as theory-laden and theories are suspected to be "underdetermined by experience" (Carrier et al. 2004: 1–2). Social constructivists, for example, who may be seen to represent a form of relativism, emphasize not only that social conditions are crucial for theory building, but also that the "validity of arguments is inevitably culture-specific" (Carrier et al. 2004: 2). In this regard, relativist accounts of science try to encompass both epistemic and ontological concerns. The relativist position can be roughly summed up as follows:

> Science is not governed by inexorable logic and undisputable evidence. Science is a social institution and consequently shaped by social rituals and customs such as narratives, rhetorical strategies, negotiations. (Carrier et al. 2004: 2)

Applying relativist, especially social constructivist, positions to certain issues has been very popular in the social sciences since the past century. The social constructivist endeavor is simply a change in perspective. While decades of philosophy have been engaged in revealing how certain objects (observable and non-observable) are constructed, the social constructivist account focuses on the subjects constructing the objects (Mallon and Ron 2014). In short, the philosophical questions *what* and *how* have been turned into the question *concerning who*. But the notion of social constructions, as Hacking observes in *The social construction of what?* from 1999, has become instead a metaphor, as it is applied to almost every issue without substantial proof. Moreover, "Sokal's hoax" even reveals that social constructivism may be criticized for itself being socially constructed and not adding any value to scientific theory. The critique that social constructivism is applied in an inappropriate manner is the core issue of the paper by physicist Alan Sokal that was published in a postmodern journal, *Social Text*, in 1996. In the article *Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity*, Sokal argues that physical reality is socially constructed.[97] Just to give an example: He refers to Derrida's and Einstein's field equations of the general theory of relativity, arguing that "the π of Euklid and the G of Newton, formerly thought to be constant and universal, are now perceived in their ineluctable historicity" (Sokal 1996: 222).

Shortly after the paper was published, Sokal admitted that it had been a hoax: its actual intention was to unveil the lack of foundation in postmodern accounts of science. He argued that the possibility to publish an article full of scientific flaws and misguided quotations is evidence for the fact that postmodern accounts of science lack substance when discussing issues of the natural sciences.[98] Moreover, "[t]he message was that an author's adoption of the right jargon and approval of the generally endorsed clichés were sufficient for winning postmodernist applause. Content, correctness, clarity or plausibility play no role in postmodern thought – or so the criticism ran" (Carrier et al. 2004: 3).

[97] In 2008, Sokal published his book *Beyond the Hoax*, where he argues for a modest scientific realism. The book starts with a chapter named "The parody, annotated", an enlightening as well as entertaining explanation of every single "joke" he elaborated in the hoax paper. See Sokal (2008: 5–93).

[98] For example, he claims to summarize Heisenberg's uncertainty principle in a quote, which is in fact only Heisenberg's philosophical interpretation of the uncertainty principle Sokal (2008: 12). In another annotation, Sokal questions his own quotation that "physical 'reality', no less than social 'reality', is at bottom a social and linguistic construct" Sokal (1996: 217, 2008: 9) in the following way: "Thus, the statement . . . interpreted literally, is ridiculous: can even the most ardent social constructionist really believe that there was no physical reality before about 200,000 years ago, when Homo sapiens evolved and human language and social life were thus born?" Sokal (2008: 8).Though polemic, he illustrates the inappropriateness of social constructivist approaches for argumentations in the natural sciences that follow this approach to deriving theories from facts.

This initiated a controversial debate on the use of social factors in the natural sciences. Especially after Sokal and Jean Bricmont published *Fashionable Nonsense* (1998), a book which triggered the debate that would later bear the title Science Wars. In this book, Sokal and Bricmont pursue two crucial aims: First, they defend a modest scientific realism by claiming that science is objective and thus has access to truth. Modest realism aims at finding objective knowledge. It seeks to determine how things really are, but it also recognizes that this goal can hardly be achieved (Sokal and Bricmont 2004). On the other hand, they also call attention to the misuse and misinterpretation of scientific and mathematical concepts (Carrier et al. 2004: 3).

Undoubtedly, the Science Wars reveal not simply that different scientific disciplines follow their own rules, or even their own sorts of paradigms, and apply different, often conflicting methods. Sokal's hoax even evoked an escalation of the debate on conflicting scientific theories. It also shows that scientific theories of one discipline can hardly be adopted by another. Theory adoption requires a high degree of similarity regarding scientific aims in order to adapt similar scientific procedures.

Some of the weaknesses of relativism were discussed in section 4.3. But neither does scientific realism provide a method for capturing the real world, or even future knowledge about the world. It too provides insufficient knowledge, which Rescher explains as follows:

> There is clearly insufficient warrant for and little plausibility to the claim that the world indeed is as our science claims it to be and that our science is correct science and offers the definitive "last word" on the issues. . . . [W]here scientific knowledge is concerned, further discovery does not just supplement but generally emends the bearing of our prior information. Accordingly, we have little alternative but to take the humbling view that the incompleteness of our purported knowledge about the world entails its potential incorrectness as well. (Rescher 2012: 162)

This quotation supports the fact that even the most realist scientific methods have to deal with the insufficiency of their knowledge on the way to scientific progress. Feyerabend's suggestion of the methodological "anything goes" for scientific progress thus seems to be inherent to the methodology of futures research: Since this discipline is not based on a classical scientific method or classical concept of prediction, there is need for customized, aim-oriented scientific procedures.

4.4 Epistemic implications for foresight

In the previous sections, I outlined some general scientific positions in different scientific fields and highlighted in parallel why foresight does not fit well in these concepts of science. But these concepts operate on different levels, including scientific explanation, method, and practice in general. Although there have been different new theoretical approaches which undermine the positivist account of science, Hempel and Oppenheim's definition of science from 1948 had a major influence on the general perception of the scientific method in all disciplines for a long time (cf. Helmer and Rescher 1958; Aligica 2003). At the same time, the Kuhnian concept of scientific revolutions revealed the impact of scientific practice per se. By contrast, the Science Wars also show that, from a (modest) realist point of view, postmodernist accounts of science may also cause misunderstanding and confusion (Carrier et al. 2004: 3).

Furthermore, the results of the preceding chapters on the scientific methods of experimental sciences suggest that foresight can also not be classified by any of the classical approaches to scientific knowledge which are based on logic justification. Whether based on a deductive or inductive approach, propositions about the future cannot be justified rationally. In particular, the epistemic deficiencies of foresight are visible when compared to epistemic standards in experimental sciences. This can already be seen in the objective of rational inquiry as formulated by Hempel and Oppenheim:

> To explain the phenomena in the world of our experience, to answer the question "why?" rather than only the question "what?", is one of the foremost objectives of all rational inquiry; and especially, scientific research in its various branches strives to go beyond a mere description of its subject matter by providing an explanation of the phenomena it investigates. (Hempel and Oppenheim 1948: 135)

This quotation reveals the specific perception of science and scientific inquiry from a scientific realist point of view – an issue that was raised anew by the Science Wars. The success of a scientific method depends on its ability to capture reality, or at least, to explain phenomena by processes that can be perceived and measured. Nevertheless, the fact that foresight cannot be ascribed to any existing account of science does not necessarily imply that futures research is not scientific. For this reason, in raising the question whether foresight qualifies as scientific, we have questioned not only whether foresight fits in prevailing concepts of science, but also what the specific procedures, practices and methods are used in foresight, which would justify calling it scientific. Here, epistemic questions arise on three different levels:

(1) First, there is the ontological question about what future knowledge can be in general when it deals with a certain form of prediction.
(2) Second, there is the question whether foresight belongs to one of the established scientific methods. This is related to the question whether science is defined by method and explanation or by procedure.
(3) Third, one ought to ask whether existing frameworks help to formulate an epistemic base for foresight.

Concerning the first point, we must clarify the meaning of prediction in terms of foresight with regard to established definitions used in science. This point was already addressed in the discussion of the HO-model, where I introduced Betz's notion of prediction as a point of comparison. Furthermore, I summarized the different forms of predictions used in philosophy of science (cf. Lenk 1986). These epistemic inquiries have also been discussed in the futures context, and will be discussed in more detail in chapter 5.2.

This inquiry into scientific methods gives reason to conclude that foresight – on account of its methodological heterogeneity – cannot be assigned to one scientific method in sense of philosophy of science. The wholist positions outlined in 4.2 in reference to Kuhn and Feyerabend suggest that, while it is possible to formulate some general criteria for scientific inquiries, for example, Kuhn's epistemic values, it is not possible to transfer one scientific system to another. In chapter 5 I will discuss in more detail how futurists explain the epistemic foundation of futures research and its placement within the sciences.

Reference points for a futures theory can be found in the actual development of scientific practice. It has already been said that, even though Kuhn's work is recognized as pathbreaking, it is not directly applicable to other sciences (Kuhn 1962/2012: x). Nowadays, scientific practice is strongly influenced by computer sciences, and as Hacking notes, "[e]ven experiment is not what it was, for it has been modified and to a certain extent replaced by computer simulation" (Kuhn 1962/2012: ix). But having learned about the transition from forecasting to foresight in chapter 2 and with Kuhn's definition of scientific revolutions and paradigm shifts in mind, we may recognize that the development of foresight reflects a process of scientific theory building. Foresight and foresight theory did not evolve out of itself. Definitions and theoretical underpinnings were established by adapting existing theories and frameworks from other scientific fields. To be comprehensible, foresight cannot simply create new definitions out of nothing; rather, it needed and still needs to build upon the language of existing sciences – otherwise nobody would understand it (Chalmers 1999: 105). Hence, Kuhn's *Structure* is just one of the oldest theories which may contribute to explaining a foresight epistemology as an outcome of a joint scientific practice. At the same time, the problem of building theories and definitions is especially due to the different scientific backgrounds of the foresight practitioners.

5. Foresight Theory: Explanatory Approaches

At the beginning of the futures studies era, the main contributions deal with the epistemic problem: What can we know about the future? In the preceding chapter, I suggested that we cannot know anything about the future using the criteria of science developed in positivist and relativist approaches. These scientific approaches show that assumptions about the future can be justified neither empirically nor *a priori*. Nevertheless, ever since the beginning of futures studies, scholars have been taking epistemic issues into consideration.

The oldest epistemic consideration in the futures field can be dated back to different works published in the 1960s, including *The art of conjecture* (1964/1967) and *Futuribles* (1965) by Jouvenel, Olaf Helmer's *Social technology* (Helmer 1966) and *The year 2000* (Kahn and Wiener 1967/1967). The early works of Stegmüller and Lenk at the end of the 1960s are the first epistemic inquiries of futures research in Germany (Lenk 1970). A more recent clarification on what we can know about the future, including how predictions can be defined in the futures field, is given by Rescher (1998). Wendell Bell (2003, 2004) has written a comprehensive two-volume work dealing with epistemic issues; Aligica (2003; 2009) has examined different accounts of scientific critique in the context of futures studies; Masini's work is also dedicated to epistemic questions (Masini 2006, 2001, 2010). Although futures research has been located mainly within the social sciences (Huber and Bell 1971; Karlsen et al. 2010), recent emphasis has been placed on interdisciplinary approaches that apply knowledge from diverse fields (Bell 2003). Fuller and Loogma (2009) even discuss whether foresight can be defined from a social constructivist approach.

At the same time, the field of futures studies has come under heavy critique. As Miles notes, most of the foresight theories are descriptive and not ground-breaking theories in their own right (Miles 2008). There have been controversial debates on futures studies and its impact, especially during 2001/2002. In this context, for example, Marien (2002a) points to the decline in importance of the field, reflected in a decline in the number of people engaged in futures studies and the number of publications in special journals.[99] According to the developments in philosophy of science and new answers to the question what science is, there have been various new works on the epistemology, ontology and methods underlying futures studies and foresight. For example, the ques-

[99] In a 2002 paper he debunks "seven disabling myths" Marien (2002a).

tion has been raised concerning which paradigm is guiding these fields and how new ones may be formulated (Mannermaa 1991; Hideg 2002).

The following three sections reflect three discursive strands in futures epistemology: first, the discussion whether foresight – or futures studies in general – is an art or science; second, the long tradition of treating futures studies as a social science; and third, a rather recent development in futures studies to treat the framework of futures epistemology and ontology alongside its practice.

5.1 Art rather than science?

Epistemic reflections on the question whether foresight – and futures studies in general – is an art or a science started to appear in the 1960s in conjunction with the use of different future-looking methods in practice. At that time, the subject matter was not called foresight or futures studies, but futurism, futurology (Flechtheim 1970) or conjecture. With *L'art de la conjecture*,[100] Jouvenel (1964/1967) was the first to classify this field as an art. Nevertheless, Jouvenel's main argument concerns the outline of the interdependency of processes and action (Jouvenel 1964/1967: 132); (Uerz 2006: 263). A concrete art-or-science discussion can be found, for example, in an article by Cornish (1969). He discusses what impact the work of a futurist has, either as an artist or as a scientist, and emphasizes that a professional futurist should be capable of dealing with statistics, science, technology, sociology etc. The futurist is an artist and scientist at the same time due to the different stages and methodologies applied in future looking processes: when exploring different future possibilities in an open manner, the scientist and the analyst questions the potential effects and impact of a "futurible", and tries to determine the likelihood of it occurring (Cornish 1969: 134–5). Cornish's differentiation can also be read the following way: while explorative tasks ask for the futurist as an artist, normative tasks ask for the futurist as a scientist, who uses concrete methods to envision a pathway to a desired future, for example, by probabilities or modeling.

Today such a distinction is somewhat superfluous, as foresight practitioners apply both normative and explorative methods, depending on the task. For futurism and futures studies the question whether it is an art or a science has been essential because it has time and again tried to establish itself as a scientific discipline. But the early "art rather than science" discourse took place during a time when logical positivism and empiricism had a major impact on the common perception of how to define science – and was a controversial topic in philosophy of science. For example, the social sciences were

[100] Published in Geman as *Die Kunst der Vorausschau* – literally "the art of foresight", Jouvenel (1964/1967).

often confronted with the accusation from positivists and realists of not being scientific. Accordingly, futurism also had to prove that it is based on scientific procedures.

In their work *On the Epistemology of the Inexact Sciences*, Helmer and Rescher[101] argue that the longstanding distinction between the so-called exact and inexact sciences, between two apparently fundamentally different classes of science, has all along been based on a myth (Helmer and Rescher 1958: 1). Their general claim is that an idea or proposition is scientific if it can be proven by anyone following an objective test. This applies to both the exact and the inexact sciences. Further, it is not solely the precision of a proposition, but also the systematic and reasoned way of deriving the proposition that characterizes a procedure as scientific:

> [A] discipline which provides predictions of a less precise character, but makes them correctly and in a systematic and reasoned way, must be classified as science. (Helmer and Rescher 1958: 2)
> [I]n any field in which our ability to forecast with precision is very limited, our actions of necessity are guided by only slight differences in the probability which we attach to possible future alternative states of the world, and consequently we must permit predictions to be based upon far weaker evidence than explanations. (Helmer and Rescher 1958: 18–9)

These quotations are evidence that the epistemic question on explanation and prediction – or rather the notion of its asymmetry – has already been raised in the early days of futures studies. Helmer and Rescher argue that prediction and explanation, laws, evidence and confirmation, follow different rules in the so-called inexact sciences. Nevertheless, they too can lead to objective scientific results. Their main concern is to emphasize that when dealing with future issues that can be forecasted, it is not appropriate to use the methods of so-called exact sciences, following the rule of deductive-nomological models; therefore, they criticize the HO-mode. In this work, they also introduce the epistemic base of the delphi method.

Helmer discusses once again the impact of the exact and inexact sciences and their scientific results on the future in his book *Social Technology*. In the context of physical and social sciences, he emphasizes the need for futures research methodologies within the social sciences in order to respond to certain challenges:

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[101] Helmer and Rescher have each made individual contributions to the field of futures knowledge with works on social technology, Helmer (1966), and pragmatic-epistemic considerations, Rescher (1958, 1982, 1998).

> Thus, just as in physics and biology, so are we in the social sciences faced with an abundance of challenges: how to keep the peace, how to alleviate the hardships of social change, . . . how to cope with revolutionary innovations, and so on. But unlike physical sciences, where failures normally mean mere delays, the social sciences cannot afford to fail in their major aspirations; to do so could have a direct and catastrophic impact on society. (Helmer 1966: 4)

According to Helmer's argument, exact sciences are insufficient for futures research as they cannot address the impact of science and technology on society. Helmer does not only indicate the insufficiency of exact sciences for futures research; he also addresses the weaknesses of a technocratic view to cope with future challenges to society. Hence, it is necessary to consider the impact of social aspects in the futures field. Several other authors emphasized this need, though not always referring to futures research as a scientific method. Before sketching these positions in 5.3, I will first outline Rescher's more contemporary approach to an epistemology of predictions.

5.2 Rescher's conceptual, epistemic and ontological considerations

In 1998, 40 years after the publication of Helmer and Rescher's epistemic work on scientific predictions, Rescher published *Predicting the future* (Rescher 1998), in which he outlines a theory of prediction. Prediction is addressed on three different levels: conceptual, epistemic, and ontological. A major achievement of this work is the detailed analysis of the structure and features of predictive questions and predictive answers, as well as their application in different fields.

As outlined in section 4.1.3, predictions are crucial for deriving scientific knowledge about the world, especially in the natural sciences. Rescher clarifies some crucial epistemic features which have a major impact not only on the way foresight is conducted, but also on the reliability, credibility and validity of its results. These issues are all strongly bound to the type of predictions that are made.[102] He emphasizes the differences of predictive issues in order to distinguish their reliability (Rescher 1998: 37–52). Predictions as such are defined by specific conditions. This includes, for example, that they

[102] The issue of predictions is already discussed at the end of chapter 4 in direct relation to the futures field.

"must rest on some evidential basis"[103] (1998: 38). Further, to count as a prediction and not only as a random future statement, it has to be credible that it is "providing putatively true answers to our predictive questions" (1998: 39). At the same time, someone has to take "responsibility for endorsing its correctness" (1998: 39). Therefore, predictions are not the same as mere "future-oriented statements" (1998: 39) or "possible courses of future developments" (1998: 40). How the questions are posed, retrieved and made credible, depends on the people questioning, answering and endorsing the statements that are to count as predictions. Concretely, predictions can be classified as either categorical or conditional, or – when occurring as forecasts – as definite predictions. The following table gives an overview of the different types of predictions:

Type	**Subtype**	**Description / Example**
Categorical		• *"E will happen"* or • *"E will not happen"*
Conditional	Specific	• *"E will happen if F does"* • "when-next": indefinite prediction concerning the time of occurrence
	General	• *"E will happen if F does"* • Predictions of the occurrence of "whenever" • *"Whenever condition C is realized, Result R will ensue"*

Table 1: Types of prediction, adopted from Rescher (1998)

Accordingly, predictions are supported in different ways by evidence. For example, there is an essential difference between predictions appearing as forecasts and those resting on probabilities. Forecasts, for example, are neither conditional nor general and open-ended, nor are they probabilistic. Rescher defines a forecast as a

> definite prediction concerned with specific and concrete events . . . [which] in this somewhat technical usage will-unlike predictions in general-be definitively verifiable/ falsifiable at some particular juncture of the ultimate course of events. (Rescher 1998: 43).

Hence, such forecasts do not depend on today's decision making. On the other hand, probabilities are used to characterize the status of a prediction. Probabilities per se are not apt predictions. Instead, probability-based predictions enable the formulation of

[103] Rescher (1998: 38) argues further: "some rational substantiation must be at hand because serious cognitive interest attaches not to predictions as such but *rational* predictions – those that are credible in the sense that there is good reason to accept them as correct then and there, before the fact". Rescher's definition of predictions bears the claim for a certain degree of truth, or at least the credibility of a prediction to possibly become true.

predictive answers by a substantial argumentative added value (Rescher 1998: 42). This task is essential, for it concerns all disciplines involving rational predictions that are not solely definite predictions in a forecasting manner. Rescher explains this point as follows:

> [T]he epistemic step from an attribution of probability–and even high probability–to an actual prediction is always a substantial one. It constitutes a step not dictated by principles of abstract logic but by practical policy of insisting on having the best available resolution where the evidential situation is indecisive. (Rescher 1998: 44)

Rescher argues that probabilities contribute to establishing credibility as a crucial "predictive merit" (Rescher 1998: 44). Credibility, enabled by probability, also contributes to the assertion of future statements. So predictions also require assertion, commitment and cogency in order to be taken seriously (1998: 56).[104]

The distinction between categorical and conditional predictions, including the way they are supported by evidence, also has a major impact on foresight. This is an indication that foresight activities do not generally rely upon predictions as forecasts but solely upon those gaining credibility by expert judgment within a range of possibilities. This raises crucial epistemic and conceptual difficulties for foresight. On the one hand, credible expert judgment may be used for creating credible predictions, which can be assessed as epistemically valid. On the other hand, the conceptual framework of foresight, which insists on multiple futures, and the equal value of possibilities and probabilities, shows the difficulty of its epistemic and ontological validation. Hence, the latter point cannot be resolved for foresight. For example, as Rescher shows, scenario construction, one of the main methods used in foresight, does not rely upon prediction at all. While predictions attempt to describe what *will* be, future statements, which are instead possible and speculative, describe what *might* happen. This is the case in scenario construction:

> However, the fact remains that scenarios are a matter surveying *possible* courses of future developments. They are imaginative speculations about what *might* happen and not informative specifications attempting to preindicate what *will* happen. By their nature, then, prediction and scenario construction are different sorts of enterprises. Their pursuit involves different aims and their effective cultivation calls for very different sorts of intellectual resources; namely, realistic foresight [sic!] in the one case and lively imagination on the other. (Rescher 1998: 40)

Here "realistic foresight" is used in the sense of a valid, credible rational prediction, for example, based upon a concrete forecast. It must not be confused with the actual term of

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[104] Rescher also argues that the merits of prediction have to be recognized before their occurrence, otherwise prediction is useless; Rescher (1998: 56).

foresight used in this work in the context of futures studies.[105] The sort of scenario construction Rescher is referring to is the technique of narrative scenario writing. Scenario construction, however, can be classified by different techniques, ranging from narrative to consistency-based.

Rescher's point shows that foresight validation is even more difficult. It supports the fact that futures research relies upon past and present facts that cannot be used to make general predictions. Such facts are used instead to create futures by means of language and imagination and not by observable, general rules (Grunwald 2009: 26). In fact, futures research is not a research about the future, or the research of future states, but an investigation of images about the future that can be created at present. Since it is about what *might* be rather than what *will* be, it is inevitably less predictive than for example, natural sciences. Paradoxically, foresight as a form of futures research is not predictive at all in any sense of a scientific rule. It is completely committed to the present and to relevancies of present knowledge. Thus, as Grunwald argues, progress in future knowledge is inevitably dependent on the passing of time, evoking change of knowledge about past and present facts (Grunwald 2009: 27). Finding the 'right' questions is as crucial as finding the 'right' answers in futures studies, but also challenging (Mitroff 1977).

So how can the credibility and reliability of predictions be assessed at all? And how can the validity of futures knowledge be determined? Rescher depicts the predictive merit of both predictive questions and predictive answers along concrete dimensions. These dimensions help to determine whether predictive questions and answers provide valid knowledge in the sense of holding "predictive merit".

[105] Rescher uses the term foresight literally and not in the futures studies sense. With reference to Rescher, one may also open a debate about whether foresight as a future-looking activity is labeled wrong.

Dimensions of merit for predictions
I Dimensions of merit for predictive questions
• Importance • Interest • Resolvability • Difficulty
II Dimensions of merit for predictive answers
• Relevancy (to the question at issue) • Detail/Precision (informative merit on points of contrasts such as specific vs. vague, particular vs. general, precise vs. imprecise etc.) • Correctness (categorical alethic merit: true vs. false) • Accuracy (comparative alethic merit: closeness to the truth) • Credibility/Evidentiation (evidential merit of cogency: credible vs. baseless, warranted vs. unwarranted; probable vs. improbable; good vs. poor evidence – To what degree can one count on the prediction coming true?) • Robustness (via agreement with the indications of other predictive resources)

Table 2: Dimensions of merit for predictions, table adopted from Rescher (1998: 114)

These dimensions are supposed to help assess the validity and usefulness of predictions. But they are not applicable in general to predictions in foresight. Instead, they emphasize some crucial conceptual and epistemic points outlined earlier – for example, that predictive issues follow different aims. Hence, these criteria could only be adopted for foresight methodologies based on conditional predictions, and not for methodologies that use imaginary possibilities, such as narrative scenarios, as they do not fulfil the dimensions of merit. This option, however, is limited to modelling approaches. On the other hand, the dimensions of merit for predictive questions may be applied to all sorts of foresight activities, as they affect the way the problem or subject matter is formulated.

But since predictions also rely on assertion and cogency, Rescher also proposes a set of factors for assessing predictive competences (Rescher 1998: 127). These are summed up in the following table:

Factors at issue in assessing predictive competence of predictors	
Reliability	or validity in terms of correctness and accuracy. Most important factor.
Versatility / range	as determined by the extent of the topical and thematic range within which the predictor is able to function effectively
Daring	as determined by the ability to tackle (and to succeed)
Perceptiveness	in terms of the detail and definiteness of its predictions
Foresight	as determined by the temporal reach – the span of the future over which the predictor is able to function effectively
Consistency	as determined by the uniformity of the predictor's performance over time
Self-criticism	as determined by the accuracy of the predictor's self-appraisal – manifesting superior performance where the predictor indicates greater confidence and/or claims greater competence
Knowledgeability	as determined by the predictor's cognitive competence with respect to non-predictive issues in the sphere of its predictive domain.
Coherence	as determined by the compatibility and systematic harmony of its predictions

Table 3: Factors at issue in assessing predictive competence of predictors

Rescher's outline of a theory of prediction indicates that social factors too have a major impact on certain kinds of predictions, especially on those widely used in the field of futures studies. Even though Rescher himself is more a pragmatist and not a social epistemologist, the outline of knowledge in foreisght in chapter 7 will indicate that his factors for assessing predictive competences of predictors may also be considered in foresight.

5.3 Social concepts of a futures epistemology

In a paper published in 1971 titled, *Sociology and the emergent study of the future*, Huber and Bell (1971) outline the roots of futures thinking in the social sciences. They believe the earliest analyses on futurology in the social sciences took place in the early 1930s.[106] They argue that several factors led to the emergence of a general interest in the future from a social science perspective in the 1960s: First, it is argued that "as war memories faded", the belief that "the political and social future could yield human betterment" (1971: 287) re-emerged and became a theme of study; second, there is the rule of planning and planning methods in business and politics; third, more accuracy in predicting the future was expected due to technological innovations, especially computer models;[107] fourth, the need to anticipate future events to provide orientation and help guide action was intensified by the "acceleration of the historical process" (Huber and Bell 1971: 288).

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[106] In their paper, Huber and Bell outline how Nathan Israeli undertook different attempts to create a "social psychology of futurism": His evaluations on possible future trends and experiments to "isolate the nature of the predictive process" did not support his earlier promises – and thus hardly gained attention in the scientific community. At least two other psychologists, Douglas McGregor and Hadley Cantril, continued this path of inquiry into the nature of prediction at the end of the 1930s. Concretely, they "wanted to know what factors influence the predictions an individual makes" by conducting a questionnaire-based approach that links predictions to social backgrounds etc. of the respondents; Huber and Bell (1971: 287). Almost two decades later, Hans Toch took up their methodology and analyzed predictions about the year 1952, which Cantril had collected earlier. Based on his own research and the research of McGregor and Canrtil, he defines the nature of prediction in four points. It is helpful to consider those generalizations from a contemporary point of view, for they comprehensively describe all social science insights on predictions formulated in the context of futures research. Huber and Bell (1971: 287) summarize these points: (1) accurate prediction is related to the individual's ability to foresee novelty and change; (2) subjective factors influence prediction to a greater extent if the predictor considers the event in question vital to his or her own interests; (3) cautious statements and accurate predictions seem to be positively related, and (4) immediate experience has a considerable influence on the nature of given predictions and on the aspects of the future emphasized in them. In other words, reliability of predictions depends, according to claim (1), on the expertise of the respondent. Accuracy of cautious statements (3) can be reached when the predictions concern issues that can be forecasted and which have a shorter time horizon. And for claims (2) and (4), different examples of contradictory and emotional predictions of climate change and energy may count as examples. Despite the fact that all of these points have eventually been confirmed by practice in futures research, this systematic study is unique in the social sciences. While the epistemic insight of Toch's claims has not changed, different conceptual and methodological ways of treating predictions from a social science perspective have emerged.

[107] Climate models are a typical example in this case; for an overview on advances in climate modeling, see Flato and Marotzke (2014).

As indicated in the previous chapter, in *Social Technology* Olaf Helmer strongly emphasizes the social impact in future-looking activities. Moreover, Helmer believes that the new methods developed for the field of futures research could improve the accuracy of theories in the social sciences. He argues that their potential to contribute to discussions on topics of everyday life, social issues and technological innovations, supported by new methods like delphi, must be taken into consideration, and that they can help us orient ourselves towards crucial issues of the future, and relate them to scientific and technological progress. There is need for new approaches in the social sciences: While there is continuous progress in the physical sciences, leading to new technologies, social sciences are lagging behind in investigating the impacts on human society (Helmer 1966: 3). For this purpose, he offers "specific proposals for methodological modification of traditional procedures" (Helmer 1966: 3). The need in the social sciences for a methodological orientation towards futures may also be described as follows:

> Whether our society will be able to undergo these modifications [the change caused by technological innovation, E.S.] without severe disruptions will depend greatly on the wisdom and effectiveness of our social planners. (Helmer 1966: 4)

In light of the fact that *Social Technology* was published in 1966, it is obvious that the underlying concept of futures research still refers to *planning* the future. Helmer describes future-looking methods as new social science methods by presenting them as tools for operational model building (Helmer 1966: 6–10). This is the established approach of mathematical and simulation models that explain world issues scientifically. These "models of the operations-analytical type" may also include mathematical and simulation models. Examples are simulation models that make "statements about the simulative entities of the model", operational gaming, role playing or scenario writing. The main element that all of these tools for operational model building share is the use of expert knowledge. Helmer describes the impact of expert knowledge on decision-making in future-oriented issues as follows:

> When an operations analyst constructs a model, simulative or not, he usually does so in order to determine the most appropriate action to take in the face of a given situation. His function is, after all, to give operational advice to a decision-maker. Often, he may find himself at the frontier of the state of the art, and he may have to rely heavily on whatever expert judgment may be available, rather than on a solid (non-existent) theory. His model is therefore apt to be *ad hoc*, tentative (that is, subject to modification or improvement), future-directed, and policy-oriented. Frequently, the reliability of such a model may leave much to be desired; yet its justification should derive from the fact that recommended actions based on it have a good chance of being more appropriate than actions selected without use of the model. (Helmer 1966: 7)

This quotation could be read as a definition of foresight, except for the fact that the notion on constructing multiple futures is missing. Nevertheless, from this modeling point of view it becomes obvious why futures research is rooted in the social sciences: the need for orientation is a crucial aim of futures research, and this is provided by expert judgment, which is a main object of analysis in the social sciences. Hence, following Helmer, foresight methods can be described as formal models. While science and technology studies experienced tremendous success in the following years, the strict orientation of the future-looking methodologies towards simulation models, combined with different efforts by computers to provide predictive support for forecasting, led to a methodological and epistemic impasse (see chapter 3).

In the early 1960s, futures research was guided by a strong belief in the success of forecasting. According to their early publications 1958 and 1966, it is clear that Helmer, and Rescher recognized early on the epistemic deficiencies of futures knowledge. But they also recognized that methods of the inexact sciences – namely, the social sciences – could be useful for futures research. Helmer's suggestion that one define future-looking methods as model-based approaches is one example. This means that all non-epistemic issues, including political and social issues and social values, can be integrated into the model of expert knowledge. Basically, from a social science perspective, the perception of the impact of epistemic and non-epistemic issues on futures knowledge has not changed in the foresight era.

At the beginning of the 20th century, Wendell Bell revised the efforts of futures studies in the context of social sciences and beyond. Bell's two-volume *Foundations of Futures Studies* (2003, 2004) is a comprehensive and detailed treatment of the social elements of epistemology, procedures and aims in foresight. Bell takes up the methodological and theoretical problems of futures research already addressed by Huber and Bell (1971) and describes the field of futures research as a "transdisciplinary action and social science" (Bell 2003: 189). The following quotation summarizes his epistemic standpoint:

> Futurists focus on the transformation of hindsight into foresight. On the one hand, they speculate, think laterally, intuit, reason counterfactually as well as factually, cogitate linearly *and* dialectically, entertain outrageous – and even despised – notions, and creatively invent in order to unveil possible and probable futures. On the other hand, they specify past and present data using a multitude of standard and special methods, collecting, analyzing, and interpreting evidence in order to make posits about possible and probable futures and to construct surrogate knowledge as reliably and validly as they can. (Bell 2003: 238)

Bell attempts to link foresight epistemology to critical rationalism. His definition of critical rationalism involves accounts of scientific realism as well as logical empiricism (Bell 2003: 207–8). The quotation may be seen as an attempt to embed the definition of futures epistemology in the concept of critical realism, but it also shows that despite the methodological variety, future knowledge is classified as surrogate knowledge. Helmer's notion of the need for expert knowledge and a model-based methodological framework is exactly what underlies this concept, which means this surrogate knowledge is strongly influenced by non-epistemic issues. Nevertheless, Bell tries to provide an epistemic framework for futures studies that includes the social impact. For example, he emphasizes that social biases may threaten validity (Bell 2003: 208). In the second volume, he argues that "[t]he critical realist theory of knowledge can incorporate the testing of value propositions just as it tests truth claims about the past and the present" (Bell 2004: 69). He introduces different approaches to prove that value judgments can be objective. So, while the first volume of *Foundations of Futures Studies* deals with epistemic considerations on futures knowledge, the second volume is oriented towards the ethical foundations, dealing with human values, goals and preferences (Bell 2004: 2–4). Overall, Bell's concept of futures studies builds upon the epistemic position that

> a great deal of scientific research is directed at creating knowledge not as an end in itself but as a means for solving practical problems or achieving other valued ends. . . .
> (Bell 2004: 2)

Bell touches upon two crucial issues that futures research and foresight have in common with scientific research: first, the aim to solve practical problems, and second, validation of value judgments and of values in general. These two points are also essential for a socio-epistemic approach to a foresight epistemology. The impact of 'the social' is also a vital part of epistemic discussions on foresight, not only in Bell's work (Bell 2004, 2003; Bell and Olick 1989), but also in Karlsen et al. (2010), who discuss epistemic challenges in foresight from a sociological perspective, including anticipation, complexity, ambiguity and uncertainty. Social aspects in foresight are also widely discussed with a view to the application of foresight methods, for example by Slaughter (Slaughter 1995).

Comparing contemporary social science approaches in foresight to the early model-based methodology for dealing with future issues in *Social Technology* (Helmer 1966), one can see that non-epistemic issues still play a central role. But one can hardly find detailed sketches of a conceptual social science framework for foresight.

5.4 Approaches to contemporary theories of science

In section 5.3, I argued that social sciences had a major impact on the development of futures studies, but they were not the only field to have an impact on futures studies.[108] This circumstance has been taken up by different authors who have used contemporary concepts of science to explain foresight theory and futures theory in general. In the following sections, I will sketch two main contemporary strands of philosophy of science that have been taken up in futures studies: first, approaches to evolutionary concepts and, second, references to post-normal science, for example, the post-normal science concept by Funtowicz and Ravetz (1993, 1994).

5.4.1 Evolutionary concepts

A main influence of the evolutionary approach is John Ziman, who argues in his work for the plurality of sciences based upon an evolutionary approach to philosophy of science (Ziman 2003, 2000, 1998a, 2003). Ziman's main point is that physical, biological and human sciences are distinct realms of science each using their own "languages". Like Chalmers, Ziman argues that there cannot be a "theory of everything". But his argument is that this idea contradicts the evolutionary feature of spontaneously evolving entities. While becoming more complex – by evolving from elementary particles to organisms and then eventually to self-aware humans and societies – these entities develop novel principles and properties, which means they cannot be described, let alone predicted, by the language of their constituents (Ziman 2003). As sciences develop, they follow the same principle. Hence, the rule of different paradigms in different sciences can also be described as evolutionary. The idea of an evolutionary theory of science may be summarized as follows:

[108] As a matter of fact, there are even more contemporary branches in philosophy of science and theory of knowledge which might be fruitful for epistemic considerations in futures studies, especially those arising with and after the practice turn. See for example Bas van Fraassen's work, especially *The scientific image* (1980/1990) on constructive empiricism, which fosters the scientific anti-realsit point of view. This rejection of truth-aimed science might also be applicable in futures studies. Like Giere (1988), van Fraasen also emphasizes "the non-linguistic character of models", see Morrison and Morgan (1999a: 4). Other philosophers, such as Morrison and Morgan (1999b); Morrison (1999); Suárez (1999) also emphasize the role of models in scientific resoning. Such approaches may also be useful scinetific concepts for futures studies, which could be interpreted as a field producing futures models, respectively. The impact of the practice turn has been widely discussed in relation to other scientific fields and disciplines like sociology, science studies, cultural theory, history and anthropology, e-g. in Schatzki et al. (eds. 2001); see also the examples in Pickering (ed. 1994).

> Scientists did not develop it ["the conventional paradigm of a multi-leveled scheme of ever more inclusive systems"] step by step upwards in order to facilitate their scientific thinking. It is only really available to us because it is a fact of nature. Human beings were presented with a world that they could indeed dissect into a nested hierarchy of relatively stable composite entities of various levels of complexity. The baryons, nuclei, molecules, living cells, multicellular organisms, conscious beings and social institutions that we found in nature were related to each other in just that way. So at each level of the hierarchy we not only found entities that could be analysed into lower-level constituents: we were also supplied with modular constituents for a higher-level model. (Ziman 2003: 1622)

According to this theory, the more detailed our knowledge is about the world, the more complex are the possible models. At the same time, this means that the formalized principles of mathematical and physical sciences are not a suitable scientific language for higher-level constituents of the world, as "scientific knowledge cannot be restricted to generalized synchronic models, but involves historical narratives of specific events and unforeseen circumstances" (Ziman 2003: 1617). Hence, the plurality of sciences is part of the universe; it embraces "the imagined future as well as the remembered past" and arises in social contexts (Ziman 2003: 1617).[109] Ziman notices in reference to the long history of philosophy of science – especially the epistemology of natural sciences, as described in chapter 4 – that the acceptance of a need for different scientific languages in different fields of science should also be recognized for sciences that deal with social institutions:

> So scientists have long accepted the need for alternative modes of discourse, embodying different logical principles, to represent different realms of knowledge.
> What is not yet accepted, however, is that other modes of discourse may also be needed to account scientifically for what actually goes on in much more familiar domains. Take, for example, the domain of social institutions. (Ziman 2003: 1627)

So, according to the logic of an evolutionary scientific progress, not only do established theoretical fields of physical, biological and human sciences need their own language to represent their knowledge, but also the new fields of science, especially those that incorporate interdisciplinary scientific work. Could Ziman's argument, then, also be used to demonstrate that foresight is an interdisciplinary yet independent scientific field? To be sure, foresight has distinct aims, its own discourse and field of application, and it has adapted its own distinct methodologies according to its own multiple futures paradigm. In fact, foresight has already established its own scientific language. How can this approach contribute to futures studies? Or to put it more concretely: How has it been adopted so far?

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[109] On this point, Ziman's understanding of science is related to Feyerabend's.

Several authors refer to evolutionary concepts of science in order to ground futures studies theoretically, for example, Sahal (1977), Mannermaa (1991), Hideg (2002) and Gidley (2013). But other authors focus exclusively on evolutionary theory. According to Sahal, future problems can only be perceived by a future-oriented framework, as "[t]here is no conservation law which states that the future will equal the past" (Sahal 1977: 159). The progress of time shapes the world in an evolutionary way. Therefore, using hindsight to create foresight is insufficient, as the future cannot be seen on a history-based model. Rather, the future is affected by evolutionary events. Sahal's crucial argument is that within a systems-oriented paradigm, futures should be considered in a holistic way. Hence, an appropriate concept of 'evolutionary futures' consists of a framework which takes both into consideration: methods for creating reductionist models in order to provide information in systems analysis and techniques for the "study of the holistic aspects of the system under consideration" (Sahal 1977: 160). Concretely, this argument can also be read as a demand for including both quantitative and qualitative methods into future-looking activities.

In the foresight field, Ziman's work has also been taken up in another direction, especially witch references to the Mode 2 concept of scientific practice (Gibbons, ed. 1994) and the post-normal approach to science (Funtowicz and Ravetz 1993, 1994). [110]

5.4.2 The post-normal science concept

Another contemporary approach that is related to the evolutionary approach is the concept of post-normal science developed by Funtowicz and Ravetz (1992, 1993). They propose a new framework to manage uncertainties in science and policy issues, which they see as the main challenges of contemporary scientific practice. Their analysis of contemporary scientific practice leads to a picture similar to Ziman's on real science. This is evident in the following statements about science:

> Whereas science was previously understood as steadily advancing in the certainty of our knowledge and control of the natural world, now science is seen as coping with many uncertainties in policy issues of risk and the environment. In response, new styles of scientific activity are being developed. The reductionist, analytical worldview which divides systems into even smaller elements . . . is being replaced by a systemic, synthetic and humanistic approach. The old dichotomies of facts and values, and of knowledge and ignorance, are being transcended. (Funtowicz and Ravetz 1993: 739)

[110] Further references can be found in the work of Slaughter (1996b); Bowonder et al. (1999) and Linstone (2011).

One may question whether new approaches to science are indeed more humanistic than are reductionist approaches. Funtowitcz and Ravetz's main epistemic point is that contemporary scientific practice follows a new structure and new goals within a larger practical field. They highlight the emergence of new functions and methods of science, which no longer correspond to the Kuhnian definition of normal science, as scientific progress is conceived as the "extension of the laboratory" (Funtowicz and Ravetz 1993: 741). Another crucial notion is the repeal of the fact-value dichotomy. The following quotations summarize some main features of contemporary science:

> [V]alues are not being presupposed but made explicit. . . .
> The historical dimension, including reflection on humanity's past and future, is becoming an integral part of a scientific characterization of nature. . . .
> When science is applied to policy issues, it cannot provide certainty for policy recommendations; and the conflicting values in any decision process cannot be ignored even in the problem-solving work itself. . . .
> One way of distinguishing among the different sorts of research is by their goals: applied science is "mission-oriented"; professional consultancy is "client-serving", and post-normal science is "issue-driven". These three can be contrasted with core science-the traditional "pure" or "basic" research-which is "curiosity-motivated". In the area of post-normal science the problems of quality assurance of scientific information are particularly acute, and their resolution requires new conceptions of scientific methodology. (Funtowicz and Ravetz 1993: 740)

This approach acknowledges that values have a major impact on science: purposes, procedures, involved persons. Contemporary science is value-laden on different stages. This view of science also indicates that paradigms of scientific method that are dominating the discourse of philosophy of science no longer encompass the contemporary use of scientific method. Moreover, as can be seen in the two following illustrations by Funtowitcz and Ravetz, traditional research paradigms, while widely discussed and responsible for various dogmas about science, are restricted to a small field of scientific practice.

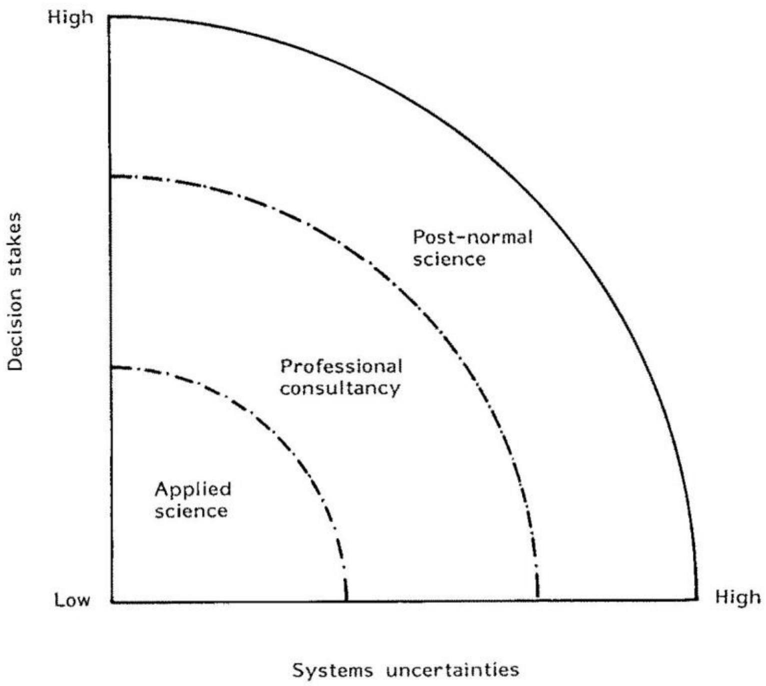

Figure 7: Problem-solving strategies according to Funtowicz and Ravetz (1993: 745)

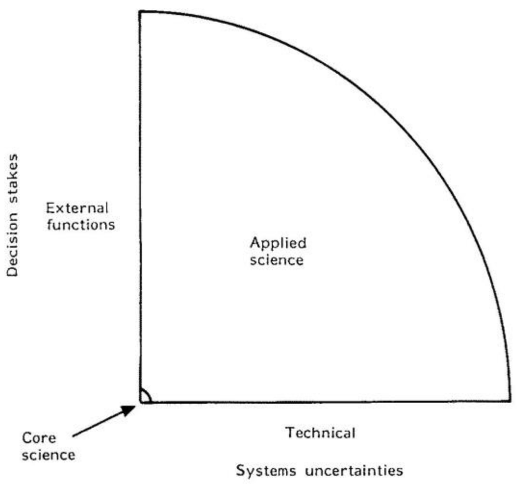

Figure 8: Relation of core science and applied science according to Funtowicz and Ravetz (1993: 746)

Besides these structural observations on science, the main argument is that systems uncertainty grows from applied to post-normal science in accordance with the growing impact of values, societal issues, and their new research goals, but also due to a wider environmental focus of the research. Each stage requires the former stages, but they still need new methodologies in order to reach their research aims. This also refers to the challenge of quality assurance. The authors emphasize that criteria and procedures of scientific quality assurance, as it is conducted within a framework of Kuhnian normal science (e.g. within the logical empiricist account of science), are not applicable to research within post-normal science, for example, policy-related research, as they do not take into consideration ethical or societal issues. For this reason, they recommend another approach:

> [A]n integrated approach to the problems of uncertainty, quality and values . . . [where] different kinds of uncertainty can be expressed, and used for an evaluation of quality of scientific information. (Funtowicz and Ravetz 1993: 743)

The authors distinguish between three different forms of uncertainties that should be set in context to the illustrations above:

> (1) Uncertainty at the technical level, corresponding to inexactness. Appears in standard routines like statistics. Managed by use of techniques and conventions developed for particular fields.
> (2) Uncertainty at the methodological level, corresponding to unreliability. Appears when more complex aspects of the information, as values or reliability, are relevant. Managed by personal judgments depending on higher-level skills, personal consultancy.
> (3) Uncertainty at the epistemological level, corresponding to "border with ignorance". Appears when irremediable uncertainty is at the core of the problem; generally in post-normal science. (cf. 1993: 743–4)

As a matter of fact, there is no solution given for the third form of uncertainty, as it basically corresponds to uncertainties in post-normal science. While quality assurance is certainly possible on the first level, it is more difficult and in need of other tools on levels two and three, as values and larger systemic frameworks have to be taken into consideration. The following quotations on post-normal science offer more clarification:

> [P]ost-normal science occurs when uncertainties are either of the epistemological or the ethical kind, or when decision stakes reflect conflicting purposes among stakeholders. We call it "post-normal" to indicate that the puzzle-solving exercises of normal science (in the Kuhnian sense), which were so successfully extended from the laboratory of core science to the conquest of nature through applied science, are no longer appropriate for the solution of global environmental problems. . . .
> Post-normal science has the paradoxical feature that, in its problem-solving activity, the traditional domain of "hard facts" over "soft values" has been inverted. . . .
> The traditional fact/value distinction has not merely been inverted; in post-normal science the two categories cannot be usefully separated. The uncertainties go beyond the systems,

> to include ethics as well. All global environmental issues involve new forms of equity, which had previously been considered "externalities" to the real business of the scientific-technical enterprise. These involve the welfare of new stakeholders, such as future generations, other species, and the ecosystem as a whole. Funtowicz and Ravetz (1994: 1884)

Clearly post-normal science is a fruitful concept for futures studies: (1) it addresses the systemic research on larger, holistic socio-technical and economic issues; (2) it respects ethical and societal issues as well as values; and (3) it reflects future developments of these value-laden issues.[111] It justifies including laymen and values into one task and can account at the same time for its scientific foundation.

Finally, the concept post-normal science still appears as a fixed concept, though emphasizing the value-laden character of scientific practice and the high degree of uncertainty in solving problems related to real-world, environmental, societal or future issues. In contrast to Kuhn, Funtowitcz and Ravetz recommend a concept in which post-normal science seems to be the final form of scientific practice. However, they note that the problem-solving strategies "should not be seen statically, but rather dynamically, where different aspects of the problem, located in different time zones, interact and lead to its evolution" (Funtowicz and Ravetz 1994: 1884). This position seems to reflect the flexibility needed at different stages of foresight practice. But still, in the Kuhnian sense, there is no space left for scientific progress regarding the potential emergence of new paradigms. It is not clear whether there can be anything new beyond post-normal science. The concept of post-normal science has been frequently taken up in work on futures studies (van der Sluijs et al. 2005; Schomberg et al. 2005; van Asselt 2012).

5.5 Summary

With reference to Rescher, scientific knowledge requires epistemic discussions and the consideration of specific epistemic virtues. But this is not expedient in the futures field. The other approach is to adopt certain accounts of science in scientific practice in the futures field. Yet these attempts indicate that there are many different methodological approaches within interdisciplinary sciences rather than one single concrete theory that can count as an epistemic base for foresight.

In fact, these many examples – including the early links to the social sciences, evolutionary concepts and post-normal science – show the variety of scientific backgrounds and methods the field draws from, and they reveal its capacity to adapt new methodolo-

[111] For example, they illustrate the concept of post-normal science on the issue of global climate change, which is not only dependent on climatic forecasts, but also on economic, social and cultural developments. See Funtowicz and Ravetz (1994: 1884).

gies. These examples also show the impact of values and social issues on objectivity and reliability of foresight. They indicate possible paths one may take to argue that foresight is a science, provided that there is a clear and shared understanding of the underlying scientific concept. Further, the art-or-science question in foresight is a remnant of times when sciences differed from each other by emphasizing that they follow different paradigms in their scientific practice.

Nevertheless, following Ziman's point that distinct languages are needed to describe systems, from biological to mathematical to cultural, it should also be possible to adapt an distinct language to describe foresight scientifically. This requires not only a definition of epistemic features, but also a closer examination of ontologies and (scientific) practices within the field. All these points have been taken into consideration by various authors in a more or less comprehensive manner. Rescher's *Predicting the Future* is the most comprehensive work, as it encompasses not only conceptual but also epistemic and ontological issues. Nevertheless, as Rescher shows, the difficulties in applying such a theory to fields of practice cannot be solved on each of these levels. Finally, in light of discussion above and the definition of the sociology of the future, futures research should be described as an interdisciplinary field, which has to deal with essential epistemic issues (see Rescher, section 5.2) but also social issues.

The challenge in foresight – or futures studies in general – is to formulate a theoretical framework that enables validation and encompasses the practical orientation at the same time. Other aspects too need to be addressed, such as truth, objectivity, framework conditions and procedures, aims and the impact of social factors. A contemporary approach could be socio-epistemic. The following chapter outlines the concept of social epistemology, which manages to embrace of all these features and possibly provide connecting points to a framework for foresight theory and practice.

6. On Social Epistemology

In classical epistemology, the guiding questions are what knowledge is, what we can know and how we can verify knowledge. In chapter 4, I outlined the different accounts of science to highlight why foresight does not fit with these approaches, while chapter 5 showed the limitations of contemporary approaches in formulating a comprehensive theory of foresight.

Similar to evolutionary theory (outlined in section 5.5), naturalistic epistemology, historic epistemology and feminist epistemology, social epistemology is one of the younger branches of classical epistemology (Schützeichel 2007: 290). The socio-epistemic view of science reveals that the principles laid out in the philosophy of science do not correspond with the reality, with how the different disciplines generally function in practice. This is most apparent when one examines more closely the value-free ideal that has guided science over the past century, and which some authors still defend. The key idea of the value-free ideal is the distinction between epistemic and non-epistemic values (Douglas 2009: 89–90). Yet values have different functions in research. To ensure objectivity in science and scientific communities, that is, to produce reliable results, it is necessary to take into consideration the different kinds of values and the ways they enter science. This is also connected to the credibility and authority of experts.

In this chapter I first define what social epistemology is by distinguishing its different strands. At the center of this chapter is the discussion of values and objectivity in reference to the theories of Heather Douglas (2000, 2008, 2009, 2011, 2013) and Helen Longino (1990, 1996, 2002, 2004, 2015). Issues of objectivity and values should be discussed in isolation from each other. One of the earliest and most influential papers to discuss the issue of the value-free ideal in the social sciences, Max Weber's *Die ‚Objektivität' sozialwissenschaftlicher und sozialpolitischer Erkenntnis* (1904/1985), focuses primarily on objectivity. But in order to formulate the categories and criteria of a foresight epistemology, it is important to consider both objectivity and values in their relation. I will examine them in light of Longino's concept of transformative criticism for scientific communities.

6.1 General remarks on social epistemology

The main subject of social epistemology is the social dimension of knowledge (Goldman 1987; Schützeichel 2007). The first paper to address the idea of a social epistemology is Margaret Egan and Jesse Shera's *Foundations of a Theory of Bibliography* from 1952 (Egan and Shera 1952). By social epistemology, according to Egan and Shera,

> is meant the study of those processes by which society as a whole seeks to achieve a perceptive or understanding relation to the total environment – physical, psychological, and intellectual. . . . Social epistemology merely lifts the discipline [of epistemology] from the intellectual life of the individual to that of the society, nation, or culture. (Egan and Shera 1952: 132)

As a librarian and information scientist, Shera is interested in social epistemology in terms of how information is produced, distributed and accessed in society. For this purpose, he created a framework to show information production and consumption, which he expanded during the 1960s and 70s in the context of a librarian project (Zandonade 2004). The basic idea was taken up again in the 1980s and 1990s and developed in new directions. In general, social epistemology deals with the impact of society on knowledge creation and the way knowledge is gathered and institutionalized in epistemic communities. It pursues the general aim of science to find justified knowledge, but it re-evaluates issues like objectivity, the value-free ideal, trust, relevance and reliability in science (Douglas 2009, 2000; Longino 2015, 1990; Kitcher 2001). Social epistemology also focuses on the cognitive division of labor, "distributed cognition" and group rationality (Schützeichel 2007: 290). Although it may seem at first sight that social epistemology is not fundamentally different from knowledge sociology, it has to be emphasized that they differ in that social epistemology focuses on ontological and epistemological questions that are neglected in sociological theories of knowledge. For example, one may question the individual or collective subject or the epistemic consequences arising from knowledge as a social product (Schützeichel 2007: 291).

There are different ways to classify the variety of approaches to social epistemology. Following Schützeichel, the different positions are classified in accordance with their attitude towards justification and truth, which would be a distinction between the rather philosophical, veritistic strand and the naturalist, sociological strand (Schützeichel 2007: 292). An example of the latter is the work by Steve Fuller. With his book *Social Epistemology*, published in 1988 (Fuller 2002), and the scientific journal of the same name, which had been started one year earlier, he was the first to take up the project of social epistemology following Shera. The veritistic strand, which is closer to philosophy of science, is mainly represented by the work of Goldman and by less radical approaches, for example, Kitcher (1990, 2001), Longino (1990, 2002) and Douglas (2000, 2009). Basically, these approaches define knowledge as justified true belief. Kitcher, for instance, investigates how the division of cognitive labor affects the establishment of justified truth (Kitcher 1990, 2001). Goldman investigates how collective scientific practices can produce true beliefs (Goldman and Cox 1996; Goldman 1999, 2004, 2009, 2012).

In a more recent paper from 2011, Goldman provides a new overview of the different strands of social epistemology. In the following sections, in order to show the different strands and epistemic problems, and especially the differences with social constructivism, I will refer to Goldman's recent categorization. Essentially, it refines the classification provided by Schützeichel (see above). Goldman distinguishes between three types of social epistemology: (1) revisionism, (2) preservationism and (3) expansionism (Goldman 2012). This distinction is based on the relation of each concept to traditional epistemology. While revisionism corresponds to the naturalist strand of social epistemology, preservationism and expansionism encompass the different developments of the veritistc strand. In the following sections, 'revisionism' is discussed in light of the differences between social epistemology and social knowledge (6.1.1), whereas preservationsim designates conservative approaches to social epistemology (6.1.2). The final section will focus on expansionist social epistemology (6.1.3).

6.1.1 Social epistemology vs. social knowledge

At first sight, social epistemology appears similar to sociology of science, since both inquire into social aspects of scientific knowledge. But whereas sociology of science uses social skepticism to undermine realist accounts of science, social epistemology builds upon realist aims and inquires into the social dimensions of scientific knowledge. As a representative of the philosophical strand, Goldman denies that the sociological perspective of social epistemology, which he calls "revisionism", is real epistemology. This is because it does not inquire into "real" epistemic questions. Following Goldman, this perspective

> would associate 'social epistemology' with movements in postmodernism, social studies of science, or cultural studies that aim to replace traditional epistemology with radically different questions, premises, or procedures. Although these enquiries examine the social contexts of belief and thought, they generally seek to debunk or reconfigure conventional epistemic concepts rather than illuminate the nature and conditions of epistemic success or failure. (Goldman 2012: 248)

This quotation highlights how that sociology-oriented strand of social epistemology constructs a new framework to discuss the impact of social contexts per se, while the other perspective, which Goldman divides into *preservationism* and *expansionism*, can be seen as a new branch of philosophy of science. Here, the focus is on epistemic conditions of knowledge acquisition. The essential difference between the revisionist sociological concepts becomes clear once one examines the main contributions to this position. Besides Steve Fuller, who calls his work 'social epistemology', other positions of social constructionism overlap with the revisionist social epistemology concept in their definition of knowledge, especially the "strong program" of sociology of science (see also Schmitt 1994a). For example, Goldman refers to Rorty, who claimed that it is more vital to "keep the conversation going than to find objective truth", and Shapin's claim that "truth is a social institution" (Goldman 2012: 250). From this perspective, facts and truth are defined as social constructions of the world that are made by humans and discovered in the world (Latour).[112] Consequently, knowledge is "simply whatever is believed, or perhaps 'institutionalized' belief" (Goldman 2012: 250). The work of Knorr-Cetina is also in line with these positions, especially *The manufacture of knowledge* (1981), in which she investigates scientific practice from an anthropological perspective.

Social constructionist positions, especially Latour's, "debunk or undercut the alleged role of evidence and truth in science" (Goldman 2012: 251) – albeit from the perspective of the philosophy of science. Thus, as Goldman argues, they do not add any value to mainstream epistemology, as they do not provide any answers to epistemic questions. Instead they open the field to mere relativism (Goldman 2012: 251–2).[113] By contrast, the two other concepts of social epistemology, *preservationism* and *expansionism*, are in line with classical epistemology in raising epistemic questions about the role of society in the development of knowledge. While the preservationist remains very close to classical epistemic questions, the expansionist adds new episemic questions.

[112] This position is defended especially by Latour in his early work, see Latour (1995).

[113] On the other side, the so-called New Age relativism provides better connecting points for evaluating epistemic issues. In reference to one of its representatives, Wright (2008), Goldman offers the following definition: "New Age relativism would be the thesis that the truth of statements about epistemic justification is assessment-relative, with systems of standards providing the relevant assessment-contextual parameter". And further: "Revisionist relativism would agree on a central presupposition of New Age relativism, namely, that multiple epistemic systems are possible and justification claims can be assessed relative to any of these different systems" Goldman (2012: 252). Consequently, one could also question whether a relativist epistemology of foresight is at all possible. This discussion would connect with section 5.3.

6.1.2 Conservative social epistemology

Certain classical epistemic questions have a social character, or at least their answers do. Social epistemology, according to the stricter preservationist approach, can be seen as 'real' epistemology since it deals with such questions and answers. Naming it 'social' epistemology simply highlights the kind of epistemology, specifically its field of objects (Goldman 2012). Their socio-epistemic character is particularly evident in their underlying assumptions and methods for gathering evidence. In a wider sense, these epistemic issues appear in different statements and contexts of argumentative exchange (Goldman 2012: 259). Following Goldman, there are three cases where a social epistemic impact is evident:

(1) doxastic decision making with social evidence
(2) gathering social evidence
(3) speech and communication with an informational purport (assertion, debate, argumentation etc.)

(1) In social epistemology, the impact of the social development of knowledge and its epistemic value is discussed in reference to collective belief (Gilbert 1994, 1987), group belief (Schmitt 1994b), group agency (List and Pettit 2011), group knowledge and collective doxastic agents (Goldman 2012). While some authors discuss group belief from within an ontological framework, others pursue a more conservative and analytical approach.

One may question why the first point – doxastic decision making with social evidence – is even mentioned in the context of social epistemology, as it is also a central theme of mainstream philosophy. In general, "the central business of traditional epistemology is the epistemic evaluation of epistemic decision-making (DDM)" (Goldman 2012: 253) and does not imply any connection to social questions or answers. But two issues of epistemology, namely, testimony and peer disagreement, are concretely addressed by social evidence. Since these two points are crucial in epistemology and appear in the following sections, they should be defined more explicitly.

Testimony has been an important theme of philosophical discussions since Plato, as it poses the question "When is a person justified to accept another person's testimony?" (Goldman 2012: 254; Schmitt 1994a: 1). As Schmitt argues, throughout the history of philosophy, different positions highlight the impact of testimony in judgments. For example, Hume and Aquinas argued that testimony may be useful for stating true beliefs

(Schmitt 1994a: 2).[114] Even in contemporary philosophy of science, discussions on epistemic justification are still occupied with testimony (Siegel 2003; Laudan 2011). Like testimony, peer disagreement too has been discussed in classical philosophy, and is a central theme of contemporary philosophy (Lackey and Sosa 2006). Peer disagreement can be defined as follows:

> Peer disagreement raises the question of whether rationality requires one to revise one's belief (or degree of belief) if one finds oneself in disagreement with someone else who shares roughly the same evidence and has comparable cognitive abilities. (Goldman 2012: 254)

Both issues raise the question of epistemic justification in a classical philosophical sense. According to Goldman, since some questions of testimony and peer disagreement are based on social evidence, they also qualify as socio-epistemic problems (Goldman 2012: 254).

Nevertheless, it should be noted that, despite their differing positions, epistemologists use the principles of doxastic decision making in support of their positions. These principles form the basis of scientific practice that embraces real and social epistemology in debates about testimony or peer disagreement. This means that, with the tools of traditional epistemology, socio-epistemic questions can be investigated, too. This applies especially to issues relating to social evidence like peer disagreement or testimony.

(2) The question concerning how to gather new evidence is also important for epistemology, which, in contemporary philosophy, also focuses on social evidence. Generally, the activity of gathering evidence in science is the procedure of "inquiry" or "investigation", which requires the "design and implementation of tests, measurements, and experiments" (Goldman 2012: 254). In chapter 4 we saw different ways of scientific evidence gathering, which Kuhn also describes as scientific paradigms. When defining a successful scientific argument, the definition of belief in the different accounts of science plays a major role.[115] Modern belief-forming approaches, for example, the Bayesian, take into consideration the subjective impact of belief.[116] Different kinds of belief reveal the difficulty in separating epistemic matters from practical interests, and this is what social epistemologists focus on. What, then, is the special issue of social evidence gathering? The answer is introduced by Goldman as follows:

> It is not essential to SE's [SE = Social Epistemology, E.S.] viability that there be wholly distinct principles of evidence gathering (or doxastic decision making) for the social domain. There may be only general principles of evidence gathering that apply equally to so-

[114] Following Hume, for example, "[s]ocial factors could extend an individual's faculty of perception by supplementing it, through testimony, with what is perceived by others"; Schmitt (1994a: 1–2).

[115] In the context of this work, it would be overly ambitious to address them all. It is sufficient to refer to Goldman's summary of (1) true belief, (2) high-degree-of-belief and (3) agnosticism.

[116] See Alston (1994); Gettier (1963).

> cial and non-social domains. This would not diminish the interest of their application to the social-evidence domain.
> However, there may well be distinctive aspects of evidence gathering in the social domain. One is the choice among experts (or putative experts) from whom to solicit opinions. . . . Special problems in the area of social evidence gathering may also be connected with issues that arise in the peer disagreement literature. (Goldman 2012: 258)

In general, socio-epistemic evidence gathering follows the same principles as evidence gathering in non-social domains. Forms of social evidence gathering, which are of special interest for social epistemology, are "choice among experts" and "peer disagreement".

Obviously, these two points are also of special interest in the context of foresight. Social evidence gathering in the stricter preservationist sense underlies, however, the truth-seeking aim of science (Goldman 2009, 2012). In this regard, the preservationist strand of social epistemology does not provide any validation processes for foresight. It may nonetheless be worthwhile to discuss whether it makes sense to use evidence-gathering techniques in order to validate decision making in foresight processes, even if the epistemic goal in foresight is not truth. In addition to the issues of choice among experts and peer disagreement, Goldman argues that pragmatic factors, similar to the epistemic ones, play a role in evidence gathering (Goldman 2012: 258).[117] Possible connecting points to foresight become clearer in another socio-epistemic issue addressed in the preservationist strand: the social epistemology of speech and communication. How does the insight that doxastic decision making also includes socio-epistemic questions relate to the issue of foresight epistemology? In foresight practice, different epistemic problems arise which may be seen as socio-epistemic problems – for example, peer disagreement or the relations between experts and laymen in workshops. How could these problems be solved in a proper epistemic way?

(3) The social epistemology of speech and communication investigates the ways arguments are justified, specifically the way statements are made and arguments exchanged

[117] Goldman's argument (2012: 258) why epistemic and practical matters can barely be separated is as follows: "Undoubtedly, which topics deserve evidence gathering attention or energy is often a purely practical matter, not an epistemic one. Nonetheless, *given* that topic T deserves attention or energy, questions about which kinds of evidence are relevant (and maximally helpful) and how to gather such evidence come into play. These choices are squarely epistemic, at least largely so. Second, even if a residue of the practical infuses these decisions (e.g. how much money and time to devote to evidence gathering), recent epistemology has abundantly shown that epistemic matters in general cannot be divorced from the practical. In the analysis of both knowledge and justification, proponents of the 'pragmatic encroachment' thesis have persuasively argued that standards of epistemic assessment are raised and lowered as a function of practical interests . . . Finding that similar pragmatic factors play a role in evidence gathering should not remove this type of activity from the epistemic sphere."

(Goldman 2012: 259). The social-epistemic approach explains argumentation via interpersonal reasoning and justification. Nonetheless, interpersonal reasoning is not mere persuasion. For this purpose, there have to be shared norms. But according to Goldman, this task is not merely epistemological, for it is also discussed in dialectical approaches to argumentation.

Goldman's veritistic approach may be considered a version of analytical social epistemology. It has been criticized for not meeting the requirements of an analytical philosophical inquiry. His approach reveals that it is possible in social epistemology to develop a concept of knowledge that recognizes the impact of society. But its focus on finding truth by scientific inquiry is nonetheless inappropriate for a concept of foresight. The more flexible strand of social epistemology (expansionism) does not necessarily rely upon truth in knowledge validation – aside from Longino's theory, which manages to create a framework of transformative criticism that is based on the truth-seeking account of science. It is worthwhile to take a closer look at issues discussed in this branch, where more helpful links may be found with regard to foresight knowledge validation.

6.1.3 Expansionist social epistemology

In contrast to the 'preservationist' strand, which focuses on the socio-epistemic elements of doxastic reasoning, the expansionist strand comprises socio-epistemic approaches that deal with forms of scientific practice. The expansionist strand of social epistemology is the most interesting as it opens epistemology to new fields of inquiry which have been neglected in classical epistemology, for example, (1) collective/ group belief and (2) "the influence of social 'systems' and their policies on epistemic outcomes" (Goldman 2012: 262). The latter point has been employed by several authors in different fields, developing new perspectives for philosophy of science. Longino's work, for example, in *Science as Social Knowledge* (1990), connects social-epistemic insights with feminist theory and gender-oriented examples. In *Science, Truth and Democracy*, Kitcher highlights the structure and goals of science in democratic research structures in reference to the example of contemporary genomic research (Kitcher 2001, see chapter 14). More recently, Heather Douglas questions authorities and the value-free ideal in science in *Science, Policy and the Value-Free Ideal* (2009).

Considerations on this level do not appeal to textual arguments but instead question scientific practices in general. It may be more fruitful, then, to determine if and how the issues addressed by expansionist social epistemology are relevant to foresight.

6.2 The need for values in science

From a socio-epistemic point of view, values are inevitably involved in scientific procedures and may consequently compromise objectivity. This conflicts with the tradition of the value-free ideal, which has generally underpinned classical epistemology and for which only the so-called epistemic values are permitted.[118] Epistemic values ensure significance and credibility. In Carrier's words, they "provide measures of epistemic significance and standards of credibility that hypotheses need to satisfy in order to pass as acceptable" (Carrier 2013: 2551). Hence, cognitive values are needed to set standards in scientific reasoning and acquire reliable results, and to establish and develop new scientific theories.

A well-known account of "permanent values in science" that are decisive in theory choice can be found in Kuhn's essay, *Objectivity, value judgment, and theory choice* (Kuhn 1977), where he lists the following five: 1) accuracy, 2) scope, 3) fruitfulness, 4) consistency, 5) simplicity. Kuhn discusses the values in the context of theory-building and his notions on scientific revolutions and paradigm shifts. These epistemic values function as a guideline for evolving theories and new paradigms. Kuhn draws a clear line between epistemic and non-epistemic values, that is, between science and society. As he outlines in *The Structure of Scientific Revolutions*, defending the value-free ideal is necessary in order to provide a framework for scientific progress (1962/2012: 164). According to this view, the scientific community's detachment from society and non-epistemic values is what ensures scientific success. Recent philosophy of science has questioned the idea that scientific success manifests itself in the value-free ideal. Even when scientists adhere to these "permanent values", there may be methodological under-determination. Laudan addresses the deficiencies of the value-free ideal as follows:

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[118] The idea of distinguishing between the impact of epistemic and non-epistemic values in science can be traced to Max Weber. In his paper on the object of value-free social and economic sciences (Weber (1917/1985), he defends the value-free ideal for social sciences by specifying ideal types (*Idealtypen*) which distinguish between the subjective values of a scientist and the objective – but also chaotic – real world. Weber outlines the relations between values and sciences – especially the social and economic sciences in different essays, Weber (1904/1985, 1917/1985), and in *Wissenschaft als Beruf*, translated into English as *Science as Vocation,* Weber (1919/1985), which is also transferable to other sciences. His writings of values in science and the value-free ideal have often sparked debates on value judgments especially in German philosophy of science, (and not only in the social sciences); see, for example, Feix (1978) or the anthologies by Albert and Topitsch (eds. 1979) and Zecha (ed. 2006).

> Kuhn's view is this: if we examine situations where scientists are required to make a choice among the handful of paradigms that confront them at any time, we discover that the relevant evidence and appropriate methodological standards fail to pick out one contender as unequivocally superior to its extant rival(s). (Laudan 1984: 88).

With the notion of under-determination, Kuhn admits that the rules and standards (based upon the permanent/epistemic values) enable the scientist to choose an appropriate method – but they do not indicate the superiority of one paradigm over another.[119] One should keep in mind that Kuhn refers primarily to natural sciences and not to social sciences. This point is also reflected in Kuhn's definition of "disciplinary matrix", a substitute he proposes for the term "theory" (1962/2012: 181).[120] A disciplinary matrix consists of four components. First, there are "symbolic generalizations . . . which are the formal or the readily formalizable components of the disciplinary matrix" (1962/2012: 182). This component corresponds to the "techniques of logical and mathematical manipulation", the basic methods for scientific practice in natural sciences – or in Kuhn's words: for puzzle solving. The second component is the "metaphysical parts of paradigms", which is the commitment to beliefs in the use of certain methodologies, including "beliefs in particular models" (1962/2012: 183). The fourth is partly related to the second, as it focuses on the "group's shared commitments" related to paradigms (1962/2012: 186). The third is most crucial as it deals with shared values. These are best introduced by the following longer quotation about values:

> Usually they are more widely shared among different communities than either symbolic generalizations or models, and they do much to provide a sense of community to natural scientists as a whole [sic!]. Though they function at all times, their particular importance emerges when the members of a particular community must identify crisis or, later, choose between incompatible ways of practicing their discipline. Probably the most deeply held values concern predictions [sic!]: they should be accurate; quantitative predictions are preferable to qualitative ones; whatever the margin of permissible error, it should be consistently satisfied in a given field; and so on. There are also, however, values to be used in judging whole theories: they must, first and foremost, permit puzzle-formulation and solution;

[119] Kuhn discusses four arguments to clarify the latter point: a) the "ambiguity of shared standards" argument, b) "collective inconsistency of rules" argument, c) the shifting standards argument and d) the problem-weighting argument. See Kuhn (1977); Laudan (1984: 87–102); Hoyningen-Huene and Kuhn (1989: 150–4); Longino (1990: 32–7). All these arguments can also be seen in favor of a position that sees such discussions as social negotiation processes in science; hence they support the point that science is a social enterprise, influenced by non-epistemic values. Put differently: it corresponds closer to the reality of scientific practice to embrace non-epistemic values than to artificially combat their influence.

[120] Kuhn defines a disciplinary matrix as follows: "For present purposes I suggest 'disciplinary matrix':' disciplinary' because it refers to the common possession of the practitioners of a particular discipline; 'matrix' because it is composed of ordered elements of various sorts, each requiring further specification" Kuhn (1962/2012: 181).

> where possible they should be simple, self-consistent, and plausible, compatible, that is with other theories currently deployed. . . .
> [V]alues may be shared by men who differ in their application [sic!]. Judgments of accuracy are relatively, though not entirely, stable from one time to another and from one member to another in a particular group. But judgments of simplicity, consistency, plausibility, and so on often vary greatly from individual to individual. (Kuhn 1962/2012: 184)

The first characterization given in this quotation is that values are always shared by a given community, for example, the community of natural scientists. The notion of prediction shows the character of epistemic values: accuracy, scope, fruitfulness, consistency and simplicity are the guideline for scientific practice. When it comes to theories of judgment, values such as plausibility and compatibility should be considered, too. Shared values are inherent to scientific practice, even though they are not always discussed. Kuhn emphasizes that the impact of these values is apparent especially in decisive moments: disputations about theory or method choice among participants, or crisis detection. Finally, he admits that, in practice, how these values are applied depends on the value judgments of the different persons. Certainly this point has been attacked by critics, as it means that subjectivity is included among the values in the natural sciences. But as Kuhn outlines in the following quotation, these decisive and contentious issues in scientific practice also mark the beginning of paradigm shifts and can therefore lead to scientific progress:

> First, shared values can be important determinants of group behavior even though the members of the group do not all apply them in the same way. (If that were not the case, there would be no *special* philosophic problems about value theory or aesthetics.) . . . Second, individual variability in the application of shared values may serve functions essential to science. The points at which values must be applied are invariably also those at which risks must be taken. (Kuhn 1962/2012: 185)

Nevertheless, these points indicate that, at certain stages such as method choice and crisis detection, it is difficult to argue that shared values are not affected by non-epistemic values. It is quite obvious that, in practice, special research interests or other issues such as social and ethical considerations may have an impact on research decisions. Note that, according to this argument, reference to subjective interpretations, that is, the inclusion of non-epistemic values, is needed for scientific progress. Hence, Kuhn's argument was welcomed by critics of the value-free ideal as it recognizes the need for non-epistemic values. At the time of its publication, the strict focus on basic epistemic values was still popular. As indicated above, separating epistemic and non-epistemic values in science is rather difficult. Some recent works, for example, Laudan's *Science and Values* (1984), builds upon Kuhn's work.[121] While supporting the rule of cognitive values in science, Laudan also emphasizes the crucial point that "even among researchers who share the same aims or values, methods may legitimately differ" (Laudan 1984: 138).

The insight that scientists make value judgments throughout the scientific process can already be found in Rudner's 1953 paper "The scientist qua scientist makes value judgements" (Rudner 1953).[122] But the general discourse on values in science rejected this point and claimed that science should be value-free. Scientific rules and methods strongly depend on normative directives – which, in consequence, also means that these normative directives and agreements can be negotiated in the progress of science. In light of the strong influence of the value-free ideal, there is still need for a clear formulation of values – of their different kinds and functions.

Distinguishing merely between epistemic and non-epistemic values has the disadvantage of not only neglecting social and ethical values; more generally, it is too one-dimensional to account for the various processes that belong to scientific practice. Traditionally, they were directly applied to knowledge per se – epistemic values such as simplicity, explanatory power, predictive accuracy etc. were seen as suitable criteria for a truth-oriented science.[123] However, as shown by Kuhn's work, even in the context of the natural sciences, so-called non-epistemic values enter the research process. They appear in different forms (social, ethical and cognitive) and may play different roles (direct and indirect) (Longino 1990; Douglas 2009). In recent years, the differences between cognitive values, on the one hand, and social (and also ethical or moral) ones on

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121 Laudan belongs to the initiators of STS; his epistemic point of view relies upon the need for non-epistemic values in science. Thus he elaborates especially the difference between the so-called epistemic and cognitive values, emphasizing that most epistemic values are virtues rather than values. See Laudan (1984, 2004).

122 Although influenced by the prevailing view of his time that philosophy of science ought to favor the value-free ideal, Rudner nonetheless rejects certain forms of it: "Now I take it that no analysis of what constitutes the method of science would be satisfactory unless it comprised some assertion to the effect that the scientist as scientist accepts or rejects hypotheses. But if this is so then clearly the scientist as scientist does make value judgments. For, since no scientific hypothesis is ever completely verified, in accepting a hypothesis the scientist must make the decision that the evidence is sufficiently strong or that the probability is *sufficiently* high to warrant the acceptance of the hypothesis. Obviously our decision regarding the evidence and respecting how strong is "strong enough", is going to be a function of the *importance*, in the typically ethical sense, of making a mistake in accepting or rejecting the hypothesis. . . . *How sure we need to be before we accept a hypothesis will depend on how serious a mistake would be*" Rudner (1953: 2). In his paper, Rudner points out that ethical and moral judgments should also affect the decisions made in science, especially with regard to the consequences that decisions and scientific progress may have.

123 But even epistemic criteria can easily be questioned. Longino shows this in a simple example of feminist critiques of science; Longino (1996: 41–50), see also Douglas (2009: 90–1).

the other, have been intensively discussed, for example, by Longino (1996), Douglas (2008, 2013, 2009), Lacey (2005) and Carrier (2013). Philosophers such as Longino and Douglas highlight the need for non-epistemic values in science and show how science can be structured without falling victim to subjectivity. Longino puts this point in the following way:

> My aims are to show both how social and cultural values play a role in scientific inquiry and how broadening our conception of that inquiry from an individual to a social activity enables us to see that the sciences are not, nevertheless, hopelessly subjective. (Longino 1990: 37)

A socio-epistemic approach like this, which embraces non-epistemic values in the scientific process, does not aim at a social constructivist perspective of science. Instead, its aim is to raise awareness of the fact that non-epistemic values inevitably enter scientific practice and reveal that this fact does not need to undermine science's objectivity. In fact, in her paper from 2009 Douglas even rejects the "dichotomy between epistemic and nonepistemic values" and prefers instead to distinguish between cognitive, social and ethical values. She argues that "we can better understand the tensions involved in weighting various kinds of values in any given scientific judgement, for example, when cognitive and ethical values conflict" (Douglas 2009: 89).

In the following, I will reconstruct the different kinds of values and the different areas where they may appear, and I will do so in reference to Douglas (2009), who provides a comprehensive structure that can be used for the purpose of foresight. In chapter 7 I will argue that the different functions of these values can be illustrated very clearly in reference to foresight.

From a socio-epistemic point of view, values can play different roles in science. Similar to Longino, Douglas recommends defining the role of values and their need in science. In *Science, Democracy and the Value-free Ideal* (2009), she outlines an idealized topology of values. Values can play a direct role in science with regard to certain kinds of decisions. Throughout the scientific process, values also appear in their indirect role. According to Douglas,

> "[t]his distinction between direct and indirect roles allows for a better understanding of the place of values in science—values of any kind, whether cognitive, ethical, or social. (Douglas 2009: 88)

Ethical, social and cognitive values are the different kinds of values that shape scientific practice and theory. They have specific functions in the scientific research process (Douglas 2009: 87–9). Different functions of values can be clarified along the steps of typical research processes:

(1) Aim. Research starts with deciding which questions to pursue. This means that the first decision is made in reference to the aim of the task (2009: 88).

(2) Method. To pursue the task or aim, a decision needs to be made concerning the methodological requirements. At this point, judgments too are needed to get the processes started. Decisions made at this stage may be limited to particular methodological issues of the task. But they may also be "under constraints of ethical acceptability, resource limitations, and skill sets" (2009: 88). Hence, methodological decisions, as Douglas further notes, "profoundly shape where one looks for evidence" (2009: 88).

(3) Interpretation. The third step consists in interpreting the data and drawing conclusions. In certain cases, decisions made at this step are not as evident as expected. Sometimes judgments are needed to determine whether the data really supports a hypothesis. These interpretations involves decisions concerning whether to accept the data, and correspondingly, whether to accept or to reject a theory based on the evidence (2009: 88).[124]

Asserting the validity of results of the scientific processes, it is decisive not only at which stage the values enter, but also what type of values they are.

6.2.1 Types of values affecting science

Douglas distinguishes between three types of values: ethical, social, and cognitive.[125] It should be pointed out that she also takes esthetic values into account for certain sciences. But since her work focuses on sciences relevant to policy making, she refers only to the first three types. Since esthetic values seem not to be decisive for outcomes in foresight, I will neglect them, too. An example of another type of values that may have an impact on research in specific disciplines is religious values.

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[124] Alternatively, it is also possible, as Weingartner proposes, to further specify the interpretation of results by distinguishing four different forms (2006: 57): He distinguishes values appearing in (1) considerations about the aim of science, (2) methodological considerations, (3) in cases where facts are explained by values, aims or motivation, (4) in cases where value judgments are made for explanations.

[125] Note that there are other possibilities to distinguish epistemic and non-epistemic values, too. Longino for example uses the differentiation of contextual values, that is, social, cultural, ethical values etc., as a contrast to classical epistemic and cognitive values, which may enter scientific practice and reasoning; see Longino (1990, 1996). Laudan (1984, 2004), for example, makes clear distinction between cognitive values as epistemic virtues and non-epistemic values, such as social and ethical ones. For other viewpoints on different values in science see Hansson (2003, 2007), or Lacey (1999, 2005).

Ethical values

Ethical values are used to decide whether we perceive a research process or outcome as "the good or the right" (Douglas 2009). They are needed especially when we have to determine whether a specific form of research or the results of such research may have significant consequences for the general public. Douglas specifies the definition of ethical values as follows:

> Ethical values help us weigh whether potential benefits are worth potential harms, whether some harms are worth no price, and whether some harms are more egregious than others. (Douglas 2009: 92)

Examples of ethical values in scientific research, as proposed by Douglas (2009: 92), include the following:

- "the right of human beings not to be used for human experimentation without fully informed consent"
- "the consideration of sentient beings for their pain"
- "concern for the death and suffering of others"
- "whether it is right to pursue research for new weapons of mass destruction"
- "whether an imposition of risk is ethically acceptable"

There are numerous examples of scientific research sparking controversial debates on ethical issues. As a result, the field of applied ethics today is very diverse. In includes, for example, bioethics, machine ethics, military ethics, business ethics, cyber ethics and political ethics. All of these ethics are ascribed to a field where research is carried out. Especially in those areas where scientific progress is most evident and where the results have a direct impact on human life – such as bioethics, machine ethics and military ethics – ethical values are already (or should be) involved in the formulation of research aims, in the scientific procedures and in the evaluation, interpretation and further application of the outcomes. Not only is scientific research affected by ethical values; it also demands continuous negotiation and that the common understanding of ethical values be respected in science. This socio-epistemic claim concerning ethical values in science should not be confused, however, with classical technology ethics or technology assessment (even though it applies to those fields too). Ethical values discussed here correspond to their proper – or improper – use in scientific practice. Hillerbrand (2016) makes the differences explicit in reference to the two practice turns in the philosophy of science: While the first practice turn, starting in the 1960s, led to the establishment of STS studies, Kroes and Meijers, eds.(2001) initiated a second practice turn by placing the emphasis particularly on the impact of ethical issues in engineering. So while the first turn refers to societal and moral implications of technology, the second focuses on ethical concerns in philosophy of engineering. Accordingly, Hillerbrand argues that there has been a third practice turn with regard to ethical values in scientific practice of engineering.[126] This approach highlights the difference between assessing ethical implications of technology and particular disciplines, on the one hand – which, of course, is still essential today – and the impact of ethical values and background assumptions that shape scientific procedures and results, on the other.

Thus, the practice in scientific disciplines is shaped differently by ethical values in each case. Besides Douglas's ethical values for experimental sciences listed above, the scientific community of each discipline should discuss the relevant ethical values of its field in reference to the field's progress.

Social values

Social values should not be confused with ethical values. As Douglas (2009: 92) notices, social values "arise from what a particular society values" and may, for example, concern

- justice
- freedom
- social stability
- innovation
- etc.

In scientific contexts, social and ethical values often appear at the same time, as certain outcomes can have an impact on, or be influenced by, social and ethical values at the same time – or by contrast, research may be driven by both ethical and social values, such as medical research on diseases like malaria or, more recently, Ebola. The vision for medical research funding of the WHO, for example, is basically guided by social and ethical values, with the aim to make medical products affordable and accessible to each person in the world:

> The new 2030 agenda, summarised in the Sustainable Development Goals (SDGs), sets a clear path for future action by placing equity and universal health coverage on centre stage. The health goal, SDG 3 – "Ensure healthy lives and promote wellbeing for all at all ages" – underscores the importance of access to medical products by aspiring to:
> • End the epidemics of AIDS, tuberculosis, malaria and other communicable diseases by 2030
> • Achieve universal health coverage, and provide access to safe and effective vaccines and medicines for all
> • Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines. (WHO 2016: 3)

[126] This idea is elaborated in Hillerbrand and Roeser (2016).

In this agenda, the ethical value of enabling each person to live a healthy life that is free of suffering is connected to social values of justice and innovation, and made concrete by scientific progress in medicine and healthcare. Nevertheless, social and ethical concerns may also be in conflict with each other, as Douglas shows with the example of the civil rights movement, where "the social value of stability was antithetical to the ethical values underlying the push for desegregation and the civil rights movement" (Douglas 2009: 92). While this example clearly does not involve science directly, scientific research must be sensitive for such cases.

Cognitive values

Cognitive values build upon the epistemic values used in classical philosophy of science. Classical epistemic values are criteria for truth-oriented science. They are useful when the goal of science is to achieve reliable knowledge about the world. But while epistemic values essentially follow the idea that science aims at truth, cognitive values may encompass many more aspects. Consider the Kuhnian list of epistemic values: accuracy, scope, fruitfulness, consistency and simplicity. According to Douglas, ethical, social and cognitive values "serve different goals and thus perform a different function in science, providing guidance at points of judgement when doing science helping one weigh options" (Douglas 2009: 94). Douglas states further that cognitive values are

> those aspects of scientific work that help one think through the evidential and inferential aspects of one's theories and data. Taking the label "cognitive" seriously, cognitive values embody the goal of assisting scientists with their cognition in science. . . .
> [T]he presence of any cognitive value should improve the productivity of an arena of science. It should allow for more predictions, new avenues of testing, expansion of theoretical implications, and new lines of research. In sum, cognitive values are concerned with the possibilities of scientific work in the immediate future. (Douglas 2009: 93)

Cognitive values are an epistemic baseline that can be referred to by different scientific disciplines following different aims of science. But cognitive values should not be confused with the epistemic values used in classical philosophy of science. The purpose of cognitive values within different scientific disciplines depends on the role that epistemic virtues like objectivity, truth or judgment play. For example, the cognitive value of predictive precision is more important in natural sciences, which build upon truth-oriented theories of science, than it is in the social sciences. The distinction between classical epistemic values and cognitive values is also visible in the way they operate. Douglas clarifies this thought:[127]

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[127] It should be noted that Douglas builds upon Laudan's argumentative distinction between epistemic and cognitive values (1984, 2004). Douglas also draws a line between epistemic virtues, on the one hand, which function as criteria for acceptable science aiming true knowledge, and cognitive values on the other.

> These epistemic virtues [e.g. internal consistency or predictive competence] operate in a negative way, excluding claims or theories that do not embody them, rather than as values, which are aspects of science for which to strive, but which need not be fully present in all cases. For this reason, so-called "epistemic values" are less like values and more like criteria that all theories must succeed in meeting. (Douglas 2009: 94)

Finally, here are some examples of specific cognitive values (Douglas 2009: 93):

- simplicity ("the full implications of complex theories are harder to unpack")
- explanatory power (The stronger the explanatory power of a theory, the more it provides connecting points and implications for future research.)
- scope ("theories with a broad scope apply to more empirical areas, thus helping scientists develop more avenues for testing the theory")
- consistency of a theory with other areas of science (they are easier to use, "allowing for application to both new and old theories, thus again furthering new research")
- predictive precision (helps to refine theories)
- fruitfulness (a productive theory provides scientists with many avenues for further investigations)

In general, cognitive values indicate how and if a theory encourages progress and future work in a scientific field. Among these, consistency and predictive precision are also treated as epistemic values in classical philosophy of science.[128] But the crucial point of this structure of values is that there is space left for the different scientific fields to interpret the need and importance of each value in relation to their own scientific progress, while at the same time providing a common baseline that is of special interest, for example, in interdisciplinary research.

6.2.2 Direct and indirect roles of values in science

As the examples above indicate, values can play different roles in science. They may enter science when formulating aims, when choosing and applying the method and when interpreting the results. Following Douglas, science today is guided not by the value-free ideal but rather by a social value that we place on science to provide us with a reliable understanding of the world, enabling us to make responsible decisions for the future:

[128] Laudan outlines the difference between epistemic and cognitive values with the example of consistency and predictive precision both as epistemic values and cognitive values. He argues that these should be seen instead as virtues, because they do not describe value states but rather deal with degrees of exactness; Laudan (1984, 2004).

> The very decision to pursue science thus depends upon a social value. Because of the value we place on science, because we care about having a reliable understanding of the world, science must meet certain standard to be acceptable. . . . It is because we care about having reliable empirical knowledge that scientific theories must be internally consistent and predictively competent. (Douglas 2009: 95)

Science needs epistemic criteria to be conducted in an objective, comparable manner. These criteria also belong to cognitive values. Despite the importance of epistemic virtues, the presence and influence of other values should not be denied; rather, they should be included and investigated. The impact of social and ethical values should be carefully examined, as this may extend to judgments and decisions throughout the process. Ignoring or even denying their impact means their influence on science goes unnoticed, as though they were allowed to enter, so to speak, through the backdoor. To better understand their impact, it is helpful to distinguish between their direct and indirect roles in research, that is, how they influence the process of research. The main idea of this distinction can be summarized as follows:

> In the first direct role, the values act much the same way as evidence normally does, providing warrant or reasons to accept a claim. In the second, indirect role, the values do not compete with or supplant evidence, but rather determine the importance of the inductive gaps left by the evidence. (Douglas 2009: 96)

Values are used to determine uncertainties of specific claims and even as reasons for accepting claims, or to determine the importance of certain evidence or which judgments can be made from it. In the following, the direct and indirect role of values in science is described alongside their role in scientific processes.

The direct role of values

Values can play a direct role when they determine our decisions or when they serve as reasons that motivate or justify choices (Douglas 2009: 96). Direct values have a normative impact on choices in the scientific process. They enter the scientific process from the beginning, influencing which scientific projects should be undertaken and which aims should be pursued in research. Normative choices concerning the selection of scientific projects and the choice of methods, including whose interests – governmental or even private – are at stake by a given project, are basically shaped by ethical and social values. To date, research structures are to a large extent dependent on governmental funding, but also on international funding, for example, the EU. In addition, private research funding is increasingly influencing scientific progress, especially in the applied sciences. This means that ethical and social values are also needed as a guideline to decide if scientists want to conduct a research project funded by a certain stakeholder. The value in funding a certain research project may also be influenced by ethical concerns. All these choices are directly shaped by values and “[t]he value scientists place in their intellectual interests is sometimes the primary reason for the choice" (Douglas 2009: 99).

At this first stage, values help to determine whether to accept or reject an option based upon ethical or social implications. Fundamental here are funding structures, research interests and ethical concerns on outcomes of the research. Judgments concerning uncertainty or consistency are not in the focus at this stage. Rather, such judgments become important when decisions have to be made about which methodology to use to investigate the selected research question. But also, "[i]f the chosen methodological approach involves flatly unethical actions or treatment of others, the approach should be rejected" (2009: 99). It is therefore not only inevitable, but also desirable that ethical values play a direct role when humans themselves are the object of a research project. This concerns not only projects, for example, in medical or psychological research, where humans might be injured or where their rights may be violated, but also in research where technological and scientific progress might affect human lives in the present or in the future. Douglas suggests that an internal review board, for example, may analyze if the decisions made by scientists at this stage are appropriate concerning ethical or social values. The diversity of research teams, also concerning their scientific background, helps to overcome individual values or to determine whether certain values are affecting and impeding theory choice where they should not.[129]

Consequently, when ethical values are at stake, the choice of methodology may cause conflicts. Douglas describes this with the example of pesticides research: Cognitive values suggest the best method to determine what effects pesticides have on humans would be to test them on humans. But social and ethical values prohibit the use of such methods as they are harmful and in violation of human rights (Douglas 2009: 99–100). Many examples in recent philosophy of science address the treatment of ethical and social values in specific disciplines. For instance, Lacey (2005) investigates the controversy on transgenic crops, which is basically driven by the influence of non-epistemic values in research. Künneke et al. (2015) discuss value conflicts of moral, social, technical and economic nature in offshore wind energy systems. Longino (1990) questions the role of values in research on sexual differences in evolutionary and behavioral studies . One of the most prominent fields where different social and ethical values collide is research on climate change; Leuschner (2012) discusses this topic in detail under consideration of possible socio-epistemic solutions.[130]

Conflicts arising in the choice of methodology make the direct role of values in the early phase explicit: since there is still no evidence which methodology is most suitable,

[129] This point has also been intensively discussed by Longino (1990: 194–7).

[130] See also Lloyd and Schweizer (2014) with an emphasis on objectivity concerns, Beck and Krueger (2016) and Hillerbrand and Ghil (2008).

social and ethical values serve as reasons for the choices made. Certain cognitive values may also be taken into consideration in these choices, for example, by arguing with simplicity or scope.

Nevertheless, there are also restrictions to letting values play a direct role in scientific processes. Producing reliable knowledge is still a main aim of science. Therefore, it is important that values not serve "to direct the selection of a problem and a formulation of a methodology that in combination predetermines (or substantially restricts) the outcomes of a study" (Douglas 2009: 100). Personal preferences and desired outcomes ought not to play a central role in the choice of theory or methodology, that is, direct values ought not to serve as reasons for ethically or socially acceptable choices for methodology, but for enforcing the scientists' or customers' personal interests. Douglas provides the following argument for this point:

> Therefore, a direct role for values in the early stages of science must be handled with care. Scientists must be careful that their methodology is such that it can genuinely address the problem on which they have chosen to focus, and that they have not overly determined the outcome of their research. . . .
> Nevertheless, we are all human, and there are no sure-fire ways to guarantee that we are not subtly presuming the very thing we wish to test. The best we can do is to acknowledge that values should not direct our choices in the early stages of science in such a pernicious way. (Douglas 2009: 101)

These issues also arise in foresight. For example, when a normative aim is set and when the customers' aims are used as reasons to choose a certain theory, values would enter the scientific process and direct the outcome of a study. At this point, the fuzziness of foresight becomes evident: the selection of a problem depends, among other things, on customers' interests. Hence, the process of selecting the problem and methodology must be handled with special care in foresight. On the other hand, foresight also has a special feature which helps prevent values from guiding problem selection or predetermining methodology formulation: the diversity of project teams.

For this reason, Douglas insists that "the direct role must be limited to the stages early in science, where one is deciding what to do and exactly how to do it" (Douglas 2009: 101). It is not acceptable that values enter directly into the scientific process once the research has started. This is only acceptable if new evidence shows that ethical or social aspects are impeded by the chosen methodology. Otherwise, the aim of producing reliable knowledge would be impeded. This may happen, for example, if scientists use direct values to argue that they reject certain data should they contradict the chosen theory. This would then falsify the evidence. Outcomes are also distorted when direct values enter the interpretation of evidence, that is, if scientists rely on cognitive or social preferences to weigh the evidence. The following remarks by Douglas sum up the use and misuse of values that enter science in a direct way:

> We do science because we care about obtaining a more reliable, more true understanding of the world. If we allow values to play a direct role in these kinds of decisions in science, decisions about what we should believe about the world, about the nature of evidence and its implications, we undermine science's ability to tell us anything about the world. Instead, science would be merely reflecting our wishes, our blinders, and our desires. If we care about reliable knowledge, then values cannot play a direct role in decisions that arise once a study is under way. (Douglas 2009: 102)

It cannot be avoided that during the scientific process values appear, but they must play at most an indirect role.

The indirect roles for values

If values in science play a direct role only in the early phase of choice-making, yet nonetheless also play a role in other phases of research, then we determine precisely at which stages values may enter the scientific practice so that they do not undermine its objectivity entirely.

Whenever scientists must make decisions or weigh judgments, values may make an appearance. There are stages, however, where values may affect the scientific process in an indirect way without violating its objectivity. Douglas (2009: 103) identifies three situations where values should be allowed to play an indirect role in science:

- to evaluate the sufficiency of evidence
- when uncertainties have to be weighed
- when the consequences of error have to be weighed

These situations appear in the different stages of scientific processes.

(1) In the first phase, when methodological choices are made, value judgments may play an indirect role, for example, when standards for statistical significance have to be assessed. Important value-laden questions at this stage include, for example, how much evidence is needed for the results to be significant. These choices require that the scientist weighs two different possible types of error: false positives and false negatives.[131] Within this spectrum, values play an indirect role in the sense that they are needed to decide, based upon "parameters of available resources and methods", whether or which improved experimental tests reduce false positives or false negatives. Following Douglas "[w]eighing those costs legitimately involves social, ethical, and cognitive values" (Douglas 2009: 104)[132]

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[131] False positives and false negatives are defined as follows: "False positives occur when scientists accept an experimental hypothesis as true and it is not. False negatives occur when they reject an experimental hypothesis as false and it is not" Douglas (2009: 104).

[132] There is a vague notion on the indirect role of values of such a kind in Bell (2004, 75), evaluating Hempel (1965/1968: 81–96). Bell names these "extra-scientific values".

(2) When conducting a scientific study and applying the chosen methodology, values may be needed to interpret data. In certain cases, the chosen methodology might lead to data which do not provide clear evidence. As a consequence, the reliability of a sample, an event or experiment has to be examined critically. Various questions can arise at this stage: For example, how should one deal with irregularities and uncertainties? How should one weigh and characterize borderline cases when experts disagree? In such cases, there is a need to reflect values indirectly in order to avoid or minimize errors:

> The valuation of the consequences of error is relevant and necessary for making a decision in these uncertain cases. When one has judgment calls to make at this stage, values are needed to characterize data to be used in later analysis, although most scientists would prefer there be no borderline cases requiring a judgmental call. (Douglas 2009: 106)

(3) Finally, the interpretation of final results based on the data that has been gathered and characterized may still allow values to enter the process in an indirect way. In some cases, it may not be evident if the data supports the hypothesis. But the scientist is in charge of making decisions: Does the methodology and the data provide sufficient evidence in support of the hypothesis? For these decisions, the context has to be considered, as well as potential errors (See also Rudner 1953; Longino 1990). Douglas summarizes this thought as follows:

> In our society, science is authoritative and we can expect (even desire) officials to act on the basis of scientific claims. So the implications of error include those actions likely to be taken on the basis of the empirical claim. Such actions entail social consequences, many of which are ethically important to us. Therefore, social and ethical values are needed to weigh the consequences of error to help determine the importance of any uncertainty. . . . Given the need for moral responsibility in accepting or rejecting empirical claims, it is clear that social and ethical values can and should play an important indirect role in these scientific choices. (Douglas 2009: 106)

Decisions made in the last stage of research projects, when the outcomes are evaluated, may have a major impact on future research and on society. Therefore, it is important at this stage to carefully reconsider the indirect role values play.[133] This phenomenon is of special interest in foresight projects, where uncertainties are high and expert judgment is decisive. But while other sciences go to great lengths to avoid situations of uncertainties that require value-laden judgments, in foresight this is a regular occurrence – especially because foresight cannot produce any true claims based on empirical data. The confrontation with uncertainties is even needed in order to weigh possible impact and consequences. In particular, the authoritative character of science is visible in foresight, where recommendations often have a social and ethical impact. Nevertheless, s, it is not

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[133] This thought has already entered the scientific discourse with Rudner (1953). See footnote 122.

a deficiency for foresight to go beyond evidence; Douglas's point concerning uncertainties is the following:

> More evidence usually makes the values less important in this indirect role [of values], as uncertainty reduces. Where uncertainty remains, the values help the scientist decide whether the uncertainty is acceptable, either by weighing the consequences of an erroneous choice or by estimating the likelihood that an erroneous choice would linger undetected. (Douglas 2009: 96)

It is precisely by these values in foresight that make it possible to think through consequences and scenarios and prioritize recommendations. As foresight is basically involved in dealing with uncertainties and alternatives based on present facts, it is important to know which kind of values need to be taken into consideration and at what point in the process. Finally, it should be noted that Douglas outlines direct and indirect roles of values in science and experimental sciences, and that, at this stage, these initial thoughts on this concept's applicability in foresight are rudimentary. They will have to be elaborated further in chapter 7.

6.3 Douglas's forms of objectivity in science

Objectivity as an epistemic virtue in science has a rather short history, emerging during the mid-19th century. Daston and Galison describe this transition as follows: "Before objectivity, there was truth-to-nature; after the advent of objectivity came trained judgement" (Daston and Galison 2007: 27–8). In light of the competing accounts of science described in chapter 4, this means that a universal definition of scientific objectivity has never existed. In the range of scientific accounts there are also different understandings of objectivity. Yet the concept of objectivity is nevertheless inspired by older concepts. In classical epistemology, the definition of objectivity is strongly influenced by Francis Bacon's *Novum Organon* published in 1620 (Bacon 1620/1990: 37–65). Bacon's notion of objectivity is based on idea of neutrality towards the object and an adequate representation of phenomena. In this way, prejudices are avoided (cf. Carrier 2013: 2549). In this individual-oriented definition of objectivity,

> researchers are advised to avoid any premature formation and one-sided examination of hypotheses and to include alternative perspectives, potential counterexamples and additional influences into their considerations. (Carrier 2013: 2549)[134]

[134] Bacon had a major influence on the Empiricists such as Locke as well as Descartes and Leibnitz, but also on natural scientists such as Robert Boyle and Isaac Newton. Ideology critique did not arise until the 19th century with de Maistre and Cassirer. Cf. Krohn (1990: XIII–XIV).

For social epistemology, Bacon's concept of objectivity is appealing because it goes hand in hand with the division of labor, which has come to characterize scientific practice. He outlines this thought in the *Novum Organon* (NO I 113). Bacon provides a rather contemporary conception of objectivity with his view of science as a social enterprise. But this view is still restricted to epistemic values.

As noted above, Longino adds to the concept of scientific knowledge the idea that science should inquire into social issues. Starting from a realist account of science, she defines the application of scientific methods as "activities of scientific inquiry" to

(1) produce theories
(2) produce concrete interactions with natural processes, or
(3) produce models of it (Longino 1990: 67)

The underlying claim of objectivity is that science should be based on facts. Longino sees objectivity as a central characteristic of all forms of scientific inquiry, regardless of its aims or methods. Following Longino, we can define two different forms of objectivity that science can provide:

(1) first, "objectivity is bound up with questions about the truth and referential character of scientific theories, that is, with issues of scientific realism"
(2) and second, "objectivity has to do with the forms of inquiry" (Longino 1990: 62).

This suggests that objectivity is based on descriptions of the natural world, relying on non-subjective criteria for developing, accepting, and rejecting the hypotheses and theories constituting a certain point of view (Longino 1990: 62). These non-subjective criteria include, for example, cognitive values. Longino lists two main reasons we ascribe objectivity to a given method. First, the theories and hypotheses are justified by the presumed objectivity of data they are based on and the method that was used. Second, the process of confirming or denying a method's objectivity also serves as an evaluation: it reveals whether the methods used are accepted as a suitable tool for an unbiased and unprejudiced assessment of hypotheses and theories (Longino 1990: 63). But she also emphasizes that "[t]he integration and transformation of these activities into a coherent understanding of a given phenomenon are a matter of social negotiations" (Longino 1990: 67). Obviously, scientific processes and scientific practice cannot be separated from the people conducting science. But they are also in charge of negotiating and setting up the rules, that is, the methods which lead to knowledge (cf. Longino's definition of method: "method, the process by which knowledge is produced, is the application of rules to data" (Longino 1990: 66)).

Scientific practices and processes depend on the justifications and evaluations of the scientists involved. According to Longino's theory, scientific inquiry is inherently social. It is defined by the following points:

- Scientific disciplines are social enterprises, its individual members are "dependent on one another for the conditions (ideas, instruments, et cetera) under which they practice" (Longino 1990: 67).
- Education is a requirement for scientific inquiry
- "[A]s the practitioners of the sciences all together constitute a network of communities embedded in a society, the sciences are also among a society's activities and depend for their survival on that society's valuing what they do" (Longino 1990: 67).

So how is objectivity possible if science is characterized as a social enterprise? Longino notes that it is precisely this catalogue of social scientific practice which enables objectivity. Scientific communities have to fulfil certain criteria and follow certain rules if the scientific knowledge they produce is to be objective. Accordingly, "[a] method of inquiry is objective to the degree that it permits *transformative* criticism." Objectivity is supported by critical dialogue. For this reason, Longino proposes a new form of scientific critique, which takes the social aspects of scientific knowledge production into account. In addition to the classical ways of critically analyzing hypotheses in view of evidence and context, she includes transformative criticism, which can be seen as an outgrowth of intersubjective criticism.[135] Longino's definition of scientific objectivity and its dependence on the application of scientific rules and processes show that objectivity is not merely a theoretical concept but rather linked to the rules of scientific practice.

Objectivity in reference to scientific methods and procedures emphasizes their reliability, validity and authority. Objectivity also implies trust, for example in objective claims or objective procedures or even among those how conduct objective research. As Douglas notes, "[c]ommon to all the uses of objectivity is this sense of a strong trust and persuasive endorsement" (Douglas 2009: 116). While Longino defines two forms of objectivity, Douglas breaks it down further. In order to clarify the concept of objectivity she lists seven different bases for trust. Like Longino's "activities of scientific inquiry", Douglas distinguishes between three different kinds of processes that belong to objectivity, based on human interactions with the world, individual thought processes as well as social processes.

[135] In section 6.5, I will outline in more detail the functions of this criticism and how must be conducted to reach objective knowledge.

> (1) interactions that one can have with the world (e.g. experimental processes, observations over time, simple interactions in daily life
> (2) an individual's apparent or reported thought process, focusing in particular on reasoning processes that lead to certain claims
> (3) social processes, which are interactions or ways of doing things among groups of people. (Douglas 2009: 117)

Here we can find the seven different bases for trust in objectivity. In 1) we find manipulable and convergent objectivity, in 2) detached, value-free and value-neutral objectivity, and in 3) procedural objectivity and intersubjectivity. In the following, I will describe these forms of objectivity before applying them to objectivity in foresight in chapter 7.[136]

(1) Manipulable objectivity

The first form of objectivity appears in the context of processes used in human interactions with the world. It is named "manipulable objectivity" because "the process of manipulation or tool use [are] central to its meaning" (Douglas 2009: 118). This form of objectivity corresponds to the ability to interact with the world in a reliable and repeatable manner. Such processes can be found especially in experimental contexts, where experimental results are repeatable. Further, this form of objectivity is manifest in the "reliable use of objects", for example, in objective claims about the function of specific objects such as characteristics of glass (2009: 118–9). Douglas states that "this method of ascribing objectivity does not require more than one observer-participant, as long as that observer is able to repeat his or her interventions" (2009: 119). Nevertheless, this form of objectivity is not a direct indicator of a successful process.

> In sum we get degrees of manipulable objectivity by considering how reliably and with what precision we can intervene in the world, and how essential our claims about those interventions are to the **success** of those interventions. (Douglas 2009: 119)

But the scope of manipulable objectivity, its focus on describing processes, is too limited for foresight, where we never find such circumstances for description.

[136] Douglas's concept of forms of objectivity has been chosen because it incorporates the different thoughts on objectivity throughout the sciences. Further, she encompasses the notions on objectivity presented by Longino (1990, 2002) and Kitcher (1990, 1993, 2001), who have also had a major influence on debates on values and objectivity in science and society. The overall aim of this summary of different forms of objectivity is to provide a base for objectivity considerations in foresight and to include them in a potential foresight framework. For this reason, a critical discussion is omitted at this stage. Critical notions on the socio-epistemic view on issues like objectivity, values, reliability, relevance or authority are summed up in section 6.4.

(2) Convergent objectivity

Convergent objectivity, and manipulable objectivity too, "require examination of the experimental process (or more generally, human-world interactions) to find the process markers that support ascription of objectivity to (that is, endorsement for trust in) the result" (Douglas 2009: 121).[137] The first two forms of objectivity indicate different "degrees of confidence" towards scientific results, as they operate on different levels. In manipulable objectivity, reliability and success are confirmed, while convergent objectivity means substantiating an empirical claim with as many independent sources as possible. This is what makes an empirical claim objective. The second sense of objectivity also appears in human interactions with the world, but more indirectly than manipulable objectivity. When different lines of evidence are used to support a certain conclusion, the claim of objectivity is convergent (2009: 120). Douglas puts this thought in the following way: "When evidence from disparate areas of research all point towards the same result, our confidence in the reliability of the result increases" (Douglas 2009: 120). In contrast to the first form, convergent objectivity builds upon results of other scientists. Douglas illustrates the impact of convergent objectivity in research with the example of atomic theory development:

> When multiple and diverse areas of research all pointed to the atomic nature of matter, the multiplicity and diversity of evidence convinced scientists of the objective nature of atomic theory, long before individual atoms were manipulable. In the work of Jean Perrin . . . in particular, one can see the building of an argument based on convergent objectivity. Perrin measured Avogadro's number (the number of molecules per mole) in several different ways, using, for example, the vertical density of an emulsion, horizontal diffusion in a liquid, and rotational Brownian motion in particles. Drawing upon the work of other scientists, Perrin detailed over a dozen different ways to calculate Avogadro's number, each producing the same (or nearly same) result. This convergence of evidence is what convinced scientists of the molecular nature of matter. (Douglas 2009: 120)

Objectivity in the sense of convergence of evidence can also be found in other natural sciences, for example, in astronomy. And people also appeal to this kind of objectivity in everyday, non-scientific contexts.

But there are some limitations to this kind of objectivity. While its strength builds upon the reliability created by multiple tests, as Douglas argues, "the reliability of the result rests on the independence of the techniques used to approach it" (Douglas 2009: 120).

[137] Douglas (2009: 121) sums up the two ways of objectively intervening in the world as follows: "For manipulable objectivity, we look for success in using the empirical claim to reliably and successfully intervene in the world. Empirical claims that allow us to intervene repeatedly and across multiple contexts are considered objective. For convergent objectivity, we look for multiple and independent (as possible) sources of evidence that point toward the same result or empirical claim. When we see this kind of diversity of evidence, we readily ascribe an objective status to the claim supported."

Another weakness of convergent objectivity is that different phenomena may give a misleading appearance of convergences by all indicating a specific result. Common mistakes in such situations include, for example, the misinterpretation of correlation and causality. Nonetheless, convergent objectivity is often supported by predictions which use the claim, and, as Douglas states, “[s]uch predictions, if found accurate, allow for more supportive evidence for the claim” (Douglas 2009: 120–1). Convergent objectivity requires numerous independent sources and methods. The more a claim is substantiated by different sources, that is, the more independent it is of particular contexts and methods, the more objective it is in the sense of convergent objectivity.

Convergent objectivity should appear in foresight indirectly: when expert knowledge of a specific field is required, foresight depends on the expertise of researchers of that field. The reliability of expertise used for foresight depends on the degree of convergent objectivity of a given scientific field.

(3) Detached objectivity

Objectivity forms 3 to 5 designate objectivity in reference to individual thought processes. Here the role of values is decisive. Douglas notes the following:

> Instead of focusing on the interaction between the experimenter and the world, these aspects of objectivity focus on the nature of the thought process under scrutiny, and in particular on the role of values in the individual’s thought processes. (Douglas 2009: 121)

The first sense of objectivity may be described very briefly, for its central idea is that one ought not to use “values in place of evidence” (Douglas 2009: 122). Attaining detached objectivity requires that social, ethical and cognitive values be avoided in evidence. Douglas describes further:

> Acting against detached objectivity, allowing values to function in the same role as evidence in one’s reasoning, damages the purpose of pursuing empirical knowledge, which is to gain knowledge about the world, not to gain an understanding that suits one’s preferences. (Douglas 2009: 122)

Detached objectivity is the basis of the norms that stipulate the role of values in science, and is thus crucial for scientific practice (Douglas 2009: 124). But while there are three distinct forms of objectivity in individual thought processes, they are not always clearly distinguished from one another. For example, detached objectivity is often confused with value-free objectivity (2009: 122).

(4) Value-free objectivity

In this form of objectivity, the value-free ideal is most manifest. Science should be free from all values that compromise its neutrality. As values are seen as “inherently subjective things”, they undermine the objectivity of reasoning processes.

Douglas rejects value-free objectivity, however, as an ideal for science, because she believes values cannot be excluded entirely from research. For one, she believes it is not possible to clearly distinguish between epistemic and non-epistemic values.[138] For example, discussions on the importance and interpretation of scientific results are inevitably affected by the scientist's cognitive values. Values affect scientific work, especially where decisions are made. Douglas points to scientific papers as an example: dedicated to the value-free ideal of science, the structure of scientific papers is very "formulaic" and thus "the role of the scientist as active decision maker in the scientific process is deftly hidden" (Douglas 2009: 123). Consequently, value judgments remain hidden and are concealed by procedural styles and an objective language. A second problem with excluding cognitive values completely from research is that it allows scientists to disregard all moral responsibility, to ignore all ethical values and social or ethical consequences of scientific research and development. So how should values be included in the scientific process? Douglas's socio-epistemic answer to that question is that scientists must be aware of the role that values play. They are not meant to replace scientific reasoning; instead, value judgments are needed in science to weigh the consequences of scientific results and claims, and especially in decision making:

> scientists must learn to negotiate the fine but important line between allowing values to damage one's reasoning (for example, blotting out important evidence or focusing only on desired evidence) and using values to appropriately make important decisions (such as weighing the importance of uncertainties). (Douglas 2009: 123)

This quotation summarizes how scientists should deal with values in science and also highlights the point where Douglas distinguishes between detached and value-free objectivity.

(5) Value-neutral objectivity

The last form of objectivity concerning individual thought processes in science is value-neutral objectivity. It does not prohibit values from entering into science, but nonetheless favors a neutral position. Douglas defines it as follows:

> this sense focuses on scientists taking a position that is balanced or neutral with respect to a spectrum of values. In situations where values play important roles in making judgments but there is no clearly "better" value position, taking a value-neutral position allows one to make the necessary judgments without taking a controversial value position and without committing oneself to values that may ignore other important aspects of a problem or that are more extreme than they are supportable. (Douglas 2009: 123–4)

Value neutrality may also be regarded as a "reflectively centrist" position towards objectivity (Douglas 2009: 124). It is useful, for example, when conducting literature re-

[138] The differences between epistemic and non-epistemic values are discussed in section 6.2.2.

views or when different possible explanations are desired. Here it is appropriate to defend a "reflectively balanced position". But value-neutral objectivity has its limits, for example, when certain social or ethical issues are addressed with regard to the sources. Douglas illustrates this thought with an example:

> For example, if racist or sexist values are at one end of the value continuum, value-neutrality would not be a good idea. We have good moral reasons for not accepting racist or sexist values. And thus other values should not be balanced against them.
> (Douglas 2009: 124)

While the case for moral reasons against racist and sexist values may be rather obvious, the shortcomings of the ideal of value-neutral objectivity are also evident in contemporary scientific debates, for example, in medical, environmental and sustainability issues. And these shortcomings are especially evident when a futures focus is involved, for example, in debates about where to place the primary value – whether to invest in industrial jobs for a robust local economy or to invest in healthcare and environmental protection against harm caused by those very same industries (Douglas 2009: 124).

To sum up, detached and value-neutral objectivity are viable for individual thought processes. Both can be described in degrees, as one can be "more or less neutral with respect to various values" or "more or less detached from one's subject" (2009: 124). In detached objectivity, one must take into account the role of values in the reasoning process, while value-neutral objectivity requires a moderate position with regard to the range of values.

(6) Procedural objectivity

Procedural, concordant and interactive objectivity form the base of objectivity in social processes. Here, objectivity is not bound to individual thought processes, but to

> the process used among groups of people working to develop knowledge, and specifically, the process used to reach an agreement about a knowledge claim. (Douglas 2009: 125)

In procedural objectivity, social processes in science are seen as objective "if the same outcome is always produced, regardless of who is performing the process" (2009: 125). A core element of procedural objectivity is quantification through rules, which enables identical results in processes. Multiple choice tests are a typical example of such a kind of objectivity. In multiple choice tests there is one correct answer in a set of possible answers to a question. When grading the test, no individual judgment is needed; regardless of who grades the test, the right answers are always the same. Errors might occur in the grading, but not due to disagreement on the right answer.[139] Its claim of standardiza-

[139] Douglas (2009: 125) adopts this form of objectivity from Theodore Porter, who investigates its role in accounting and engineering.

tion through the quantification of rules is the main strength of this form of objectivity, as it enables public trust. Douglas clarifies this point as follows:

> Quantification through rules (as opposed to expert judgment) allows for both an extension of power across traditional boundaries and a basis for trust in those with power. Procedural objectivity thus serves a crucial function in the management of modern public life. (Douglas 2009: 125)

The fact that anyone is capable of verifying the outcome produced by such process fosters public trust. On the other hand, despite the absence of personal judgment, "values are encoded in the processes themselves" (Douglas 2009: 126). In this respect, rules of quantification are built upon certain value judgments that appear in the process of condensing the importance of an issue:

> Which inputs are emphasized as important for the decisionmaking process reflects whatever values are built into the process. Thus, rules can force one to disregard evidence that one might otherwise consider relevant. (Douglas 2009: 126)

Values are inherent to procedural objectivity, though individual judgments are excluded. In foresight we find a claim for this form of objectivity, for example, in bibliometric and statistical approaches. More generally, the reliability issues of the forecasting era were also bound to forms of procedural objectivity (see Martino 1983: 280).

(7) Concordant objectivity

The two other forms of objectivity in social processes can also be subsumed by "intersubjectivity" in two senses: concordant objectivity, which is the agreement in judgments between different people, and interactive objectivity, which is an extension of the former, whereby agreement is produced through argument and deliberation.

Concordant objectivity is reached when the judgments of different people agree. This form of objectivity is inspired by Quine's notion on intersubjectivity as a requirement for objective science (Douglas 2009: 127). Douglas defines it as follows:

> concordant objectivity is applied in cases where the individuals are simply polled to see how they would describe a situation or context, or whether they would agree with a particular description. There is no discussion or debate here, no interactive discourse that might bring about agreement. . . . If the observers agree, then the observation is concordantly objective. (Douglas 2009: 127)

In this respect, concordant objectivity intercepts the individual judgment omitted in procedural objectivity; it is agreement based directly on observation rather than agreement brought about through discussion or debate. Note that procedural objectivity may reduce potential disagreement and serve as a context for concordant objectivity. There is greater concordant objectivity when individual judgments of observation are made without a context of procedural constraints. Like the other forms, concordant objectivity too has its weaknesses. First, it may lead to distorted views of an object when a group of observers all share certain values which influence their judgments, encouraging them to over- or undervalue certain aspects of it; Douglas describes this as “the chance of group illusion” (Douglas 2009: 127). Another weakness of interactive objectivity is that the initial decision concerning the composition of the group is prone to bias (Douglas 2009: 127). A classical example is foresight workshops conducted in foresight research, where concordant objectivity should be reached. In foresight workshops, however, group illusions might appear when the groupis too homogenous.

(8) Interactive objectivity

Like concordant objectivity, the final form of objectivity is also bound to intersubjectivity. But this third form of objectivity is more complex than the forms described above as it is based on discussion between participants. Its main claim is that by “keeping scientific discourse open to scrutiny, the most idiosyncratic biases and blinders can be eliminated” (Douglas 2009: 128). The crucial issues for interactive objectivity are “[t]he quality of interaction among investigators and the conditions for those interactions” (Douglas 2009: 128). Hence, to reach objectivity in this sense, it is necessary to share scientific data, enable the examination of models and replicate experiments where possible.

Douglas describes this form of objectivity in reference to recent philosophy of science, especially socio-epistemic philosophy of science. Supporters of this form of objectivity include Kitcher (1993, 2001) and Longino (1990, 2002). Its limitations are similar, however, to those of concordant objectivity. While it sets standards for discussion, it raises numerous questions: How do we define who can participate in the discussions? What are the boundaries between those who agree to them and those who don’t? How do we define the competence required to participate in the discussions? (see Douglas 2009: 128–9) .

These questions are crucial to foresight practice, for example, when conducting expert workshops, but also more generally when setting up and conducting a foresight project. It is important to understand the rules of interactive objectivity. Specifically for foresight it is crucial that the epistemic forms, sources and aims be clearly defined, which may also be included in the rules.

Longino identifies several conditions for inter-subjective criticism, which are crucial to reaching interactive objectivity. These include recognized avenues for conducting criticism, shared standards for arguments or community response and the equality of intellectual authority.[140] An outline of Longino’s transformative and intersubjective criticism will show that for certain fields of science all these questions have to be answered in

[140] Longino’s concept of transformative criticism, which frames objectivity issues as well as values, is described in section 6.4.

reference to particular cases. Based upon the notions of objectivity, values and relevance of the present chapter, chapter 7 will propose a first outline of answers to these questions in the context of foresight.

Note that these forms of trust associated with objectivity, as Douglas highlights, "focus on the objectivity of knowledge claims, and the processes that produce these claims, rather than the objectivity of persons, panels or procedures per se" (Douglas 2009: 116). When used concurrently, they can foster our confidence and ensure the reliability of scientific knowledge. With the different forms of trust, processes which are objective lead to "trustworthy knowledge claims" (Douglas 2009: 116). Nevertheless, objective claims are not "absolute statements" that are secured or accepted forever. Douglas puts this point as follows:

> In addition, non of the bases for objectivity should be thought of as a guarantee. . . . Objectivity can provide no such absolute assurance. Instead, objectivity ensures us that the best we can do is being done. The more objective something is, the more we can trust it to be our best epistemic effort. (Douglas 2009: 117)

Like Longino, Douglas believes that objectivity can be reached to different degrees. Objectivity is differentiated with regard to the different contexts of scientific practice it appears in. Building trust is a crucial aim of objective scientific practice.

6.4 Framing science as social knowledge: Longino's contextual and transformative criticism

In addition to showing why science can be understood as social knowledge, Longino's contextual and transformative criticism also reveals the basis of scientific theories of social knowledge. Longino's concept provides us concrete reference points to apply scientific criticism in practice. It has had a major influence on Douglas's work, which raises an important question: What does it mean to designate a scientific discipline as a form of social epistemology? What does this imply, then, about the structure of scientific practices? Perhaps it is less a designation about how science is conducted, and more about the way we speak about it and whether we respect the role and impact of non-epistemic values. In her book *Science as Social Knowledge* (1990), Longino develops the approach of contextual empiricism. She shows that scientific validation by means of evidential criticism is incomplete, as data and experiments alone do not provide sufficient evidence for or against a hypothesis. Human background beliefs and assumptions, in the form of individual and social values, influence research, the interpretation of data, experiments and ultimately scientific results. The relevance of certain hypotheses reflects the beliefs of the scientific community. This is especially visible when there are concurring interpretations of the same data and information.

Longino provides a framework for criticism consisting of three parts: (1) evidential, (2) contextual and (3) transformative criticism. She offers a comprehensive analysis of how to deal with objectivity and values in science. Recognizing how values influence scientific practice helps us to formulate specific requirements for degrees of objectivity. It also shows that scientific practice is oriented towards different aims, for which values play different roles.

(1) Following Longino, *evidential criticism* proceeds "on the basis of experimental and observational concerns [and questions] . . . the accuracy, extent and conditions of performance of the experiments and observations serving as evidence, and questions their analysis and reporting" (1990: 71). Evidential criticism is a form of scientific criticism that corresponds to realist accounts of science. In section 4.1 I suggested that, insofar as foresight be considered scientific, it is not by referring to such accounts of science. Longino's description of scientific criticism lends further support to this thought. For example, most of the results produced in foresight cannot be repeated, as they rely upon future scenarios created by participants' judgments and the selection of relevant factors. Critical analysis to assess the accuracy of experiments would be the wrong approach, for foresight does not aim at providing reproducible and accurate results.

(2) The second form of criticism, conceptual criticism, reflects "theoretical and metatheoretical concerns", of which there are three notable directions for questioning a hypothesis (1990: 72):

- First, the conceptual soundness of a hypothesis can be questioned. A historical example given by Longino is Kant criticizing and questioning the Newtonian hypothesis of absolute time and space.
- The second option is to question whether a hypothesis is consistent with accepted theory. Copernicus's heliocentric theory, for example, was rejected by medieval scholars because it was inconsistent with the existing Aristotelian concept of physics.
- Another option is to question the evidence in support of a hypothesis. This form of criticism is similar to evidential criticism, though its target is not merely data and experiments, but also assumptions motivating a hypothesis. Here scientific criticism becomes intersubjective.

In positivist and realist accounts of science, objectivity involves rejecting or accepting hypotheses based on observational and experimental data. It is thus applied only to empirical inquiries, without taking into account the various background assumptions motivating a given hypothesis. Longino argues that evidential objectivity, however, is not sufficient from a contextual perspective. She outlines the impact of this point on the objectivity of scientific methods as follows:

> Because the relation between hypotheses and evidence is mediated by background assumptions that themselves may not be subject to empirical confirmation or disconfirmation, and that may be infused with metaphysical or normative considerations, it would be a mistake to identify the objectivity of scientific methods with their empirical features alone. (Longino 1990: 75)

This quotation emphasizes that, alongside normative considerations, subjective background assumptions may enter scientific processes. Normative considerations are based on specific values. This position also reflects the limitations of manipulable and convergent objectivity outlined by Douglas, who resolves this issue by introducing concordant and interactive objectivity to regulate he impact of values. Longino's approach is to use conceptual criticism, which reflects the relevance of arguments, in order to argue for a third form of criticism, namely, 'transformative criticism'. She emphasizes not only the impact of background beliefs, but also their impact on scientific practice and the way knowledge is created, and that this impact must be regulated:

> Objectivity in the sense under discussion requires a way to block the influence of subjective preference at the level of background beliefs. While the possibility of criticism does not totally eliminate subjective preference either from an individual's or from a community's practice of science, it does provide a means for checking its influence in the formation of "scientific knowledge". (Longino 1990: 73)

This quotation reveals the proximity between Douglas's concept of objectivity and Longino's. According to Longino, values will always enter scientific practice as individual values or community values (1990: 81). She identifies different contextual values and the ways they may enter science, and suggests certain criteria to ensure objectivity by transformative criticism. Individual preferences can be limited when background beliefs relevant to a hypothesis are discussed, rejected or adjusted within the scientific community.

6.4.1 Objectivity by criteria of transformative criticism

Longino sets "four criteria necessary for achieving the transformative dimension of critical discourse" with which different degrees of objectivity can be reached in scientific communities (Longino 1990: 76, 2002).

1. *Recognized avenues for criticism*

A typical instrument for recognized avenues for criticism are peer review processes in scientific publishing such as journals and at conferences where scientific progress and findings are critically discussed by the scientific community. Such procedures shape, advance and distribute scientific knowledge. Longino argues that these activities should be valued as highly as original research (Longino 1990: 76).

2. *Shared standards*

Scientific criticism that is relevant to the scientific discourse should follow certain public standards, and researchers of a scientific community involved in such discourse should also feel bound to them (Longino 1990: 77). According to Longino, these standards or criteria can incorporate both epistemic and social values, and they may vary from community to community. For this reason there are various standards to be considered:

> Among values the standards can include such elements as empirical adequacy, truth, generation of specifiable interactions with the natural or experienced world, the expansion of existing knowledge frameworks, consistency with accepted theories in other domains, comprehensiveness, reliability as a guide to action, relevance to or satisfaction of particular social needs. (Longino 1990: 77)

Longino emphasizes that these standards share some elements of Kuhn's epistemic values (see section 6.2). In experimental sciences, for example, the first standard should be fixed, while the others need to be negotiated in particular scientific communities. There may be variations in the weighing of such standards due to different social and historical contexts.

3. *Community response*

Longino defines this criterion as follows:

> This criterion requires that the beliefs of the scientific community as a whole and over time change in response to the critical discussion taking place within it. (Longino 1990: 78)

The contents of text books, along with grants and awards, for example, serve as indicators for responsiveness. Critical discussions and responses are needed to enhance understanding of the guiding hypotheses within a community. A scientific work that sustains criticism may enhance the understanding in the field. To meet this standard, community members should keep track of the scientific discourse of the field and ensure "that the assumptions that govern their group activities remain logically sensitive to it" (Longino 1990: 78).

4. *Equality of intellectual authority / tempered equality*

The equality criterion of intellectual authority emphasizes the need for equal and unprejudiced consideration of scientists and theories:

> This Habermasian criterion is intended to disqualify a community in which a set of assumptions dominates by virtue of the political power of its adherents. (Longino 1990: 78)

This is also the case when politics suppress competing scientific theories in favor of one in particular. An obvious example is the rule of Lamarckism in the Soviet Union during the 1930s, as “the suppression of alternative points of view was a matter of politics rather than of logic or critical discussion” (Longino 1990: 78). However, this criterion also applies to situations where equality of intellectual authority could be undermined in less obvious ways, for example, when the voices of women or minorities are neglected in scientific discourse.[141] Longino adopts this criterion from Habermas and his theory of communicative action *Theorie des kommunikativen Handelns*.[142] Habermas argues that scientific reputation requires differentiated value spheres in truth-seeking activities (according to Weber) and moral behavioral control for normative influences. Communication technologies help to institutionalize the needed publicity and to promote linguistic consensus building (Habermas 1981/2016: 273–4).[143]

Transformative criticism also helps to support scientific inquiries and methods. Objectivity within a scientific community requires that transformative criticism be applied in all aspects, and that it be applied for all criteria equally. Individual and social values that inevitably enter scientific processes can be detected and incorporated into the scientific discourse. Validation of scientific inquiries and methods entails detecting individual and social values that may enter processes as background assumptions. For this purpose, each criterion requires that individuals of a scientific discipline participate in critical discussions in order to detect and actively discuss background beliefs. These criteria also help to evaluate the objectivity of scientific inquiries and scientific debates.

Finally, Longino’s approach of contextual empiricism goes beyond validating science with regard to cognitive values. More importantly, by extending evidential criticism with conceptual and transformative criticism she is able to take into account that scientific methods are diverse, while responding to both contemporary and past scientific practice (Longino 1990: 82).

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[141] Longino shows how this criterion is often violated, for example, in biology and behavioral sciences, where “assumptions about sex structure a number of research programs” Longino (1990: 78).

[142] Translated into English as *The Theory of Communicative Action*.

[143] Habermas’s original argument reads as follows: “Ein kognitiv spezialisierter Einfluss wie z.B. wissenschaftliche Reputation kann sich nur in dem Maße bilden, wie sich kulturelle Wertsphären im Sinne Webers ausdifferenzieren, die eine Bearbeitung der kognitiven Überlieferung unter dem exklusiven Gestaltungsaspekt von Wahrheit gestatten. Ein normativ spezialisierter Einfluß, wie. z.B. moralische Führerschaft, kann sich nur in dem Maße bilden, wie die Moral- und Rechtsentwicklung die postkonventionelle Stufe erreicht, wo das moralische Bewußtsein über interne Verhaltenskontrollen im Persönlichkeitssystem verankert ist. Beide Arten von Einfluss erfordern zudem *Kommunikationstechnologien*, mit deren Hilfe sich eine *Öffentlichkeit* bilden kann. . . . Je mehr die sprachliche Konsensbildung durch Medien entlastet wird, umso komplexer werden die Netze der mediengesteuerten Interaktionen” Habermas (1981/2016: 273–4).

6.4.2 Transformative criticism and the impact of values

Longino highlights that contextual values affect and influence the practice of both theoretical and applied science in different ways.[144] Such values may lead, however, to value-laden assumptions and biased results. There are notably five ways research may be affected by contextual values (see Longino 1990: 86):

> 1. *Practices*. Contextual values can affect practices that bear on the integrity of science.
> 2. *Questions*. Contextual values can determine which questions are asked and which ignored about a given phenomenon.
> 3. *Data*. Contextual values can affect the description of data, that is, value-laden terms may be employed in the description of experimental or observational data and values may influence the selection of data or of kinds of phenomena to be investigated.
> 4. *Specific assumptions*. Contextual values can be expressed in or motivate the background assumptions facilitating inferences in specific areas of inquiry.
> 5. *Global assumptions*. Contextual values can be expressed in or motivate the acceptance of global, framework like assumptions that determine the character of research in an entire field.

The five ways listed here indicate the extent to which scientific practice is affected by contextual values. Intersubjective criticism of the transformative kind helps to detect and manage the appearance of such contextual values. The degrees of objectivity depend on the criteria presented in the previous chapter. Like Douglas, Longino believes that objective knowledge is possible if one takes into consideration the kind of contextual values that affect research and if one finds a place for these values in research itself.

However, Longino also admits that there are limits to validating scientific practice by intersubjective criticism (Longino 1990: 223). Value-laden assumptions shared by a whole community may remain hidden and thus not become explicit in scientific discourse. Further, in scientific validation, we have to consider the roles "of (sometimes) conflicting goals of inquiry with respect to which hypotheses and theories are assessed" (Longino 1990). This is important because value-laden assumptions in scientific practice may influence the results, even when constitutive rules of science are not violated. In other words, scientific procedures may be valid in terms of evidential criticism, yet not in terms of transformative criticism – for contextual values may undermine the scientific process and distort the aims of inquiry. By contrast, in Douglas's approach this would mean that cognitive values enter research in an accepted manner, whereas social and ethical values enter the process indirectly. This could happen in cases where experimental methodological approaches are selected, without making the relevant social and

[144] In Longino's work, contextual values, including background assumptions based on individual and social values, correspond basically with Douglas's definition of non-epistemic, social and ethical values.

ethical values explicit. Medical and pharmaceutical research is a good example of such cases.

6.5 The potential of social epistemology for foresight

Social epistemology is an approach to philosophy of science that examines current science as it is practiced and questions its epistemic validity. In contrast to social constructivist approaches, the truth and knowledge claims are central. Following the accounts of science discussed in chapter 4, conservative social epistemologists would deny that foresight practices are epistemically valid, since they cannot aim at truth in the proper sense. This chapter has attempted to show, in Goldman words, that "epistemic matters in general cannot be divorced from the practical" (Goldman 2012: 258). This suggests that insights from social epistemology may be used to establish a socio-epistemic framework for scientific practice in foresight.

For example, the veritistic approach to social epistemology (shaped essentially by Goldman, but also by Kitcher) provides useful insights for assessing group and expert knowledge. In a foresight context, this may help assess the relevance, reliability and authority of group work and expert knowledge. As shown in section 6.2, values inevitably enter scientific processes. Douglas's comprehensive account of the different forms of objectivity also shows that all approaches to science, from realist to relativist, employ socio-epistemic practices. With respect to the diverse sources of information and knowledge, and many qualitative and quantitative methods in foresight, one may ask whether such a holistic presentation of objectivity is helpful in explaining epistemic claims and objectivity in foresight. Longino's contextual empiricism is also an attempt to bridge the gap between realist and holistic approaches by providing criteria for transformative criticism. These criteria should be used to assess the objectivity of scientific communities.

On the one hand, foresight has to cope with different value forms; on the other hand – due to methodological diversity – foresight also embraces the different forms of objectivity. The aim of the following chapter is to sketch a socio-epistemic foresight framework on two levels: on the level of foresight practice in order to validate scientific procedures, and on the theoretic meta-level in order to assess scientific practice and theory building within the community. The framework incorporates Douglas's insight concerning the typologies of objectivity and values as well as Longino's different forms of criticism.

7. Foresight as Scientific Practice: a Socio-Epistemic Framework

In a comprehensive inquiry of the epistemology of foresight, it is necessary to consider the long tradition of philosophical discourse on propositions about the future and, from a practical perspective, what we can learn from those who actually apply foresight theory. Scholars, philosophers and scientists involved in the futures field continue to discuss the epistemic gap.

As I outlined in chapter 4, foresight cannot be characterized as epistemology in the proper sense, and any attempt to do so is bound to fail. Nevertheless, as different contemporary theories in foresight show (see chapter 5), the ontological question, 'What is the future?', may be answered in different ways, including from a constructivist perspective. But the epistemic question connected to practical guidance,[145] that is, 'How do we arrive at knowledge of the future and how can we use it in a valid way?', may profit from a socio-epistemic answer since it encompasses the scientific practice of today's sciences in general. This epistemic question is connected to other questions. What lessons can be taken from social epistemology for foresight epistemology? How can we incorporate the different forms of objectivity and the insight into the influence of values into an outline of an epistemic foresight framework? Recent developments in philosophy of science in the field of social epistemology, partly building upon critical realism, may be used as a point of reference.[146] Lessons learned from applying the insights of social epistemology to other fields may help us to create a holistic epistemology of foresight and a framework for criticism. The aim is twofold: first, to use socio-epistemic insights to uncover valid epistemic forms of foresight practice, and second, to focus on issues in foresight that still lack an epistemic inquiry, such as the epistemology of group thinking.

One finds in recent foresight and futures literature discussions of a wide range of crucial features that have an impact on foresight and on its validity, including uncertainty and risk (Öner 2010; Grunwald 2007; Luis Cordeiro et al. 2013) inter- and transdisciplinari-

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[145] Loveridge stresses that the only need for a foresight epistemology may be in the context of a systemic activity: "I shall argue that epistemology is only relevant to foresight and systems thinking in as much as it has something, if anything, to say about the formal methods that are used in a subsidiary and optional way to the more fundamental thinking that foresight as a systemic activity, systemic foresight . . . hereafter, involves"; Loveridge (2009b: 39).

[146] See Longino (1990, 2002), Douglas (2009).

ty (Bowonder et al. 1999; Cuhls 2004; Amanatidou 2011; Schauppenlehner-Kloyber and Penker 2015; Brown 2015), objectivity (Bell 2004, 2003; Kläy et al. 2015), values (Malaska 2001; Bell 2004) and the validity of futures research in general (Grunwald 2009). Such issues have been discussed in view of the notion of foresight knowledge. There are even some initial concepts of evaluation frameworks for foresight, for example, in Cuhls and Georghiou (2004) and Popper et al., eds. (2010), which incorporate the insights gathered from a broad range of international foresight activities. Amanatidou and Guy (2008)[147] focus on epistemic reflections, the social impact of knowledge acquisition and the effectiveness of scientific procedures. Another example is Slaughter's framework of five levels, which evolves from individual capacities to social capacities of futures thinking (Slaughter 1996a). In contrast to these theoretical reflections, Piirainen et al. (2012) address questions related to utility and delivery, both on technical and ethical levels. More recent frameworks address knowledge acquisition in foresight on the basis of theories of system and innovation (see Andersen and Andersen 2014; Dufva 2015).

While all these examples highlight the relationship between foresight and social epistemology, none of them offer a proper contextualization of foresight research, for example, by examining the different forms of objectivity and the impact of values. This chapter aims at bringing these and further features together in a socio-epistemic foresight framework, and may be seen as the culmination of the insights of the previous chapters.

7.1 The foresight framework: foresight practice and the scientific reflection base

Foresight takes place on two levels: the level of foresight practice, where projects are conducted and methods applied, and on the level of scientific reflection, where the foresight community discusses advances in theory and methodology, exchanging experience and case examples. Instead of distinguishing foresight practice and foresight theory, I recommend calling the space where theoretical considerations take place the "scientific reflection base". My intention is to highlight the need for ongoing interaction between the two levels so that the epistemic framework for foresight theory can meet the actual needs in the field of practice. Another important point concerns the impact of epistemic issues on both the level of foresight practice and of scientific reflection.

[147] See also Amanatidou (2014).

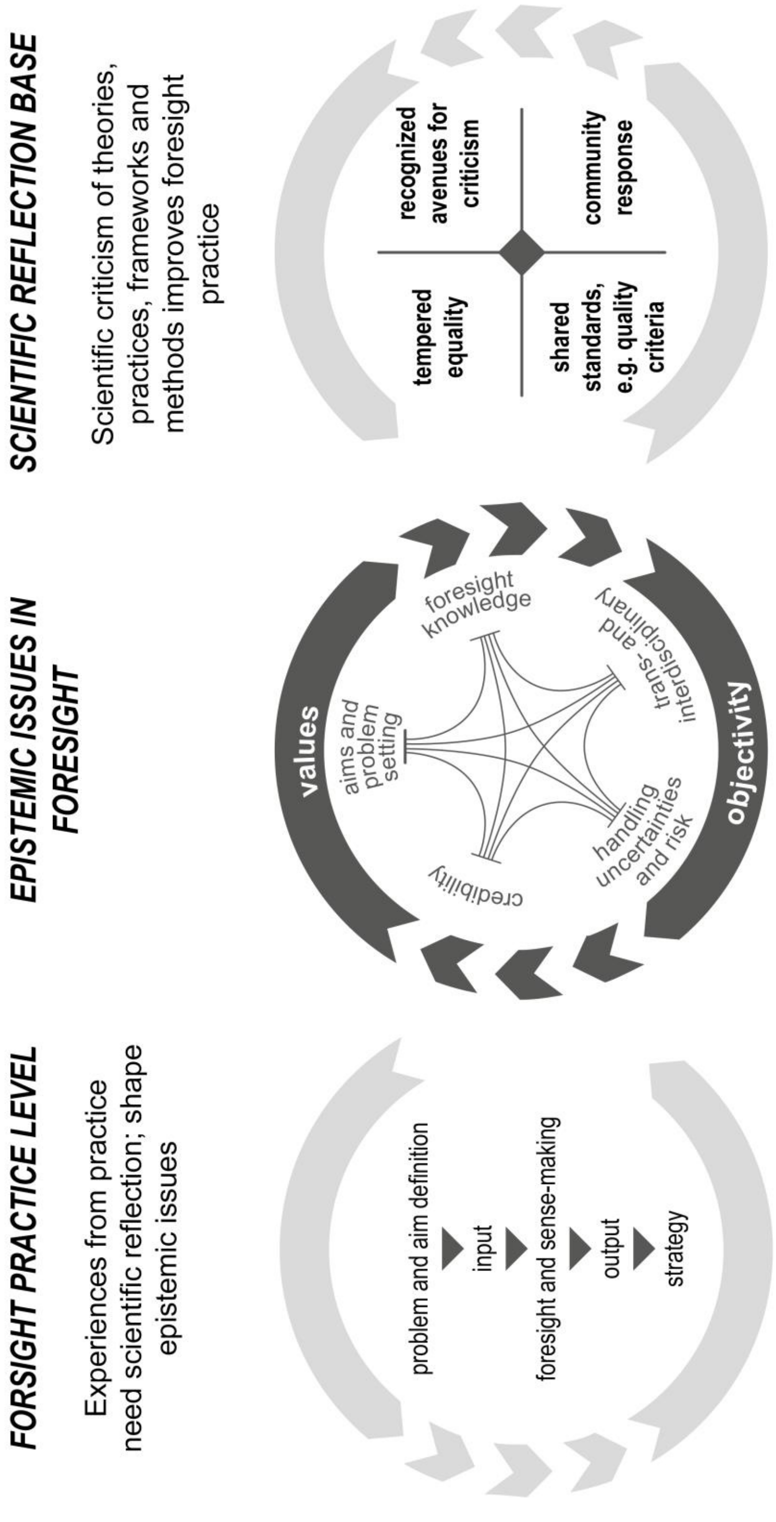

Figure 9: A socio-epistemic foresight framework

Figure 9 shows that foresight practice and scientific reflections occur simultaneously and have an impact on each other. Insights, experience, rules and criteria are all encompassed by the concept, which takes into account the impact that different forms of values have on objectivity. This goes hand in hand with questions concerning the domain-specific definitions of knowledge, aims and validity. For the scientific reflection base Longino's four dimensions of scientific criticism are adopted.

Note that this is merely a compilation of instruments used in the foresight community and definitions found in the literature. It should be clear that this is a provisionary description that brings together foresight and social epistemology, the validity of which can only be settled by the community itself. In the following, I will first describe the two phases and then the epistemic issues which connect them.

7.1.1 Foresight practice level

In chapter 3 I outlined different definitions of foresight, including its aims and methods. Foresight processes essentially build upon the three stages: input (which means application of foresight methods), output and actions.[148] The epistemic foresight framework that I have adopted for this chapter is based on the more detailed version by Voros (2003), which consists of four steps, and on Cuhls's five-step framework. I will also consider some ideas from the government foresight process model developed by SNV[149] (Buehler et al. 2013) and EFFLA[150] (European Forum on Forward Looking Activities 2013).

[148] Most of the literature here refers to Horton (1999). See chapter 3.

[149] While their concept is suitable for practical concerns, I have adopted for my work only some ideas concerning the communication of results and the strategy phase. My intention is to reach a clearer understanding of epistemic implications by means of a leaner process model.

[150] A crucial insight of the EFFLA process model is the emphasis on sense making, which highlights the need to select and apply methods in concordance with the purpose of the task and under consideration of the customers' needs. I adopt these points to the third step.

Figure 10: Foresight process in five steps

Step 1: Identification of the problem, aim setting: Problems in need of foresight are either identified by a company, stakeholder, institution or government needing future orientation concerning a certain topic, or they are a consequence of previous foresight work in need of iteration. In the latter case, open issues appear during a foresight process and may be formulated as a recommendation for a specific future foresight case. Broad, explorative foresight exercises may lead to the concretization of required foresight, for example, in the form of normative visioning or road-mapping. Important in this phase are decisions concerning the aim of the foresight project, whether it is explorative or normative. Further methodological choices and the project-specific design of the process build upon this prior decision. Also recommendations formulated at the end of the project are influenced by this decision.

Step 2: Input phase: In the input phase, information from different sources is collected in order to determine the state of affairs, which serves as a starting point for future reflections. Input methods may contain delphis on current knowledge, horizon and environmental scanning, and brainstorming (Voros 2003: 13). The aim of this step is to assess the current situation. This step may also include workshops to collect different people's opinions on a topic.

Step 3: The foresight and sense-making phase: The foresight phase is the central task of a whole foresight process, as it is used to contextualize, evaluate and discuss the situation in relation to the aim set in the first step. For this reason, in the EFFLA briefs for the EU Commission the foresight phase is also called the "sense-making phase". Their authors argue that sense making is needed in order to link the process to the purpose of the task. Sense making is also needed to address the issues posed by the customer. Questions to be addressed at this stage include what the findings and results of the single steps mean for the customer, what "the strategic, operational and practical implications" are, and what they mean for future programs (European Forum on Forward Looking Activities 2013: 6). Methods used to assess the state of research, the experts involved in the process, and prioritizations and judgments for certain future scenarios should always connect with the aim set at the beginning.

The possibility to mix different tools and methods – more qualitative or more quantitative – ensures there is adequate flexibility to address different tasks and topics. This phase varies in accordance with the task. It may be subdivided into analysis, interpretation and prospection (Voros 2003).

- **Analysis**: Methods used here include the analysis of emerging issues and trends, cross-impact analysis, and other analytic tools like bibliometric approaches. The goal is to provide a structured overview of available data and a comprehensive understanding of the current state of the subject matter.
- **Interpretation**: The goal of this step is to "look for deeper structure and insights" in order to identify dynamics and drivers (Voros 2003: 15). This goal is achieved by in-depth analyses enabling systems thinking and the classification of patterns, trends or events. Specific approaches include the concept of "critical future studies" as suggested by Slaughter or Inayatullah's causal-layered analysis (Inayatullah 1998, 2005).
- **Prospection**: This phase involves considering multiple futures. The direction of prospection depends on the overall aim of the project and may accordingly vary in scope. Explorative tasks require an open reflection of probable and possible scenarios, while normative tasks focus on desirable and preferable scenarios. At this stage, depending on the input of the previous phases, visioning and other normative methods can also be used.

Step 4: The output-phase: Foresight work of the previous steps is summarized in reports and presentations. Workshops may be conducted to discuss results with stakeholders or further expert groups, for example, to inform them about the results (last interpretations may be adopted here).

Step 5: Strategy: Strategic planning and strategy development are taken over by the customer (Voros 2003: 16). Foresight practitioners are asked to formulate recommendations from the results. Strategic reflections may also involve the follow-up foresight tasks in the future or the identification of further topics needing foresight. As described in chapter 3, this step may also be considered an independent part of the process: while steps 1 to 4 focus on strategic foresight, step 5 may initiate the process of strategic planning and implementation to make use of the foresight results for the client.

7.1.2 The scientific reflection base

To qualify as being scientifically structured, the foresight community itself must fulfil certain standards of scientific objectivity. With 'scientific reflection base' I am drawing on Longino's concept of transformative criticism. The exchange between the practice base and the scientific reflection base is needed to enable scientific criticism, and as a consequence, to ensure objective and valid procedures and to promote scientific progress. In this way the field develops a scientific discourse. For this purpose, Longino's standards for objectivity in science – which also enable transformative criticism – should also be adopted in foresight: recognized avenues for criticism, shared standards, community response and equality of intellectual authority. In foresight theory and practice, we find several examples which indicate that these standards are already being met. In addition, these standards reveal the deficiencies of foresight in terms of scientific validity. In the following, I will summarize the existing practices in the foresight community that may be attributed to the different criteria and suggest how to interpret them in the context of foresight.

1. *Recognized avenues for criticism*

Recognized avenues for criticism encompass scientific platforms where scholars in the futures research field can meet. Conferences and journals provide a space for researchers to critically assess current practices and methods, and where new insights in theory and practice are discussed. Such a space has to be publicly recognized and accessible.

Within futures studies in general, there are several peer-review journals that offer such a space:[151]

- European Journal of Futures Research
- Foresight: The Journal of Future Studies, Strategic Thinking and Policy
- Futures: The Journal of Policy, Planning and Futures Studies
- Futuribles
- International Journal of Foresight and Innovation Policy
- Journal of Evolution and Technology (JET)
- Journal of Futures Studies: Epistemology, Methods, Applied and Alternative Futures.
- LRP Long Range Planning: International Journal of Strategic Management
- Policy Futures in Education
- Technological Forecasting and Social Change: An International Journal
- The International Journal of Forecasting
- The Journal of Forecasting
- World Future Review: A Journal of Strategic Foresight
- World Futures: The Journal of New Paradigm Research

As the titles of the journals indicate, most are dedicated to futures related issues in general and not specifically to foresight. Some even contain the term forecasting in their name.

In the foresight community, there are different conferences and organizations which aim at fulfilling this task of a "publicly recognized forum" (Longino 2002: 129). Organizations promoting futures studies include the World Futures Society (WFS)[152]. Founded in 1966, the WFS describes its mission as follows:

> The World Future Society is the world's premier community of future-minded citizens. Our mission is to harness the spirit of discovery, the power of imagination, and the energy of collective action to create a brighter future. (World Future Society 2016)

As an educational and scientific non-profit organization, it offers a platform for exchange about futures studies and organizes an annual conference. A second organization

[151] As listed on the WFSF website World Futures Studies Federation (2016), https://www.wfsf.org/resources/futures-publications-journals. WFSF lists three more: *Info: The Journal of Policy, Regulation and Strategy for Telecommunications, Information and Media*; *Time & Society*; *NanoEthics: Ethics for Technologies that converge at the nanoscale.* Although foresight deals with the social impact of new and emerging technologies, its function as a strategic tool for futures thinking is not the focus of these journals.

is the World Futures Studies Federation (WFSF), which was founded in 1973. It defines its aims as follows:

> WFSF is a UNESCO and UN consultative partner and global NGO with members in over 60 countries. We bring together academics, researchers, practitioners, students and futures-focused institutions. WFSF offers a forum for stimulation, exploration and exchange of ideas, visions, and plans for alternative futures, through long-term, big-picture thinking and radical change. (World Futures Studies Federation 2016)

According to their descriptions of their missions in the field of futures studies, they do not address only scientists and researchers. Rather, they attempt to integrate and address all relevant stakeholders, to act in a publicly open manner and to be open to all thematic issues. The downside of such a mission is that their position in the field is very vague. In reference to Longino (2002: 129), one may see foresight's focus on customer oriented policy and decision making to overshadow scientific engagement in the field (see section 6.5).

2. *Shared standards*

Shared standards ought to provide transparency, thereby increasing the validity and reliability of foresight. To date, there is still no point of reference, however, to establish shared standards in foresight. What exists is a basic agreement on the procedures, on the way foresight is practiced. Despite the diversity of possible procedures, there is general agreement on which ones are most important, which I described in the previous section. But as foresight practitioners have different scientific backgrounds, standards concerning validity are often taken over from different scientific disciplines. Attempts to establish quality criteria that could apply to the whole futures field are rather new (Kuusi et al. 2015a; Vasamo 2015; Wiek and Iwaniec 2014; Gerhold et al., eds. 2015; acatech, ed. 2015b). Quality criteria as an instrument to establish shared standards may also improve validity on the level of foresight practice and thereby further trust and credibility in the field.

3. *Community response*

According to Longino, critical discussions may cause the beliefs of a scientific community to change over time (see Longino 1990: 78). There has been significant community response over the history of foresight, leading to distinct foresight styles in different institutions. An example is the different scenario techniques developed by different schools.[153] The 'foresight process in five steps' from the preceding section is an example of a standard that prevailed due to responsiveness within the community. However, as

[153] For an overview of scenario methods, see Kosow and Gassner (2008).

there are so many competing theoretical concepts and framework options and no shared standards, one may ask whether responsiveness in the foresight community actually fosters objective scientific practice or instead merely mirrors the competing concepts of the different schools and institutions.

Seen more broadly, the different historical phases of futures thinking show that the adoption of criticism has led to major changes in foresight practice. This is the case, for example, in the shift from the prediction credo in forecasting to the multiple futures credo in foresight.

4. *Tempered equality*

For Longino, the equality of intellectual authority is essential, as critical discourses need a diversity of perspectives to be "epistemically effective" (Longino 2002: 131). In fact, the foresight community is a good example of the constant work on equality of intellectual authority. The focus on inter- and transdisciplinary work, the inclusion of stakeholders in foresight processes and participation-oriented approaches contribute to tempered equality in foresight processes. Longino drafts two conditions for tempered equality: (1) "effects of reasoning and argument [should] be secured by unforced assent to the substantive and logical principles used in them" and (2) every member of a community should contribute to its constructive and critical dialogue (Longino 2002: 132). Thus, tempered equality is not reached merely by involving stakeholders, but by ensuring that they have an equal say and the discourse itself obeys principles of logical reasoning. In this regard, when new theoretical concepts emerge with the aim to further shared standards or community response, the community should critically assess their basis, that is, whether they follow logical principles.[154] Tempered equality also requires that the composition of groups be balanced, in view of the members' scientific background, age, gender and particular involvement in the issue. Finally, epistemic effectiveness also requires that political powers not define the guidelines or influence the selection of specific theories and scientific methods.

To summarize, none of the four standards is satisfied completely by the foresight field. Each needs to be specified in greater detail, that is, there is need of agreements upon clear rules and their joint development. For this purpose, the specific epistemic features shaping foresight should be taken into consideration.

[154] Concerning the question how to produce social scientific knowledge in groups, see section group knowledge in 7.2.1.

7.2 Epistemic features involved in foresight

The validity of foresight, on both the theoretical and practical levels, is composed of different types of values that form a specific kind of objectivity. Referring to Douglas (2009), I claim that valid foresight – or foresight with a scientific base – is possible if it pursues the claim of interactive objectivity in foresight knowledge. Core features of validity, such as reliability, responsibility, credibility, authority, uncertainty and risk, require foresight-specific definitions, all of which are shaped by values. Epistemic validity of this concept relies on socio-epistemic definitions of values and objectivity. As outlined in chapter 6, social epistemology encompasses definitions of value and objectivity that apply to all forms of scientific practice today. Since foresight builds upon knowledge retrieved in all scientific disciplines, it also needs a comprehensive definition of values and objectivity. These definitions are connected to definitions of the aims of foresight and foresight knowledge, which are affected by cognitive, social and ethical values and the different forms of objectivity that appear in foresight practice. These definitions are continually discussed and reshaped on the level of theoretical reflection, which in turn shape the understanding of validity.

In close interaction with both the theoretical and practical levels of foresight, scientific progress takes place by evolving and elaborating methodological diversity and by adapting new framework conditions. Here one should consider the different forms of values – cognitive, ethical and social – in order to preserve a socio-epistemic foundation for the developing methods. Specific enablers of scientifically valid foresight are, for example, quality criteria, which are a specific form of shared standards. They are an instrument created through scientific reflection, but they are also draw on experience in the interaction between the two levels. Their epistemic validity also depends upon following the socio-epistemic criteria for values and objectivity and responding to the different features of validity. Since foresight may pursue different aims and may be applied to different fields, these criteria together have to be seen, however, merely as a guideline to help formulate criteria that apply, for example, to a certain topic, to a concrete method or to specific stakeholders and institutions. In other words, the framework can be adopted to different topics and methods, and applied by different stakeholders. But it also needs to be discussed within the foresight community in order to improve its epistemic validity. Also objectivity requires community exchange and agreement upon standards. Ignoring these requirements and proposing, for instance, certain quality criteria without community reflection would undermine their objectivity. In the following sections, single features and their dependencies will be described in more detail. Figure 11 shows the interdependencies between the different epistemic issues. These all relate to values and objectivity, and are mutually interdependent.

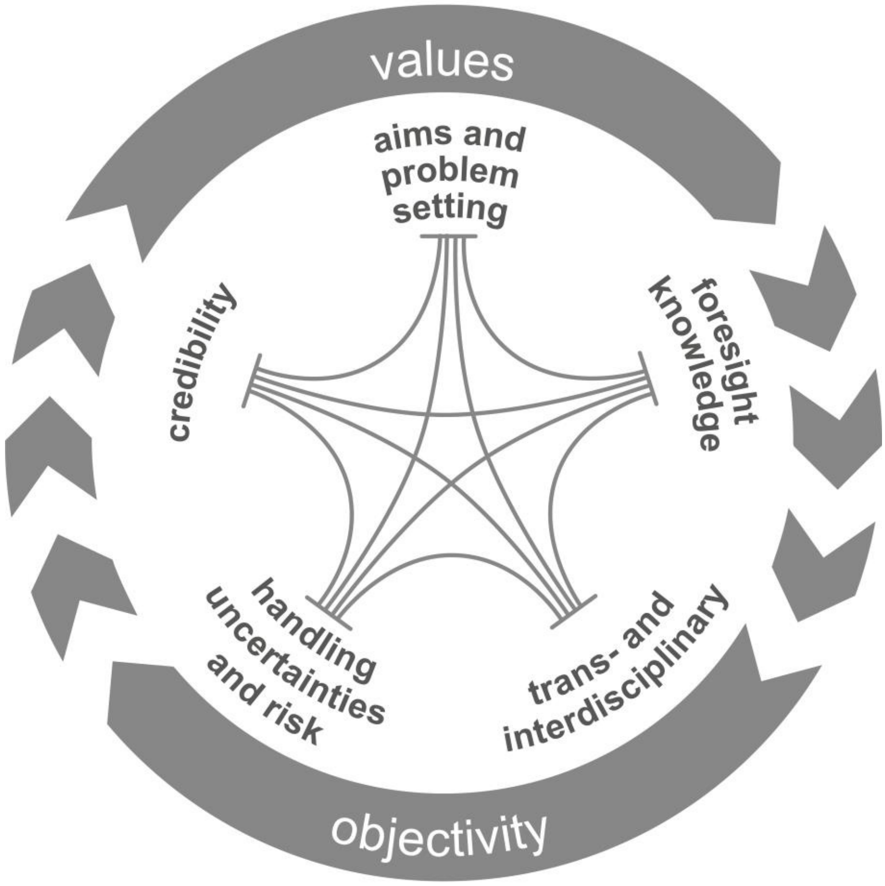

Figure 11: Interdependencies between different epistemic issues in foresight

7.2.1 Values

Values enter science and scientific processes in different ways and they play different roles. Including ethical and social values allows us to consider how other issues of human life such as political freedom and human suffering are affected by scientific processes and theory. The third kind of value, namely, cognitive values, is concerned with scientific work in the immediate future and thus serves to formulate criteria for scientific practice. In the preceding chapter, I described that these three different kinds of categories of values play different roles in science: direct and indirect, and that the socio-epistemic perspective on values reflects upon their function and impact in the single disciplines. Science is unavoidably affected by values. Acknowledging this circumstance allows us to be aware of them, and to stipulate which values can be accepted at which stage in order to ensure the objectivity of scientific processes and results.

The concept of values formulated in this section should reveal that all thoughts on values involved in foresight are also covered in the socio-epistemic approach to science. At the same time, these clear definitions of direct and indirect roles and of the different categories help us to specify how values can enter foresight without undermining their contribution to the socio-epistemic base of foresight.

Foresight literature provides different accounts of the role values play in foresight and futures studies in general. A closer comparison reveals the similarity to the socio-epistemic definition of the role of values in science. For instance, Loveridge (2009a) outlines how “the complex nature of the modification of values and norms” for individuals and society also shapes the way we see future possibilities (2009b: 25). Loveridge believes that foresight can be interpreted as an evolution of the triangle of learning, appreciation and anticipation, guided by values, norms and behavioral patterns. Slaughter, for example, in a paper from 1996, notices that often “the rich links between values, paradigms, ways of knowing and the future are overlooked”, while he himself outlines the ways values shape futures studies (1996a: 752). Malaska also emphasizes that “[f]uturology is regarded as a value-rational field of inquiry” (2001: 231) and Masini notes that “values are always present in every approach to futures studies” (2006: 1163). She also points out the need for a differentiated analysis of the forms and roles of values in futures studies:

> The frame of reference—the value system in which the futurist operates—needs to be clearly defined, for it is the futurist’s responsibility both to exercise rational judgement [sic!] in influencing decisions and at the same time to be creatively self-expressive. The expression of oneself is clearly related to one’s values, while the rational influencing of decisions must include sensitivity to the ideas and values of others. (Masini 2006: 1165)

Similarly, Bell claims that “[f]utures studies is not a ‘value-free’ science. Rather, it is concerned with both the true *and* [sic!] the good” (2004: 319). Building upon a critical realist account of science, in the 2nd volume of *Foundations of Futures Studies*, Bell highlights the role values play in science and how they might be evaluated critically.[155] In practice, value-laden decisions about “the good” appear especially during the foresight and sense-making phase, where they are useful in selecting directions and preferences with a view to the overall aim of the task and determining the social or ethical implications certain futures may have.

Some guidelines for the consideration of values already exist. In practice, VDI guideline 3780 (VDI 1991) offers a concrete list of non-epistemic values to be considered in technology assessment. These include the following: functionality, economy, prosperity, safety, health, environmental quality, and personality development and societal quality

[155] His reference to Hempel’s essay on human values Hempel (1965/1968) contains most of the notions of different kinds of values outlined in chapter 6.

(see VDI 1991: 70–7). On the other hand, reports and papers from practice reveal the impact of numerous secondary factors on foresight procedures (Chen and Huang 2007).

In the following I will attempt to address this issue with a socio-epistemic approach. Douglas's conception of values provides a comprehensive structure for assessing values in science, as it distinguishes between the impact of the different forms at the different stages throughout a process and also takes into account that they may appear directly and indirectly. By identifying values that have an impact on judgments and decision making, on the one side, and those that act as criteria in scientific practice, that is, cognitive values, on the other, we can identify pathways for scientific progress in the futures field and formulate clear expectations on validity in foresight.

Figure 12: Types of values affecting foresight

7.2.4.a Cognitive values

Cognitive values can be seen as basic criteria that every scientific work or theory must meet. Referring to Douglas, these values are simplicity, explanatory power, scope, consistency of a theory, predictive precision and fruitfulness.[156]

One of these values in particular reveals most clearly the difficulty in characterizing foresight as a science: Foresight cannot provide knowledge with predictive precision, even though its field of activity is the future.[157] This prescribed cognitive value is in conflict with the conception of truth and knowledge that belongs to foresight. Thus, this either serves as evidence that foresight is not scientific, or else this value needs to be reinterpreted or adapted to the definition of foresight. Consistency also needs to be specified more precisely, as the central point in a foresight framework is to gain consistency within a foresight framework, for example, concerning the results of different work packages and outcomes by different methods. Other difficulties could be added, for instance, interdisciplinarity. Cognitive values are indicators of the adequacy of a theory and its capacity to guide future work. Their significance in foresight is twofold. First, they can be seen as basic criteria when designing a foresight framework for a project:

- the criteria indicate the simplicity of the whole framework chosen;
- the balance between the explanatory power and the scope of the methods should reflect qualitative and quantitative methods and tools towards the chosen aim;
- the selected methods should build upon each other in a reasonable way and the framework design should be in accordance with the aim of the task (provide consistency);
- depending on the topic, foresight can also provide predictive precision with quantitative methods such as modeling (this is an optional cognitive value in foresight depending on the use of quantitative methods);
- especially in the foresight and sense-making phase, the foresight framework and the selected methods should be interdisciplinary, including the opinions of different scientific points of view, of different stakeholders, or even of different sciences concerning the object of reflection;
- a productive foresight framework taking into account cognitive values provides fruitful results, that is, outputs which are valuable for recommendations and strategy building as well as for future foresight projects.

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[156] Note that, as described in chapter 6, these values can also be described as virtues or criteria for scientific work. Cognitive values as criteria for science do not necessarily contain ethical or social considerations.

[157] This issue is discussed in more detail in chapter 5 in the section on Rescher.

In this sense, cognitive values are being considered and discussed in foresight in the context of quality criteria formulation.

The second more general role of cognitive values in foresight is to serve as indicators for valid theory building. For example, they may be used as a reference point in evaluating the epistemic validity of new methods that are being tested in foresight. Cognitive values should also be considered when further developing foresight theory. Table 4 summarizes the different cognitive values and shows how they appear in foresight with regard both to theory and practice.

7.2.4.b Social and ethical values

In foresight, ethical and social values are present in different forms. When dealing with a certain topic in foresight, STEEPV issues play a crucial role in assessing the environmental factors of the research subject, and they too have to be thought through in different futures. Hence, social and ethical values play a crucial role in the topics discussed above. They also shape the way we think about the future. Consequently, this has implications for the way we define foresight itself. Social and ethical values also shape scientific practice and influence which methods are used, thus affecting foresight practice in every phase. Bell explains this thought as follows:

> Futurists, of course, have no choice but to incorporate human values and goals and their evaluation into their discourse. By the very nature of futures studies, they, and policy scientists more generally, necessarily deal with moral evaluation scince they aim their work toward social betterment. (Bell 2004: 69)

Objectivity requires that one specify the values involved and the affect they have on scientific processes. Values may enter foresight directly and indirectly and in both cases have a specific intention. For example, self-fulfilling or self-destroying prophecies commonly appear in foresight and may even be expected, for example, when phasing out nuclear energy is directly addressed by normative scenarios. But this may also cause epistemic problems (cf. Grunwald 2013: 25). In certain cases, futurists themselves belong to the community their project addresses. Wishes and desires of the futurists and project members may enter the process indirectly in the form of ethical values at stages where they are forbidden. This would for example be the case, if a foresight project conducting energy scenarios had an explorative setting which does not explicitly favor phasing out nuclear energy. Stakeholders from anti-nuclear-movements might undermine the explorative process with their normative point of view.

Nevertheless, ethical and social values also fulfil an important role when they enter foresight processes indirectly. Foresight practitioners also have social and ethical responsibilities (Masini 2006: 1165). A further impact of ethical and social values has been considered in foresight theory especially in the guise of its inter- and transdisciplinary nature.

The values listed here are adopted from Douglas (2009). Sustainability is added as a social value; in some contexts economic stability might also be considered as a social value. Note that these values are already being discussed in philosophy of science and in technology assessment. Since they are topically and methodologically related, they may also be suitable for foresight. Of course, the socio-epistemic rationale implies that these values and their use should be discussed within the foresight community, and possible further values might be added. Ethical values, also appearing in foresight, include the following (Douglas 2009):

- ethical acceptability of risk imposition
- concern for death and suffering
- human rights in experimentation
- avoiding pain of sentient beings

Social values, also appearing in foresight, include the following (Douglas 2009):

- justice
- freedom
- social stability
- innovation

added social values

- sustainable environment
- economic stability

According to Douglas (2009), ethical values entering science concern, for example, human rights in experimentation, avoiding pain of sentient beings, concern for death and suffering, or ethical acceptability of risk imposition. Ethical values may be implicitly included in the first phase of foresight practice, when the aim of the project is set. Thinking about the future implies the assessment of ethical consequences of societal, technological or economic developments. This also includes the assessment of risks emerging from technological and scientific progress. Hence, as foresight reflects futures of science and technology, this could mean that ethical values are involved in science more generally.[158] The impact of ethical values is especially evident when normative projects are being drafted. But they can also be guidelines for an ethically valid futures research. It is generally accepted that setting up a research project entails taking ethical values into consideration. But during the process itself, that is, once a project is being carried out, ethical values should be handled with care. In chapter 6 I described the three cases Douglas outlines for when ethical values are accepted: for evaluating the suffi-

[158] Bell (2004: 95) also refers to this circumstance: “Although it is not widely recognized, all ethical thinking necessarily contains some futures thinking”.

ciency of evidence, when uncertainties have to be weighed, and when the consequences of error have to be weighed. Besides these cases that appear even if a project follows specific rules of cognitive values, there are other cases in foresight where ethical values are permitted to enter the process: when specific methods are applied, which require value judgments, for example, in workshops with citizens. Here they enter directly, whereas in the first three cases they enter indirectly when cognitive values are insufficient for reaching agreements.

It is also important to note that ethical values may enter the process indirectly, for example, in the form of personal judgments in expert workshops or when summing up alternative projections of possible future developments of certain factors. Their appearance may pass unnoticed or even be desired. Important is that those who engage in foresight are aware that ethical values may influence foresight processes, and the stages when this might happen should be made explicit, for example in the documentation of the process and in reports. Finally, the possibilities of ethical values entering foresight processes increase with the use of qualitative methods. They are permitted when future options are discussed. Aside from content-related discussions in setting up the methodological framework, ethical values should be avoided.

In the application of foresight methods, the same holds for social values. Douglas suggests that justice, freedom, social stability and innovation should be taken into account as social values that have a significant impact on science (Douglas 2009). Like ethical values, social values are also decisive when setting up the aims a foresight project. Social values may also be used as a reference in setting a normative framework for a foresight task. A specific focus on social and ethical values in this initial phase may enable, for example, the creation of alternative futures where sustainability and political freedom are set as parameters. One should also take note that ethical and social values in a foresight task tend to impede explorative processes. Predetermined social and ethical values may also impede the open, alternative-based aim of explorative futures thinking. So, while they are permitted in the initial phase of foresight, ethical and social values also set limits to futures research.

In the final phase, ethical and social values appear again in the discussion of the results and the formulation of recommendations and new strategies. Foresight practitioners should be aware of their role: results should be summed up in an objective manner. Recommendations and strategies may build upon judgments involving ethical and social values. Especially in projects with a normative framework ethical values may even be decisive. This is the case, for example, when risk assessment involves ethical claims or when sustainability claims become decisive for recommendations. For this reason it is a source of disagreement among foresight practitioners whether they should be involved in recommendation and strategy formulation at all. This is also evident in the different suggestions concerning how to structure foresight frameworks. Some make the cut before the recommendation phase, as they regard it as the task of the customer. From an epistemic point of view, this is a legitimate claim. Nevertheless, to be fruitful (in terms of the cognitive value 'fruitful'), a foresight project needs the final step of sense-making and utilization. Therefore, ethical and social values may have an impact on recommendations.

The following table offers an overview on the impact of cognitive, social and ethical values in foresight theory and practice.

type of value		scientific reflection base of foresight		context of foresight practice		
		description	questions	description	questions in foresight practice (examples)	phase they appear in (step)
cognitive values	Simplicity	Foresight theory should be easy to explain. New approaches to foresight theory should contextualize aims and methods.	· Are features like knowledge, aims, etc. defined properly? · Is the method easy enough to be applied? · Is it clear which aims the method is suitable for?	Foresight methods should be chosen and combined in a comprehensive way. Even within complex foresight frameworks, the suitability of the methodological approach and the aim should match.	· How is the framework for the project designed? · Does the framework suit the aim? Is it overloaded with tools/ methods in the single steps? · Are the milestones formulated clearly?	Concerns the initial phase. Enters the process directly.
	Explanatory power	The ability of a theory to provide connecting points for further research and enable precise explanations. Foresight theory must also explain its aims in a comprehensible way.	· How insightful are the results of this method? · Does the method handle information in a new, insightful manner? · What's the added value of the new method? Does it make use of information in a more efficient way?	Foresight methods should provide results which can serve as a base for discussions and recommendations. Results should be processed and presented clearly.	· Does the method make use of new information sources? · Are there methods which suit the aim better?	Concerns the initial phase when selecting the methods and the application phase when conducting the process. May be impeded by insufficient information. Crucial for the formulation of results and recommendations.
	Scope	A new foresight theory or method should be employable to the wide field of foresight applications.	· Can it be applied to a wide range of thematic fields? · Does the method make use of new information sources?	A project design must be adapted to the project aim: projects with a wide thematic scope need methods and tools that can handle a wide range of knowledge.	· Are the chosen methods the right ones for the project? · Can all relevant information from other disciplines be handled by the designed process?	With the formulation of the project's aim, its scope is set and decisions about appropriate and alternative methods should be made.
	Consistency (of a theory with other areas of science)	Foresight theory must be in concordance with scientific practice in other areas of science. Methods must provide consistent results.	· Is it also used in other scientific disciplines? · Is it in concordance with existing foresight methods?	Foresight methods, both qualitative and quantitative, must provide consistent results.	· Are the results of a quantitative approach replicable? Are they verifiable by another quantitative method? · Is the consistency of qualitatve methods checked? For example, scenario planning involves consistency checks.	Crucial in the application phase. Output and strategy phase should also be checked for inconsistencies in statements.
	Predictive precision	(Predictive precision is not an aim of foresight. It enters foresight practice passively.)		Refers only to quantitative / experimental methods, e.g. bibliometrical tools.	· Are results concerning the state of the art reproducible?	Restricted to state-of-the-art applications. Indicates if the descriptionsof the present rely upon the relevant methods/ literature. Appears in the application phase, e.g. when modeling is used.
	Fruitfulness	Foresight theory and methods must provide connecting points for further research and for further development of the field.	· Can the method be further developed? · Can developments in other scientific disciplines be useful in foresight?	Relies upon the quality of results to serve as input for discussions, recommendations and the derivation of future research issues.	· Are the results of a study/ project fruitful? · Are there possible follow-up activities?	Becomes apparent in the usability and applicability of the results. Consideration of the other cognitive values is an indicator for successful and fruitful processes.

social values	Justice	Social and ethical values appear in different forms in foresight: 1) In foresight, STEEPV concerns need to be considered. Hence, ethical and social values are already involved as a thematic issue. 2) They shape scientific practice both directly and indirectly. Their types and roles have to be clarified. Social and ethical values also shape the way we define foresight as scientific practice: definition of the aims of foresight. The definition of knowledge and validity claims depend on social and ethical values, and the aims of foresight are also shaped by values. Forms of objectivity have to respond to these values. On the scientific reflection base of foresight, there is need for greater awareness of social and ethical values. Here, social and ethical values may be implemented in shared standards. The foresight community has to discuss which kinds of values should be accepted in foresight in order to reduce uncertainties and foster validity.	· Are social and ethical values a standard for foresight? · How do social and ethical values shape the way we think about the future? · Do social and ethical values impede open debates about different futures? Do they cause blind spots? · Are there some social and ethical values that are more important in futures thinking than others? · Are the proposed values the only relevant ones for foresight or are there more? · How should foresight processes be structured in order to ensure that all social and ethical values are being considered? · Are there shared standards about the acceptability of social and ethical values? · Which tools and processes are needed in order to ensure that social values of certain experts and stakeholders do not impede foresight processes? · How do we balance conflicting values? · How can we track social vand ethical alues with the methods used in foresight?	Social values enter all phases of foresight directly (through discussions and judgments within the foresight process) or indirectly (as state of the art assumptions). They are needed for assessing and thinking about different futures. Further, they may shape the aim of foresight projects normatively. Problem setting should therefore either respect all social values equally (in explorative approaches) or place certain values in focus (normative approaches).	· Do assumptions about the future reconsider the value of justice and its implications? · Is justice a normative value for the project?	They may shape especially phase (1) of problem identification and aim setting, as social values can serve as a guideline for normative project aims. Indirectly, the information gathered in phase (2) may contain social values. In theforesight and sense-making phase (3), social values shoud be handled with care: judgments and sense-making procedures should take into consideration which social values were included in phase (1) so that there are no contradictions. Social values may further play a role in the output phase (4). Here, depending on the aim, the inclusion of certain social values in the form of recommendations may be rejected. Hidden agendas should not enter the process at this stage in the form of social value-laden recommendations, be it by foresighters, stakeholders or the customer. In the strategy phase (5), social values should also be considered in the same way as in phase (4), even though the results of the foresight process itself are no longer impeded.
	Freedom				· Do assumptions about the future consider the value of freedom and its implications? · Is freedom a normative value for the project?	
	Social stability				· Do assumptions about the future consider the value of social stability and its implications? · Is social stability a normative value for the project?	
	Innovation				· Do assumptions about the future consider the value of innovation and its implications? · Is innovation a normative value for the project?	
	Sustainability				· Do assumptions about the future consider the value of sustainability and its implications? · Is sustainability a normative value for the project?	
	Economic stability				· Do assumptions about the future consider the value of economic stability and its implications? · Is economic stability a normative value for the project?	
ethical values	Human rights in experi-mentation			Ethical values appear in foresight in the same way as social values. They enter all phases of foresight directly (through discussions and judgments within the foresight process) or indirectly (as state of the art assumptions or in participant's opinions). They are needed for assessing and thinking about different futures. Ethical values should only enter the process indirectly when a) evaluating the sufficiency of evidence, b) when uncertainties have to be weighed or c) when the consequences of error have to be weighed. Directly, they can be part of a process when methods requiring value judgments are applied (e.g. citizen workshops).	· Do assumptions about the future consider ethical values? · Are there implications on ethical values arising from certain future assumptions or scenarios? · Is this a normative value for the project? · Does state-of-the-art information (information about a certain topic, results from other scientific disciplines, current publications, scientific or other practices) respect these ethical values? · When this is not the case, is it clearly documented?	Can be decisive in the first phase and play a direct role. Ethical values may shape the aim of foresight projects normatively. Problem setting should therefore either respect all ethical values equally (in explorative approaches) or place certain values in focus (normative approaches). In phases 2 and 3, ethical values should only enter the process indirectly when cognitive values are insufficient in describing the state of the art or making judgments. If certain methods require the direct involvement of values, it should be made explicit. In the recommendation and strategy phase, they may appear again directly to substantiate certain decisions and paths. Strategies and recommendations should be in accordance with the ethical values guiding the problem setting.
	Avoiding pain of sentient beings					
	Concern for death and suffering					
	Ethical acceptability of imposition of risk					

Table 4: Cognitive, social and ethical values and their appearance in foresight practice and in the scientific reflection base

7.2.2 Objectivity

While 7.1.2 outlined the venues needed for scientific objectivity and scientific criticism, in this section on objectivity I will outline the forms of objectivity central to the acquisition of scientific knowledge that are relevant to foresight knowledge and the ways it deals with scientific results and evidence from other disciplines.

For foresight processes and their outcomes to be trustworthy and credible, and not merely prophecy or trend analysis, foresight practitioners must demonstrate that foresight relies on objective practices (see for example the discussion by Gönül et al. 2012). As I outlined in chapter 6, from a socio-epistemic perspective trust in results relies on objectivity. In complex forms of interactions between scientists, stakeholders and the public, which is characteristic for foresight, different forms of objectivity should be communicated clearly. It is also necessary to know when and where the different forms of objectivity can be found in foresight processes.

As propositions about the future can be either normative or descriptive, their degree of objectivity varies. On the one hand, this is due to the different sources of scientific knowledge involved in statements about the future, which are either derived from human interactions with the world or from individual and social thought processes. On the other hand, the occurrence or non-occurrence of a forward-looking statement can be provoked or inhibited actively by normative foresight activities. This apparent deficiency of validity is at the same time the main strength of foresight: as a tool for strategic planning, foresight makes it possible, to certain extent, to design the future, and give and describe directions; as a tool for visioning the possible, foresight makes what is desirable and acceptable apparent.

But how can the desirable and evident claims about the future be measured in terms of scientific objectivity? And how do we determine which kind of objectivity we are dealing with in a given foresight process? Alongside Douglas's classification of forms of objectivity, we can distinguish the following forms of objectivity in foresight depending on the knowledge provided. Objectivity must be considered on all five steps since it may enter foresight processes at different levels.

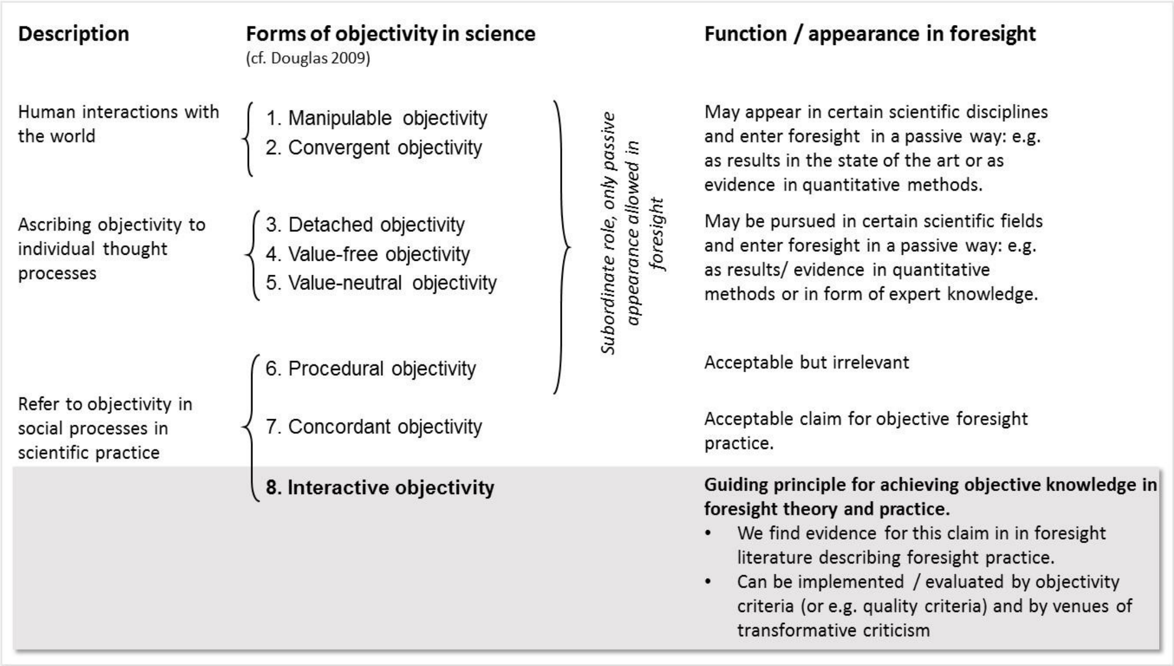

Figure 13 : Overview of objectivity claims in science and in foresight

(1) Manipulable objectivity
(2) Convergent objectivity

These two forms of objectivity appear in human interactions with the world, for example, experiments, observations or simple everyday interactions. There are still some scientific fields where this kind of objectivity is a guiding principle for validity. When experimental sciences are needed within a foresight project as a source of knowledge, these forms of objectivity may enter the process in a passive way (for example, as single steps of evidence or results in quantitative methods). Hence, they play a minor role in foresight compared to other forms of objectivity, such as those based on individual thought processes. These are

(3) Detached objectivity
(4) Value-free objectivity
(5) Value-neutral objectivity

Detached objectivity, which is guided by the simple claim that values ought to be avoided as evidence, and value-neutral objectivity, which requires a neutral position towards values in science, may legitimately enter foresight in a passive way. Foresighters must be aware that even if they are committed to interactive objectivity, the knowledge they consider to be state of the art sometimes comes from disciplines that follow other forms of objectivity. This may be information, for example, fed into quantitative foresight methods or technical expert knowledge flowing into qualitative approaches.

In chapter 6 I supported Douglas's argument the need to avoid value-free objectivity, as it negates the role ethical and social values actually play in scientific practice. As foresight similarly reflects STEEPV issues, value-free objectivity is not an option. Nevertheless, in a foresight project where the expert opinion of scientists of a certain scientific discipline is needed, it is not possible to determine whether these scientists are committed to the ideal of value-free objectivity. As foresight seeks to create a diversity of possible and probable future images, the fact that some sciences still pursue the value-fee ideal should not be neglected. We may allow knowledge based on this form of objectivity to passively assist in creating alternative assumptions. It may also be used for technical state of the art descriptions or single technical or natural descriptions, for example, in the form of roadmapping steps. Nevertheless, value-free objectivity must generally be avoided in decision making processes. The same applies to setting foresight aims and drawing recommendations.

As indicated earlier, foresight requires a form of objectivity that takes into account the social character of foresight knowledge. In contrast to the previous forms of objectivity which we find especially in passive methodological applications, that is, where processes focus on interactions of individuals with the world or on individual thought processes, social processes are a basic element of foresight. For this reason, forms of objectivity relating to these processes are of special interest. These are

(6) Procedural objectivity
(7) Concordant objectivity
(8) Interactive objectivity

These three forms of objectivity are acceptable in foresight, since all of them accept the role of values in science. Like the first and second forms of objectivity, procedural objectivity plays merely a subordinate role. It is based upon the claim that individual judgment should be excluded and that results are objective when a process may be repeated in such a way that it always leads to the same results. But such processes and methods are not of interest for foresight methods. As foresight is about the creation of multiple rather than replicable futures, methods committed to this form of objectivity would be counterproductive in late foresight phases. This does not mean, however, that they cannot be considered in early foresight phases, for example, for determining the current state of research. Here, literature reviews and the use of bibliometric and statistical analyses legitimately follow the rule of procedural objectivity. This also applies for certain models, like quantitative scenario models for energy or environmental research.

Nevertheless, it is doubtful whether such models are ever really replicable, as influence factors of scenario fields change very easily and depend on the selection by experts.[159]

As procedural objectivity may minimize disagreements by providing replicable results, it can also be used as context for concordant objectivity which relies upon agreement in judgments between different people. Transferred to a foresight context, the two forms of objectivity are involved at different stages: procedural objectivity may occur in the phases of input and foresight, especially the analysis phase, while concordant objectivity appears in all stages, from defining problems to the strategy phase. Methods committed to concordant objectivity correspond to the intersubjective manner of foresight. As different scientific backgrounds are involved, agreement upon future images, orientation and recommendation concerning the future must rely upon methods which embrace the judgments of the researchers, stakeholders and laymen. Methods used in foresight to fulfil the claims of concordant objectivity include expert workshops, workshops with citizens, surveys and delphi studies. More generally, concordant objectivity also relates to sense-making.

In addition to these forms of objectivity that can occur on the level of foresight practice, on the level of scientific reflection the foresight community must pursue interactive objectivity. According to Douglas, "keeping scientific discourse open to scrutiny" is the main feature of this form of objectivity (Douglas 2009: 128). In foresight, it is needed for gaining objective foresight knowledge, determining shared standards and advancing the field in terms of theory and methodology in an objective way. Consequently, the aims of foresight and its interdisciplinary nature require that in practice concordant objectivity be pursued while on the level of scientific reflection there is need for interactive objectivity. As there are no observable or replicable facts that may serve as evidence for the interactive forms of objectivity, other parameters are needed, such as the criteria for intersubjective and transformative criticism suggested by Longino (section 6.5). These may serve as a guideline for scientific reflection in the foresight field in general. But in practice, certain quality criteria are needed to preserve the scientific status of foresight. These could be formulated as shared standards in scientific reflection.

7.2.3 On aims and problem setting

A scientific discipline provides its own aims and shows that it deals with certain problems in a specific way. If foresight follows scientific rules, then aims and problem setting should follow scientific disciplines. Öner highlights this need as follows:

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[159] Grunwald discusses this issue in further detail on different examplesof energy scenarios reflecting the same time horizon but leading to different results Footnote on replicability of results (2012: 235–8).

> We may expect the academic work on the theory of Foresight and Futures Studies to draw from such disciplines as management, computer sciences, cultural anthropology, economics, history, industrial engineering (decision sciences), mathematics, philosophy and ethics, political science, psychology, public administration, social psychology, sociology, statistics, systems theory, etc. The Foresight and Futures Studies field must have a domain wherein it is autonomous. This is not to say that it must have a subject matter uniquely its own, but it must bring into focus a set of problems not included within the scope of other disciplines to which scientific techniques can be, and in fact are being, applied. (Öner 2010: 1020)

Hence, foresight can be defined as a discipline that deals with future developments of science, technology, society and the environment with the aim of providing orientation and enabling decision making in the present. Foresight is connected to all the different disciplines Öner lists in the quotation above. However, the quotation misses the discipline of innovation studies. At present, reference points to innovation studies are intensively discussed in reference to processes in knowledge production in foresight (Andersen and Andersen 2014; see also Grunwald 2014; Dufva and Ahlqvist 2015). This marks a new challenge in formulating the unique scientific feature of foresight, while profiting from new methodological approaches in innovation studies. At the same time, foresight relies on developments from other scientific disciplines. Different sciences are not only sources of information for foresight processes, but also fields of application.

In chapter 3 I outlined the specific purposes of foresight. While the general aims of scientific inquiry are to find truth and to describe the world, that is, prediction and description, foresight deals with both in a specific way. Foresight has developed a distinctive approach to problem setting. Terminologically, foresight posits predictions about the future, which are epistemically impossible (Rescher 5.2). The aim of creating possible, probable and desirable futures needs tools which are descriptive and not predictive. Within its broad range of purposes, the aims of specific projects are not the result of previous scientific progress but rather concrete problems posed by a stakeholder.

Unlike other scientific disciplines, problem setting in foresight does not evolve as a scientific 'end in itself'. Moreover, there are different levels of problem setting: First, there is problem setting in the form of boundary setting which focuses on processes and projects, and second, problem setting arising due to the content of the processes. Results in foresight may reveal new questions and problems to be solved. But their investigation and solution is not a 'sure-fire success'. Instead, the problem formulation and aim setting of specific tasks and project goals in foresight depends on the customer who is the target group. The success of a foresight task becomes evident in the implementation of recommendations and follow-up processes. Characteristic of foresight is that the aim of a foresight task is always conducted for a certain customer or user (see Kuusi et al. 2015a). Generally the customer participates in the process, especially in the first and final steps, but also in different expert groups. Problem setting, and also boundary setting for a foresight task, are processes of negotiation and thus highly influenced by values. Loveridge notes the following:

> However, working with unstructured problems ultimately requires the delineation of a boundary, outside of which events are considered too weakly related to have any effect in the context of the inquiry. . . . While the researcher may repeatedly widen (or narrow) the boundaries as more is learned concerning the unstructured problem, he must at some point agree on a boundary with his client. (Loveridge 1977: 54)

This recalls the serious weakness of foresight epistemology that I outlined in chapter 4. Against the background of the classic aims in science, foresight does not share the epistemic aim of finding truth in an objective manner. However, to derive valid results, foresight practice should nevertheless meet certain forms of scientific objectivity. As outlined in chapter 6, the many forms of objectivity have to be taken into consideration in scientific disciplines in general, and it is necessary to specify which forms of objectivity help to reach the foresight aims in a scientifically valid way. For example, section 7.2.2 summarizes how these forms of objectivity should be handled in foresight. Cognitive values refer to criteria for valid scientific practice. The following illustration sums up the different issues at issue in the composition of foresight aims. Note that this illustration reflects the general structure of research processes – aim, method and interpretation – as described in 6.3, as research processes and the corresponding aims have to be considered in connection with the involved stakeholders and available methods.

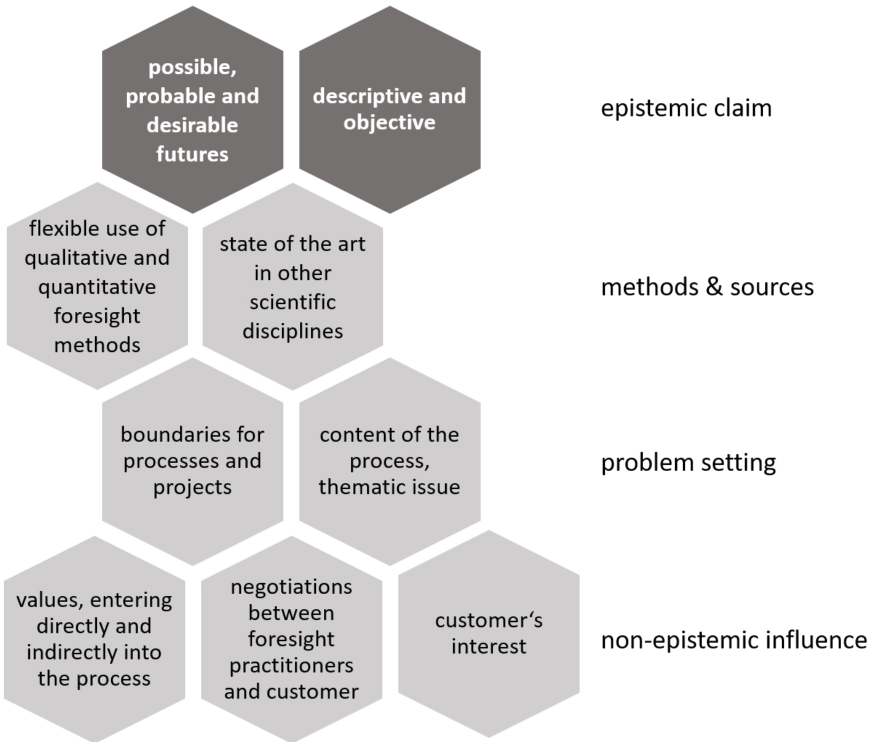

Figure 14: Issues shaping foresight aims

7.2.4 Definition of knowledge in foresight

In chapter 5 I suggested that future knowledge cannot be justified by an established account of science (the most prominent accounts are outlined in chapter 4). A distinct definition of foresight knowledge is needed. In terms of scientific objectivity, the foresight-specific definition of knowledge should meet the claims of interactive objectivity. The following definition of knowledge bridges socio-epistemic considerations on expert and group knowledge, and epistemic insights into future knowledge.

In chapter 4 I argued that the future is always an image of our present knowledge, and therefore always "a cognitive construction" (Öner 2010: 1020). Consequently, foresight needs a different type of knowledge as a base for future alternatives: expert knowledge and surrogate knowledge. Knowledge sources used in foresight are based on methods that use creativity, expertise, interaction and evidence (cf. Popper 2008a). When an empirical proof is not possible, validation of future claims must be conducted on the level of propositions. Grunwald distinguishes between four kinds of knowledge which we encounter in futures thinking (Grunwald 2009, 2014):[160]

(1) Current knowledge. This is the kind of knowledge derived from accepted disciplinary criteria, for example, facts in engineering about material consumption (2009: 31). Current knowledge may therefore also be classified as knowledge derived in sciences searching for true facts. Current knowledge in the form of facts is useful in foresight tasks where certain technical circumstances are extrapolated into the future. In its very narrow sense, prediction is possible on the basis of currently true facts, as long as the extrapolations are not combined with prepositions derived from other kinds of knowledge – for instance, the kinds of knowledge described in points 2 to 4 below. For example, a prediction about material consumption in car production can be predicted very accurately according to the different models. These predictions may hold for a long time, but they are insufficient since foresight in car production also needs to consider other factors like the price of materials, the long-term supply of raw materials, scientific progress in research on materials. Also changes in design may influence material consumption.

(2) Assessments or estimates about future developments. Prepositions of this kind build upon valid facts – that is, current knowledge – in order to make a reasonable future assumption. Such propositions are often used to describe possible demographic changes in the future, or mobility behavior. Estimates of mobility behavior may, for example, build upon progress in automobile research and development But within a

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[160] In the original German text, the four kinds of knowledge are: (1) "gegenwärtiges Wissen", (2) "Einschätzungen zukünftiger Entwicklungen", (3) "Ceteris-paribus-Bedingungen", (4) "Ad-hoc-Annahmen". See Grunwald (2009: 31–2).

foresight task, it is also necessary to consider alternative forms of mobility, or how other factors like infrastructure, urban planning and sustainability issues shape mobility behaviors. Each factor may shape a present fact in a different way. Depending on these different factors, the same present facts may be used to support alternative scenarios.

(3) "Ceteris-paribus-conditions" are the prepositions which claim that certain circumstances will not change. There is a tendency to assume that business goes on as usual and that there is a continuity concerning certain circumstances. Grunwald mentions as an example the prospect of there being no alternative flight technology to the airplane (2009: 31). Or to continue with the example of mobility, a typical ceteris-paribus-condition in that field is that there are no alternatives to the kind of cars existing today.[161] Yet the inability to anticipate disruptive changes acts as a barrier in foresight, often leading to boring, uninspiring and bland future images.

(4) Ad hoc assumptions. These are assumptions which do not need to be validated by knowledge, but may be set as a framework condition for a foresight task. For example, the absence of great catastrophes like world wars, polarity reversal of the terrestrial magnetic field or the impact of comets. In foresight tasks involving a technological topic on material consumption scenarios with a mid-term time frame, it is acceptable to make ad hoc assumptions on the environment, for example, on political stability. However, in foresight tasks with a wider topic, such as future mobility, such assumptions may be avoided due to ad hoc assumption wild cards. This was a shortcoming of many forecasting tasks conducted during the Cold War, which neglected the possibility of its end.

Results in foresight rely predominantly on estimates about the future, and conjectures about future developments based on present facts. While propositions based on current knowledge are relatively easy to validate, the other forms are not. A summary of current knowledge can be found, for example, in literature reviews, bibliometric and patent analysis. This usually happens in the second step of a foresight project, the input phase, or in the analysis phase of the third step. Propositions from 2 to 4 appear throughout the rest of the project, though ad hoc assumptions may also appear in the first step, when setting the aim. They may be considered framework conditions for the task. Throughout the process, many kinds of propositions are made in workshops, delphi surveys, interviews, and even in recommendations. Depending on the scope and aim of the task, also laymen in addition to experts formulate propositions about the future. Being dependent

[161] In contrast to contemporary scenarios of car technologies, in the past there used to be numerous disruptive scenarios – admittedly, linked to science fiction. The most prominent is the flying car. Today, the future of mobility and the car in general, while focusing on autonomous technologies, upholds the standard image of a four-wheeled car.

on these sources, knowledge acquisition in foresight is highly dependent on surrogate and expert knowledge. As indicated in chapter 6, these kinds of propositions are inevitably value-laden. Validation of futures knowledge must take place in consideration of the different forms of objectivity in science, and the different ways values enter and influence scientific processes.

Finally, truth may only be asserted of current knowledge. As propositions about the future build upon conjectures, estimates, ceteris-paribus-conditions or ad-hoc assumptions, they must be argued at least in a coherent and consistent way. Foresight is not used to establish true future knowledge, but coherent future knowledge which is rooted in present scientific issues and current knowledge. Alternative future developments and extrapolations are possible and desirable, but must be well argued. As indicated earlier, information and knowledge in foresight are processed in groups, and basically depend on experts.

Expertise and expert knowledge

In any issue addressed with a foresight project, relevant environmental factors and impact fields must be considered: factors related to science and technology, but also to ethics, society, politics and the environment. As foresight practitioners and clients may not have sufficient knowledge concerning the state of the art of emerging technologies or other influential factors, expert opinions are needed. Besides filling knowledge gaps, experts can also offer opinions in scientific communities and propose future assumptions concerning key factors. The role of the expert has been widely discussed in foresight literature, but also in older sources related to futures research, for example, in *Social Technology* by Helmer (1966), who defined the need for experts as follows:

> Expert opinion must be called on whenever it becomes necessary to choose among several alternative courses of action in the absence of an accepted body of theoretical knowledge that would clearly single out one course as the preferred alternative. (Helmer 1966: 11)

Helmer's definition is from a time when futurists placed major emphasis on quantitative, analytical methods, and expert opinions were needed for decision making. In foresight, expert knowledge is needed to produce credible and reliable results. Experts serve as authorities in their respective areas of expertise or scientific disciplines and are required for collecting more information on a certain topic, but also for making judgments. Delphi studies highly depend on expert opinions, the impact of which has been discussed by Coates (1975). More generally, Scapolo and Miles highlight the relevance of expert opinions in policy making:

> Expert views can give policy makers added information and insight into the fields where they lack sufficient knowledge to comprehend complex issues. This is especially (but by no means exclusively) the case in areas of science and technology (S&T), where policy makers are highly dependent on the quality and reliability of the information they have at their disposal. (Scapolo and Miles 2006: 679–80)

The role of the expert is also considered in social epistemology, for instance, in Douglas (2008) and Goldman (2011). Goldman offers the following socio-epistemic definition of an expert:

> an expert (in the strong sense) in domain D is someone who possesses an extensive fund of knowledge (true belief) and a set of skills or methods for apt and successful deployment of this knowledge to new questions in the domain. (Goldman 2011: 115)

These requirements also have to be met by experts involved in foresight, in addition to being able to anticipate future events related to their field of expertise. From a foresight perspective, new questions in a domain may also concern the possibilities of future development, or the societal impact of a technology. Another crucial attribute for an expert consulted in foresight is the ability to use imagination (Loveridge 2004: 50), especially for visioning and scenario tasks. These are some issues to be reflected when deciding who is an expert in a foresight process and who might participate in foresight activities (Cuhls et al. 2002: 237), or how to find relevant experts.[162] Nevertheless, there are two major challenges when relying on expert opinions: (1) Which expert should one trust? (2) How should we deal with value-laden and subjective expert opinions?

(1) In any foresight task, the level of knowledge and expertise of the persons involved may vary: the project team, the client and the experts. This means there are different constellations in which credibility and authority must be proven: the appraisal between experts and then between experts and laymen. In other words, a customer or person conducting a foresight task with no expertise in the investigated subject matter is in the position of a layman and must determine which expert to trust and on what basis to appraise his or her expertise. Even if there is enough expertise on a foresight team or if the customer is well informed, experts must appraise the authority and credibility of other experts (cf. Goldman 2011: 113). There are different ways to select experts and to build trust – between experts and between experts and laymen.

Among experts, trust in other experts' opinions and judgments is based on authority ascription. Kitcher describes two different forms, "direct calibration" and "indirect calibration", in the context of authority ascription between scientists (1993: 314–22).[163]

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[162] Besides Cuhls et al. (2002: 237–40) on how to choose experts, see also Scapolo and Miles (2006) on different methods of eliciting expert's knowledge as well as Shrader-Frechette (1995), and Yoda (2011) for the expert's perspective.

[163] See also Goldman (2011), who refers to Kitcher's concept of direct and indirect calibration.

- "direct calibration". A scientist (A) evaluates another scientist's (B) authority using his or her own opinions and research on the research subject.
- "indirect calibration". A scientist (A) appraises the expertise of another scientist (B) by using the opinions of other scientists (C D, X…), which, in turn, have been gained by direct calibration.

Different examples from foresight practice show that foresight experts also follow the rule of calibration for selecting experts. Loveridge (2004), for instance, describes how expert selection is ideally conducted in foresight processes by co-nomination. By contrast, laymen are not able to use their own knowledge to evaluate the credibility of experts as they do not have the necessary expertise for calibration (Goldman 2011: 113). To meet this imbalance, Goldman provides in his paper *Experts: Which one should you trust?* five sources of evidence laymen may use to assert their expertise.

- "Argument-based evidence. Arguments presented by the contending experts to support their own views and critique their rival's views." As there is no attempt to gain true knowledge in foresight, it should be clear that any argument-based validation should focus on consistency rather than truth.
- Agreement from additional putative experts on one side of the subject in question
- Appraisals by "meta-experts" of the experts' expertise (including appraisals reflected in formal credentials earned by the experts)
- Evidence of the experts' interests and biases vis-à-vis the question at issue
- Track records. For laymen track records of experts serve as an indicator of expertise. (Goldman 2011: 116–29)

(2) According to Loveridge, foresight results build upon "the experts' best judgment under the terms and rules imposed by the situation" (Loveridge 2004: 34). Subjective opinions are part of foresight at all stages: from setting up a foresight program or project, which involves identifying the problem and designing an approach to solve it, all the way to the stage of including expert and laymen opinions to create alternative futures and derive recommendations. Alleged experts may also carry hidden agendas, or as Loveridge notes: "Self-interest is never far away" (Loveridge 2004: 33). Some experts consulted in foresight try to convince whole groups of their point of view or even appear to act as lobbyists. This is for example the case when a foresight activity reflects issues which affect the society, future research and certain industries at the same time. In a foresight project reflecting energy futures, for example, there might be conflicting positions between industry representatives supporting nuclear energy and proponents of green energy. Climate or energy researchers might agree or contradict with the one position or the other. Besides, citizen might have desires or worries concerning certain futures which might not be reflected by any of these parties. In foresight workshops, how-

ever, one should be aware of the impact of group dynamics and rethorical skills of certain group members. This is further indication that foresight knowledge as social knowledge is value-laden. Nevertheless, judgments, may therefore be biased. Loveridge, with reference to Hogarth, lists the following causes of bias (Loveridge 2004: 45 (italics in the original)):

- "Failure to appreciate or identify *randomness*." Foresight depends on the ability to envision alternative futures. Nevertheless, randomness in selecting priorities may appear when creative or qualitative tools are used. Sense-making is particularly important during the foresight phase.
- "*Inconsistency* in judgments made across time; in foresight studies inconsistency *over the span of a study of limited duration* requires explanation. Volatility *between* studies is to be expected."[164] This issue has already been addressed in the objectivity chapter with the notion of the replicability of results.
- "*Learning* and the willingness to learn are important aspects of foresight." By contrast, this point, together with the first and next one, can also be read as follows: weak, uncreative future images are the result of an inability to embrace alternative futures thinking. Willingness to learn may be a solution for the first and the last bias.
- "*Memory* inadequacies and imperfections; predisposition to selective recall and perception, leads to interpreting information in ways to support underlying expectations and hypotheses about the future."
- "*Computational capability* of the human mind is limited."
- "*Order can be brought out of chaos* but this may limit creativity."
- "*Cognitive myopia,* the unwillingness to use imagination or to conduct thought experiments about the future."

So how can expert knowledge and expert judgment in foresight be validated despite these deficiencies? Validity should contribute to the credibility and final reliability of the results. The socio-epistemic approach allows us to check the validity on different levels:

- **Passive suitability check.** With track records, agreement of experts on the ability of a certain expert etc., the suitability of an authority as an expert for a foresight issue may only be checked passively, as it cannot prove the validity of the results. In other words, the passive suitability check is the a priori assumption that a certain authority can contribute to the subject matter in a reasonable way.
- **Objectivity check**. Checking the addressed forms of objectivity. See 7.2.3.

[164] The latter point is also discussed by Grunwald with the example of historic energy scenarios.

- **Value check**. Different forms of values which are only allowed at specific stages.[165] See 7.2.4.

In this context, one may also reflect Resccher's "factors at issue in assessing the predictive competence of predictors", as described in section 5.2: reliability, versatility, daring, perceptiveness, foresight, consistency, self-criticism, knowledgeability and cohernece. Those factors, however, can partly also be regarded as cognitive values.

Group thinking

As indicated in chapter 5, more recent works in foresight theory consider the aspect of collaborative knowledge acquisition and contextualize foresight with new theories on knowledge societies. They are inspired by approaches to innovation theory and social constructivist approaches to knowledge. In foresight literature, characteristics of the "knowledge society" are also discussed in terms of its impact on foresight (Amanatidou and Guy 2008; Cuhls 2004; Calof et al. 2012; Cassingena Harper and Georghiou 2005). For example, foresight projects and programs promote networking effects between different organizations such as universities, research institutions and firms and may lead to innovations (Amanatidou and Guy 2008: 543). Participatory approaches in foresight, which bring together different stakeholders from the public, also promote through policy and research the acquisition of knowledge and skills. Amanatidou and Guy state that this happens "through a variety of learning processes" (2008: 543). However, the benefits of mutual learning effects between individuals, organizations and communities are often overlooked.

Foresight theorists focus mainly on conceptual considerations regarding group thinking, while ignoring epistemic questions. Goodwin and Wright (2010), for example, recently raised the issue of cognitive biases in expert judgment about future assessments. They recommend evaluating forecasting tasks by breaking them down with event or fault trees. More recently, group support systems have been discussed in the context of the emergence of diverse software-based tools for knowledge aggregation as options for deliberative processes (see for example Karlsen 2014). Social epistemology provides some fruitful approaches to valid judgment aggregation. For example, it distinguishes between group knowledge per se and mere group rationality (Goldman 2004). The socio-epistemic differentiation of group rationality and group knowledge, including the challenges in judgment aggregation, is as follows:

> The rationality challenge arises when the group's collectively endorsed beliefs or judgments have to be consistent. The knowledge challenge arises when those beliefs or judgments have to track certain truths. (List 2011: 222)

[165] This point will be explained in more detail in the sections on objectivity and values.

This raises numerous epistemic questions concerning group knowledge: Does group thinking in foresight lead to group knowledge or is it just group rationality? Can group rationality be performed in an epistemically valid way? In section 7.2.4 I summarized the four kinds of knowledge appearing in foresight. So how do group rationality and group knowledge correspond to these different kinds of knowledge? Aside from current knowledge which contains propositions that are regarded as true facts, other propositions in foresight do not aim at true knowledge. Obviously, argument aggregation in foresight is not intended to lead to group knowledge but to group rationality.

Further issues and epistemic considerations can be found in Mathiesen (2006), who discusses how groups can meet at least some epistemic features to create group beliefs, and in Dietrich (2007), who analyzes judgment aggregation.[166] Note that credibility issues concerning single experts in groups also depend on the three validity checks introduced earlier: suitability, values and objectivity check. Validity of group thinking may go beyond that by validating the process of judgment aggregation on the level of arguments. The following example shows how epistemic matters concerning group thinking in foresight might be discussed.

Example: group rationality, the impossibility theorem and possible solutions

In several publications, Christian List and Philip Pettit examine "group agency" and the relation between group knowledge and group rationality (List and Pettit 2002, 2004, 2011; List 2005; Pettit 2007, 2011). Following their work, one may describe a team involved in a foresight project as an epistemic agent. List's concept of epistemic agency is also suitable for the validation of futures research institutions as it encompasses both group rationality and group knowledge. List focuses on the question concerning how groups perform as epistemic agents, that is, how they acquire beliefs or knowledge.

> [I]f a group's institutional structure allows the group to make certain public declarations, then the group may well count as an epistemic agent capable of acquiring beliefs or even knowledge. An example might be an expert panel or research group that publishes a joint report on some scientific matter . . . In short, a necessary condition for epistemic agency in a group is an institutional structure (formal or informal) that allows the group to endorse certain beliefs or judgments as collective ones; and the group's performance as an epistemic agent depends on the details of that institutional structure. (List 2011: 223)

According to List, institutional structures are given by a specific concept of "aggregation procedure", which is "a mechanism by which a group can generate collectively endorsed beliefs or judgments" (List 2011: 224). An example of an aggregation procedure is majority voting: "a group judges a given proposition to be true whenever a ma-

[166] For further work concerning group belief or group belief revision, see van Benthem (2007).

jority of group members judges it to be true" (List 2011: 224). The following illustration shows an aggregation procedure in comparison to a foresight process.

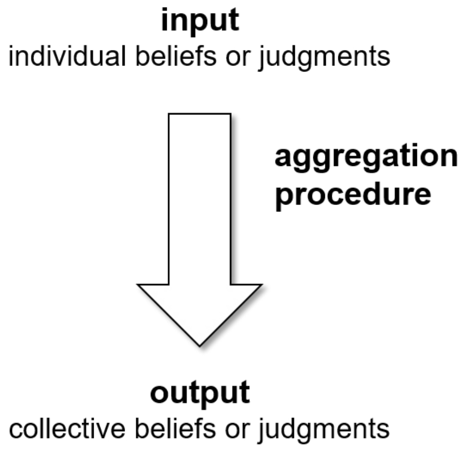

Figure 15: An aggregation procedure (List 2011)

Obviously, there is a similarity between a foresight process and List's aggregation procedure; at each step of a foresight process aggregation procedures take place. For example, aggregation procedures are used in discussing a consistency matrix in a scenario process; the consistency between each proposition of one factor and the propositions of all other factors is discussed. Another example is Delphi studies, in which each round of questions requires the judgment of the expert – first, his or her own estimation, and then in the second round, his or her estimation regarding the aggregated results of all judgments of the first round.

Aggregation procedures face different challenges, however, including the rationality and the knowledge challenge. As consistency is a basic element for validity in foresight, I will outline the "discursive dilemma" concerning the consistency of judgments. List and Pettit (2002, 2004) argue that, in a majority voting, collective judgments may lead to inconsistencies even when each member of the group provides consistent arguments for his or her judgments. This is illustrated with the example of air pollution (2011: 225):

p: The average particle pollution level exceeds 50μ gm^{-3} (micrograms per cubic meter air).

p→q If the average particle pollution level exceeds 50μ gm^{-3}, then residents have a significantly increased risk of respiratory disease.

q: Residents have a significantly increased risk of respiratory disease.

In an expert committee, each expert may have good arguments to judge whether these propositions are true. But as these factual propositions are complex, the experts may disagree. To aggregate the results, that is, to get from individual to collective judgment, majority voting may be used, and this is where the aggregation procedure may fail.

	p	*p→q*	*Q*
Individual 1	True	True	True
Individual 2	True	False	False
Individual 3	False	True	False
Majority	True	True	False

Table 5: A "discursive dilemma", adopted from List (2005, 2011)

As we can see from the Table 5, the majority claims that p is true, that p→q is true, but that q in consequence is false – a conclusion which is inconsistent with the given propositions. This dilemma is due to the impossibility theorem, which illustrates "the logical space of aggregation procedures" (List and Pettit 2002, 2004; List 2011):

> **Theorem** (List and Pettit 2002). There exists no aggregation procedure generating complete and consistent collective judgments that satisfies the following three conditions simultaneously:
> **Universal domain.** The procedure accepts as admissible input any logically possible combinations of complete and consistent individual judgments on the propositions.
> **Anonymity.** The judgments of all individuals have equal weight in determining the collective judgments.
> **Systematicity.** The collective judgment on each proposition depends only on the individual judgments on that proposition, and the same pattern of dependence holds for all propositions. (List 2011: 226)

It is not possible that the two requirements be met the same time – that is, that the individuals provide complete and consistent judgments on these propositions, and that group judgments are complete and consistent. According to List, any aggregation procedure that demands universal domain, anonymity and systematicity at the same time is affected by the problem illustrated in Table 5. The rationality challenge may be solved, however, by "relax[ing] at least one of the conditions of the theorem" (List 2011: 226).

Universal domain could be relaxed, for example, by using forms of group deliberation to reduce disagreement. List objects to such an approach because "groups involved in epistemic tasks should normally use aggregation procedures satisfying universal domain" (List 2011: 226). If anonymity is given up, then the only way to aggregate judgments is to favor the judgments of one or certain individuals.[167] This would constitute a "dictatorial procedure" and the epistemic advantages of democratic structures in groups would be lost (List 2011: 227). Perhaps a viable option is to relax the claim to systematicity, whereby "a group may designate some propositions as 'premises' and others as 'conclusions' and assign epistemic priority either to the premises or to the conclusions." However, in using either the 'premise based procedure' or the 'conclusion-based procedure', the collective judgments are not complete. So this approach may be used for tasks where groups are supposed to make judgments only on conclusions, where completeness is irrelevant. This approach may also be extended by dividing the epistemic labor, that is, by using the 'distributed premise-based procedure':

> Here, different individuals specialize on different premises and give their individual judgments only on these premises. Now the group makes a collective judgment on each premise by taking a majority vote on that premise among the relevant 'specialists', and then the group derives its collective judgments on the conclusions from these collective judgments on the premises. (List 2011: 228)

For the validation of judgments in foresight projects that rely upon judgment aggregation in groups, such as expert workshops, delphis and scenario consistency analyses, further research on aggregation procedures may be beneficial. For example, giving up systematicity may also be an option for validation of judgment aggregation in foresight, especially regarding the 'distributed premise-based procedure'. As indicated earlier, Karlsen (2014) presents software-based group support systems as an option for deliberative knowledge aggregation in foresight. The epistemic validity of such approaches may be checked alongside conditions of the theorem: in this case, one may examine if the deliberation is stable enough to provide a variety of consistent assumptions or if it leads to broad generalizations. As analyses of foresight knowledge acquisition show, there is a high dependency on the division of cognitive and epistemic labor (Dufva and Ahlqvist

[167] For List (2011), this is the case when a committee chair is charged with forming collective judgments. In a scenario process, this would be the case when key factors and assumptions are not derived on a workshop basis, but formulated by only one project member.

2015; Dufva 2015).[168] These approaches highlight the conceptual organization of knowledge aggregation, while omitting epistemic issues. When analyzing the epistemic validity of judgment aggregation, the foresight process should be structured such that it satisfies at least the claims of the 'distributed premise-based procedure'. One may also question if certain foresight projects violate too many conditions of the theorem. For example, there are often cases in foresight practice where the discussion is influenced by the opinions of a few people who may even attempt to convince other participants. Certain lobbies or stakeholders may dominate a discussion and enforce their own positions, thus undermining the theorem.

7.2.5 Validity

As indicated in the brief description of the framework, validity issues appear in foresight on basically two different levels: with regard to (1) the validity of foresight procedures and (2) the validity of practices on a more general level, that is, reflections on the validity of the methods, practices and theories used in foresight. The scientific reflection base is where the field can reflect upon its own procedures and discuss validity features like credibility and reliability, uncertainty and risk, possibility and probability, and interdisciplinary work. These discussions may take place in the different venues – with regard to criticism, shared standards, community response and tempered equality – in order to reach scientific objectivity. In section 7.2.4 on foresight knowledge I suggested that we can make judgments about the validity of futures once we know what kind of futures we are confronted with. Put differently, validity depends on the sources of knowledge and valid knowledge depends on their objectivity. Hence, the description of the following validity features is also linked to the method used in foresight, to the information source and to the scope of the task.

Epistemic requirements in the sciences in general go hand in hand with the concepts of objectivity and values. Due to foresight's distinct goals and dependence on other sciences, validity features such as credibility, uncertainty and risk, and interdisciplinarity must be defined slightly differently. These features serve as the basis for establishing quality criteria to assess validity (see 7.3.2 and 8).

[168] These approaches basically focus on an innovation systems approach, referring in part to post-normal science knowledge production as outlined in chapter 5 and to Mode 2, see Gibbons and Nowotny (2001); Gibbons (ed. 1994).

7.2.5 a Credibility

Credibility issues appear at different points in foresight. On the level of foresight practice, credibility issues emerge concerning the procedures and methods, the results, the experts, and finally, the persons conducting a foresight project. On the scientific reflection base, credibility is especially important with regard to authorities. The reliability of verifiable knowledge – that is, current, fact-based knowledge – may be easily tracked if the processes of data gathering, knowledge aggregation and modelling are disclosed. But this refers only to step 2 in foresight projects or to the use of quantitative methods in step 3. In other words, this case only refers to phases where current knowledge plays a role in the process. Other foresight steps rely principally upon judgments, especially in the sense-making phase. But if all procedures and judgment aggregation processes are disclosed, one may also validate the aggregation procedures socio-epistemically, as suggested by the List and Pettit theorem (see 7.2.1).[169] That is, one should ask whether, in situations where judgment aggregation is needed, for example, in the sense-making phases, it is necessary to stretch the claim of anonymity or systematicity. By contrast, the credibility and trust in persons and their procedures is assured by the suitability check of their authority, that is, by their ability to contribute to argument-based evidence (including empirical and normative argumentation), agreement with other putative experts, appraisal from meta-experts (foresight experts) and their track records.

Credibility and reliability issues do not only appear as epistemic concerns related to propositions, discussions, procedures and outcomes. Credibility and reliability are also relevant to foresight practitioners themselves. According to Popp, some authors of future scenarios (in a broad sense) identify scientific credibility according to the following facts (2012: 12–3):

- Their scientific expertise is proven by universities or other research institutes.
- They are part of the scientific community that deals with future questions.
- Their scientific and popular publications are based on their own empirical research or normative argumentation.

[169] In older forecasting literature, such as Flores et al. (1992), one still finds attempts at judgmental adjustment in forecasts, while more recent foresight approaches do not deal with validation of judgments and arguments. An example of a question that would need to be further discussed is the following: How often are the claims of universal domain, systematicity and authority violated in judgment aggregation processes in foresight? This would require an empirical analysis. Although relevant for philosophy of science, one may doubt the practical relevance of such inquiries. Foresight projects hardly include such epistemic tasks of argument validation. Reasons could be time and cost, but also lack of awareness about the possible contribution of judgment aggregation verifications. To date, the viability of argument-based validation of futures assumptions has only been conducted ex post, for example, in Betz and Cacean (2012) in reference to climate engineering.

We can see that criteria for identifying foresight expertise are based on socio-epistemic considerations. The first and third points meet socio-epistemic requirements for experts, track records and argument-based evidence, while the second point refers to the socio-epistemic claim of scientific criticism very generally. Popp's three criteria show why we are inclined to assume that a result from foresight research may count as scientific evidence. Credibility and reliability of the results depend on the credibility of the researchers themselves. But here again, values enter the debate. Loveridge explains:

> Perceiving future possibilities is a widely distributed ability, but the futures researcher has a special responsibility for seeing that the process is well understood in its relationship to the choices society may make from a spectrum of possibilities – what "ought" to be in human affairs, as the cornerstone of viable policy making and of action. (Loveridge 1977: 55)

This quotation highlights not only the normative nature of foresight and the importance in making the aims clear and posing the right questions, but also how values enter foresight: it is the responsibility of the foresight researcher or practitioner to bring about a foresight process where judgments lead to actions that may fulfil the aim of the task. The practitioner or researcher not only integrates ethical and social values into the process, but also affects the process with his or her own values and norms. He or she has to deal with unstructured problems and at the same time handle values, norms and information (see Loveridge 1977). It is clear that foresight is shaped in large part by the way researchers and practitioners design the process, develop the futures cone and finally discuss the results.

Credibility and reliability cannot be measured, then, by empirical or experimental results alone, for they also depend on values and judgment. Most of the judgments in foresight concerning the content and specific topics are made by experts or groups of experts. So while foresight researchers and practitioners base their trust in experts and specific criteria for credibility, for example, the criteria listed at the beginning of this chapter, they have to follow these same criteria in order for the results to be reliable. These criteria may be specified more concretely within the rule of shared standards on the level of scientific criticism. For example, specific requirements for credibility and reliability in foresight may be part of foresight quality criteria.

7.2.5.b Uncertainty and risk

Propositions about the future are inevitably affected by uncertainties. I suggested in chapter 3, in the early futures thinking era, which basically relied upon forecasts, the general trend was to address this issue with methods based on probabilities. Forecasting's success was limited since the impact of non-epistemic values, on future-related issues, was underestimated or overseen. Using qualitative methods in futures thinking and emphasizing the importance of multiple futures thinking, the success of foresight, that is, its usefulness in decision making in the present, has become more visible. Epistemic uncertainties like inductive risks still remain. In foresight literature, but also in TA, the issue of risk is often discussed in relation to uncertainties (see Loveridge and Saritas 2012; Grunwald 2007; Hillerbrand 2011; Vecchiato 2012; Luis Cordeiro et al. 2013).

Hansson differs five differnet meanings of risk in non-technical contexts which are „widely uses accross disciplines“ (2014): (1) A risk is „an unwanted event which may or may not occur“, it may be (2) the cause, (3) the probability or (4) the statistical expectation value of that unwanted effect. The fifth meaning of risk is “the fact that a decision is made under conditions of known probabilities”. In TA and futures research, the following distinction between risk, uncertainty, and ignorance is made:

> Risk is defined as a setting in which all possible outcomes of the decision are known and can be assigned some frequency pN which offers some confident estimate of the occurrence probability p of the corresponding outcome. Uncertainty is defined by a setting in which again the whole set of outcomes is known but not for all outcomes can one assign the corresponding frequencies. Situations where one lacks knowledge not only on the probabilities, but on (part of) the outcomes too, are called decisions under ignorance. (Hillerbrand 2011)

Since the foresight approach embraces uncertainties directly, it is necessary to accept that epistemic uncertainties are unavoidable. We can nonetheless reduce uncertainties by analyzing the non-epistemic values involved in futures thinking, and we can reach a clear understanding of when uncertainties need to be accepted. Douglas argues that “non-epistemic values are a required part of the internal aspects of scientific reasoning for cases where inductive risk includes risk of non-epistemic consequences” (Douglas 2000: 560). This notion is applicable to foresight as well: all forms of risk and uncertainties appearing in futures thinking are inherently linked to the complex interdependencies of science, technology, economy, environment and values. As foresight deals with themes arising in the STEEPV fields, consideration of ethical and social values is needed. Acknowledging the impact of values in foresight practice gives us a clearer picture of the stages when non-epistemic values may lead to uncertainties.

Handling uncertainties by clarity of non-epistemic values: the example of climate change

The impact of many kinds of uncertainties are discussed in the futures community, especially in technology assessment, where risk evaluations are of special interest.[170] Hillerbrand and Ghil (2008), Hillerbrand (2011) and Beck and Krueger (2016) emphasize the need for non-epistemic values, such as political, social or ethical values. One example in particular applies to the foresight context: Hillerbrand and Ghil (2008) ques-

[170] See, for example, Grunwald (2007) and Hillerbrand (2011). See Künneke et al. (2015) on the example of energy systems and Beck and Krueger (2016) on the example of climate change.

tion whether the moral obligation we have towards future generations has to be considered in climate change research. This question arises especially in decision-making processes where the needs of present generations and those of future generations have to be negotiated. In this specific case, the authors recommend approaching moral concerns in climate-change issues with an "anthropocentric consequentialism". A clear definition of the non-epistemic value of morality, more concretely the moral value of responsibility towards future generations, is set as a constraint for decision making in climate-change issues. Uncertainties about future impact are made visible by a clear position on moral values. Such decision-making cases also appear in foresight, multiplying uncertainties and leading to vague recommendations. This is especially due to unclear positions on certain values.

With a view to the orientation of a foresight project, which may either be normative or explorative, integrating accepted values may at least make uncertainties visible. The orientation of a project also indicates the type of value. In the first step of a foresight project, it is necessary to be clear about the accepted values, which inevitably frame the resulting judgments. To take up the previous example, "anthropocentric consequentialism" may be taken into consideration as an ethical value in foresight, so that risk assessment has to relate to that value.

7.2.5.c Trans- and Interdisciplinarity

Transdisciplinary research is one way to close the gap between theory and practice and facilitate the application of science in solving real world problems (Pohl and Hirsch Hadorn 2008). Interdisciplinary work is important for futures thinking, technology assessment, sustainability and all other STEEPV topics. The relevant terms are defined as follows:

Interdisciplinary work: involves collaboration between researchers from different disciplines in a coordinated and integration-oriented form (Pohl and Hirsch Hadorn 2008: 428).

Transdisciplinary research: "is needed when knowledge about a societally relevant problem field is uncertain . . . , when the concrete nature of problems is disputed, and when there is a great deal at stake for those concerned by problems and involved in dealing with them. Transdisciplinary research deals with problem fields in such a way that it can (a): grasp the complexity . . . of problems, (b) take into account the diversity . . . of life-world . . . and scientific perceptions of problems, (c) link abstract and case-specific knowledge and (d) develop knowledge and practices that promote what is perceived to be the common good" (Pohl and Hirsch Hadorn 2008: 431–2). The process is essentially structured by three phases: (1) identifying and structuring the problem, (2) problem analysis and (3) bringing results to fruition (Pohl and Hirsch Hadorn 2008: 431).[171]

According to these definitions, foresight follows the rationale of transdisciplinary research and vice versa – they also share the same epistemic weaknesses. Some recent publications argue that interdisciplinary work is essential not only in foresight, but also in other applied and social sciences (Lang et al. 2012; Schauppenlehner-Kloyber and Penker 2015; Defila and Di Giulio 2015; Brown 2015; Darbellay 2015; Polk 2015). The manifold benefits of transdisciplinary research are also applicable to foresight, as Schauppenlehner-Kloyber and Penker demonstrate in a scenario project:

> Thus, transdisciplinary research might not only offer a way to bring up case-specific policy and societally relevant results but – seen as a holistic learning process – also fosters capacity building for transforming knowledge into action, as it allows for personal development, value changes, development and testing of alternative action strategies.
> (Schauppenlehner-Kloyber and Penker 2015: 59)

Following these definitions, a basic feature of foresight is that it is trans- and interdisciplinary. A foresight project that does not make use of interdisciplinary work, for example, in the composition of the project team or in the design of expert workshops, may lack validity. While the terms transdisciplinary research and interdisciplinary work are rather modern appearances, there is already evidence from different sources and evaluations of the successful applicability of these approaches.[172] Interdisciplinary work in foresight is also in part responsible, however, for its lack of credibility. Masini puts this point in the following way:

> Futures studies strives to be interdisciplinary, to dare to come out of the niches, but at the risk of insufficient rigour. This is where futures studies have sometimes lost credibility as compared to other social sciences. (Masini 2001: 638)

So while the notions of trans- and interdisciplinarity may help the foresight community to develop framework conditions and to emphasize the relevance of foresight for policy making or even societal robustness (see Schauppenlehner-Kloyber and Penker 2015: 59), its epistemic underpinning is still unclear. This issue can be solved by socio-

[171] Note that these definitions are chosen due to their comprehensiveness. The term "transdiciplinarity" is basically shaped by Mittelstraß, who introduced it as a further development of interdisciplinarity, and for describing a principle of science and research for situations where certain definitions and issues cannot be solved within a single discipline but rather by the support of knowledge and methods from other disciplines; see Mittelstraß (1987, 2001, 2003, 2005). The concept of transdisciplinarity and transdisciplinary research is also prominent in the works of Nicolescu (2002, 2010), Funtowicz and Ravetz (1992, 1993) and Gibbons and Nowotny (2001). For further examples how transdisciplinary research is organized see also the anthologies Nicolescu (ed. 2008), Gibbons (ed. 1994) and Pohl and Hirsch Hadorn (2007).

[172] See, for example, Cuhls (2003, 2004) on participatory processes and Accordino (2013) on the Foresight Platform Futurium.

epistemic considerations. By considering the different forms of objectivity and the different levels where values enter scientific processes, the epistemic uncertainties arising in transdisciplinary research can be addressed, too.

7.3 Progress in foresight: Is it scientific?

In chapter 3 I described the different historic phases of foresight and its roots in forecasting. Over time, the understanding of the purpose of foresight shifted, alongside new developments of methods, and approaches to new fields of application. Moreover, practical experience showed that methodological approaches creating multiple futures are more successful. This is especially because they enable a more robust decision making process by questioning the effects of all possible and probable scenarios. This historical diagnosis of forecasting and early foresight practice reveals that the transfer of practical experience to the scientific reflection base had a major impact on the advancement of the field of futures studies, while lending it credibility. Reciprocal exchange between the two bases – that is, between the scientific criticism of foresight practice and the advancement of theory by practical insights – is essential for progress in the field.

Similar to other scientific disciplines, scientific progress should be a central feature of foresight. This can be observed on different levels: first, in the advancement of the methods for foresight practice, and second, in the adaptation of procedures and theory to framework conditions. Described in this way, foresight appears to be a scientific field. But on this point there is much disagreement. As mentioned earlier, this is in part due to the lack of shared standards, and the competing quality criteria with different foci. Before illustrating this latter point in the next chapter in light of three cases, I intend to emphasize in the final sections of this chapter possible progress in methodology, framework conditions and procedures.

Methodological diversity and progress

The contribution of the methodological diversity of foresight to its scientific success can be described on two different levels: first, by advances in foresight methods and the establishment of new tools and combinations, for example, in their application, success and evaluation; and second, by the consideration of validation issues within the specific methods, that is, by considering epistemic issues like credibility and consistency. Especially more recent work on methodology offers critical analysis and evaluation of existing approaches. The applicability of these approaches is being tested and they are introduced to the scientific foresight community in journals and at conferences. New methodological approaches include, for example, the use of gaming (Dator et al. 2013; Bas and Guillo 2015), participatory and creative approaches (Bas and Guillo 2015; Salo and

Gustafsson 2004; Addison and Ibrahim 2013; El Kerdini and Hooge 2013; MacKay and McKiernan 2010; Guillo 2013), the use of new software such as data and text mining (Kayser 2016; Kayser and Bierwisch 2016; Kayser and Shala 2016), and other IT-solutions for improving foresight methods, for example, in consistency analysis (Keller and Gracht 2014; Dönitz 2009).

In chapter 3 I outlined the historical development of methodology in foresight in reference to the range of qualitative and quantitative approaches. However, seen historically, the methodological diversity of foresight and its further development does not automatically follow the rationale of a socio-epistemically valid procedure. Foresight methods are applied to a variety of fields; they adopt to new technological innovations and evolve dynamically in unforeseen ways. Institutions that insist on the scientific validity of their foresight methods and approaches must partake in the different venues for scientific criticism. It is not sufficient, for example, to merely publish new cases and methodological concepts in foresight journals. Rather, these need to be evaluated in terms of shared standards, methods and success. When dealing with methodological advancement in foresight, here are some of the questions that arise:

- Which forms of objectivity does the method provide?
- Can the method encompass cognitive, social and ethical values equally?
- Are there new IT-solutions that might be useful for foresight?
- How can the opinions of experts and laymen be used more effectively? Do we make use of these opinions in a valid way?
- Is there an effective evaluation framework for the methods being used?

Framework conditions and procedures

It has been argued that there is a gap between foresight theory and practice (Barré and Keenan 2008). Today, in foresight literature there are different evaluations of foresight processes, reports on practical experience, and there is a large body of method-specific literature on the improvement of their application. Knowledge aggregation and acquisition plays a central role in improving the framework conditions for foresight practice and in closing the gap between theory and practice. This gives rise to the following questions:

- What are the framework conditions for knowledge acquisition and aggregation within a project concept?
- Is there a reasonable way for data, information and knowledge from different scientific disciplines to be integrated into the process?
- How is knowledge acquisition structured institutionally? How does knowledge transfer between different institutions and stakeholders take place?

- Is there a regulated way of transferring results from science to the public and how is the public generally involved in the processes?

I attempted to show in chapter 5 in different stages how the foresight community strives to connect with contemporary discourse, for example, by contextualizing foresight theory with certain sociological approaches, including the strand of postnormal science knowledge acquisition. More recent approaches establish the connection to innovation studies and system theories. Such attempts to substantiate foresight theory can be found in (Fuller and Loogma 2009; Öner 2010; Andersen and Andersen 2014; Dufva 2015).

The socio-epistemic view may contribute to the issue of valid advancement of framework conditions on two levels. First, the role of values and the different forms of objectivity may be discussed within such approaches. And second, as outlined in 7.1, fostering such frameworks and establishing them within the scientific community of foresight would require discussing them on different levels. For example, the applicability of such frameworks needs to be tested and verified, or rejected, by community response. They may also be further discussed and established as shared standards. In this way the community would also foster transformative criticism.

7.4 Summary

Three points discussed in this chapter should be briefly summarized. First, we should recall why foresight may be defined as a discipline concerned with social knowledge – or why a socio-epistemic framework is needed for scientific criticism. Second, we should review the central epistemic questions and options, the issues central to foresight processes which ought to be valid, which I discussed from a socio-epistemic point of view. In order to count as a scientific discipline, in foresight theory and practice a reconsideration of these issues has to take place. In this regard, they need further discussion by the foresight community itself. Third, it was suggested that quality criteria could serve as a concrete connection between the scientific reflection base and practice, and that shared standards could anchor the conceptual socio-epistemic framework.

Scientific criticism in foresight: the relation between the two phases

In the preceding sections, I described the two phases, that is, the scientific reflection base and the foresight level, as well as the different epistemic features involved in foresight. I attempted to show that, if we treat science as social knowledge in general, we have an epistemic baseline to build upon when discussing the scientific validity of foresight itself. For different reasons we need to recognize that foresight is built upon social knowledge and that a socio-epistemic framework is necessary for scientific criticism:

(1) The ambivalent role of the expert
(2) The need to reconsider the impact of values
(3) The dependency on results of other scientific disciplines and sources of information (political decisions, media, pop culture, art, etc.)
(4) Objectivity as a core aim of science can also be reached in foresight
(5) The need for valid arguments

These issues are closely interrelated and show the dependencies between the practice level and the scientific reflection base.

(1) Foresight is not possible without experts and expert knowledge. They are needed as a source of knowledge but also for decision making. Expert judgments may have a significant impact, however, on a project, including the main decisions and recommendations. Or, as Loveridge writes: "In giving an opinion an expert manipulates and integrates knowledge subjectively from all six elements of the STEEPV set" (Loveridge 2004: 34). Expert selection should be done carefully with a view to fulfilling certain criteria. A careful selection of experts is needed as they may endorse their own interests. Loveridge, assuming that the expert's self-interest is always involved, notes the following:

> Governments seek expert opinion eagerly, through advisory committees, whilst companies and advisory groups do so with equal ferocity, all with the intention of influencing the formulation of policy and regulations of all kinds. (Loveridge 2004: 33)

In this chapter, I outlined in what sense authorities foster reliability and credibility in the field. Results produced by interdisciplinary groups show the variety of futures images, and this may be seen as an indicator for validity. Nevertheless, it is important to reflect upon the aim of the task and to choose experts who truly contribute to the field. For example, a foresight task dealing with an issue that has a significant impact on society, like the futures of power supply or infrastructures, needs experts not only from the technological fields but also experts concerned with social change. Citizens, as a target group which would be affected by transformations in energy or infrastructure, also have to be viewed as an expert group. Another point, which is more essential for the customer, is selecting a foresight team able to handle a foresight process in a socio-epistemically valid way – that is, a team dedicated to transformative criticism.

Scientific criticism within a socio-epistemic foresight framework makes it possible to discuss the function and requirements of experts: foresight experts are required to set up a valid project design; scientific experts are needed for to provide information and knowledge and to help with decision making; and laymen are needed as 'experts of life', that is, the target group. An example is the discussion on the way specific groups deal with future issues. It has been shown that young people and old people imagine future developments differently.[173]

(2) The discussion on requirements that experts should fulfil also takes place considering the different values involved in foresight. These must be made explicit in order to be aware of the stages at which values influence foresight and in order to formulate which values are allowed to enter the process, and which are not.

(3) The socio-epistemic view should also raise awareness of a decisive discrepancy in foresight: on the one hand, there is the ontological impossibility of making a true claim about the future, and on the other, it is possible, with the notion of foresight as a socio-epistemic framework, to design procedures which are scientifically valid. Making this distinction explicit allows us to determine to what extent foresight is a scientific practice, even though it admittedly produces contradictory results.

(4) It is possible to conduct foresight in a way that leads to objective results. One must be aware, however, of the impact of values, of the way knowledge is produced in foresight and of the special features essential to foresight validation. It thus becomes clear why there is so much inconsistency between different foresight studies, which are supposed to deal with the same topic and within the same time frame, for instance, in energy scenarios. Since foresight is a scientific practice based on social knowledge, constellations and sources of expert knowledge can hardly be the same in two different projects. Decisions and judgments are not only shaped by the experts involved but also by the project design and the methods used.

(5) Nevertheless, the social character does not negate the need for clear and reasonable arguments. It merely draws a wider frame for values to enter the debate and for argumentative judgment. Douglas describes this point as follows:

> Accepting the role of values in science does not eliminate the requirement for good arguments. It only modifies the understanding of what can count as a good argument.
> (Douglas 2000: 560)
> Finally, there are cases where the science will likely be useful but the potential consequences of error may be difficult to foresee. This gray area would have to be debated case by case, but the fact that such a gray area exists does not negate the basic argument: when non-epistemic consequences of error can be foreseen, non-epistemic values are a necessary part of scientific reasoning. (Douglas 2000: 578)

In the second quotation, Douglas refers to the impact of inductive risk that is often found in foresight. Uncertainties and inductive risks cannot be intercepted merely with

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[173] For example, recent psychological research on imagining the future reveals that elderly have more difficulties with such tasks. See for example Schacter et al. (2013) and Rendell et al. (2012).

cognitive values. Their consequences have to be met with social and ethical values, too, and this in turn means understanding which values and what roles they play.

It should be noted that the features described and defined above are merely the first draft of a framework within which we can conceive of foresight in terms of a socio-epistemic theory and practice. Social epistemology assumes that, if it commits itself to certain forms of criticism, scientific knowledge is at once social and objective. This approach allows us to include all the different sources and forms of knowledge, as well as the different definitions of objectivity in the different sciences, in one framework. Accordingly, all the features described in the previous sections would have to undergo a phase of reflection and discussion in the foresight community to be accepted as standards for criticism and practice. The socio-epistemic approach is not just an option for arguing that foresight is a legitimate scientific practice. Foresight can only be regarded as scientific practice if there is ongoing critical analysis of the methods, practical successes and failures, and different forms of scientific objectivity – in practice as well as on the scientific reflection base. As depicted in Figure 9, foresight may only be defined as a scientific discipline if there is a continuous exchange between the two levels according to the basic rules of scientific criticism. This does not only refer to shared standards, for example, by establishing quality criteria, but also to the other three venues: recognized avenues for criticism, community response and tempered equality.

Summary: socio-epistemic questions on the validity of foresight arising from the different epistemic features

In view of the different epistemic features, there are socio-epistemic options, but also open questions and issues in need of greater discussion and research by the foresight community. Each of these issues is related to what I have earlier called ‘scientific progress of foresight’: this applies when evaluating new methodological approaches, but also when designing new frameworks related to new topics or concrete institutional environments. The key results of the socio-epistemic foresight framework proposed in the present work may be summed up as follows:

Objectivity

Objectivity is the core epistemic feature of a scientific discipline, but at the same time science is shaped by values. Of the forms of objectivity that can be found in the various scientific disciplines, foresight may be seen to be based upon interactive objectivity. However, other scientific disciplines, along with opinions from experts and laymen, and surrogate knowledge are important sources of information for foresight, which means that other forms of scientific objectivity may enter foresight passively. This is why a clear shared understanding of foresight objectivity is needed:

- How can we reach a shared understanding of interactive objectivity as a guiding principle of foresight?
- How should we implement objectivity criteria as quality criteria?
- What is the relation between tempered equality (see 7.1.2) and interactive objectivity? Are there blind spots in the inclusion of intellectual authorities? Are their opinions included equally and objectively?
- …

Values

Science is value-laden and so is foresight – essentially by cognitive, ethical and social values. Cognitive values, for example, simplicity, explanatory power, scope, consistency, predictive precision, and fruitfulness may also be perceived as scientific criteria for foresight practice. Furthermore, ethical and social values enter foresight at all stages of practice. The foresight community needs a shared understanding of which values are allowed to enter foresight processes and which are not.

- Which values should be allowed in the different foresight phases?
- Are there methods, approaches or knowledge sources which are more value-laden than others?
- How can the implicit values be made explicit? How can we avoid value-laden hidden agendas in foresight?
- Are there other cognitive values which should be taken into consideration as scientific criteria for valid foresight processes and results?
- How can we express the thought that social and ethical values are an essential part of foresight, not only in creating social knowledge but also as part of STEEPV considerations and technology assessment? Can ethical and social values be included in quality criteria?
- How do the different values shape the common understanding of valid knowledge in foresight, of aims and problem setting, and of other validity indicators such as interdisciplinary work, uncertainties and risk, and credibility?
- …

Knowledge

The validation of expert knowledge and judgment in foresight can be performed in different ways: by a passive suitability check, by checking the forms of objectivity the expert relies on, and by checking the kinds of values which may enter processes of expert opinions. This also holds for experts involved in group processes. With regard to the validation of judgments and knowledge in foresight, questions in need of further research include the following:

- Can options for checking suitability be included in quality criteria?
- Is group knowledge or group thinking produced?
- What are the rules for aggregation procedures in group thinking?
- Are there new methods for aggregating data and information in a valid way?
- …

Aims and problem setting

The aim of foresight is to design possible, probable and desirable futures in a descriptive and objective manner. Aims and problem setting are shaped by non-epistemic influences like values, negotiations, judgments and preferences of the different parties. For valid aim and problem setting, awareness of the following issues is needed, as well as the formulation of certain rules on the scientific reflection base:

- What are the rules and standards for problem setting procedures?
- How should we deal with non-epistemic influences? What are the rules?
- Are there new methods and new information and knowledge sources that may be used to reach the aims?
- How do ethical and social values influence normative aim setting?
- …

Foresight-specific validity issues

The socio-epistemic focus on values and different forms of objectivity also makes apparent that validity in foresight cannot rely merely upon cognitive values, but needs to consider further issues related to the specific knowledge and content produced in foresight.

Credibility

- Which standards do authorities (foresight experts, topical experts) follow to be credible?
- Are all credibility issues encompassed by values and objectivity claims?
- Do the standards for objectivity in science (recognized avenues for criticism, shared standards, community response and tempered equality) satisfy credibility concerns? Are credibility concerns subject of discussion in each of these venues?
- …

Uncertainties and risk

- Which values have an impact on uncertainties and risk?
- Can risk assessment take place in foresight based upon cognitive values?
- Which kind of uncertainties are acceptable?
- …

Transdisciplinary/ interdisciplinary work

- What are the rules for valid interdisciplinary work?
- How does trans-/ interdisciplinary work contribute to tempered equality?
- …

Quality criteria as an instrument for feedback and standards

One way to institutionalize this framework is to establish quality criteria that contain the socio-epistemic notions of objectivity, values, and validity. In 7.1 I suggested that, among Longino's criteria of transformative criticism, the criterion of shared standards should be discussed in more detail by the foresight community, as there is still no standard reference. In this way, certain quality criteria could be established. At the same time, the other criteria – recognized avenues for criticism, community response and equality of intellectual authority – are more firmly established as a scientific reflection base for foresight. Especially the dependency of foresight on other sciences has been frequently discussed at conferences and in different articles and journals, as chapter 5 shows.

In the preceding sections, I argued that quality criteria are a suitable means to provide standards for valid foresight processes. The creation of foresight quality criteria takes place on the level of scientific criticism, in order to establish shared standards. This reveals that foresight can be defined as a special kind of applied science, which maintains objectivity despite the ontological impossibility of creating true knowledge. Epistemic questions and reflections outlined in this chapter can be adopted as a guideline for the design of quality criteria. Nevertheless, one should keep in mind that a certain degree of flexibility is vital for responding to the variety of tasks, application fields and methods existing in foresight. Especially the various quality criteria that exist at present indicate this need. It is impossible to provide a set of quality criteria satisfying the needs of every institution or future topic. As a baseline, socio-epistemic issues can be provided at least, which should be considered for epistemically valid quality criteria.

The idea is that the community sets standards, but these standards in the form of quality criteria are repeatedly discussed and evaluated. Experience from foresight practice flow into this work. Over time, they may be supplemented by other criteria or new requirements, or specified for certain target groups or topics.

The task of the next chapter will be to outline some examples of quality criteria, to show their diverse approaches and to discuss the extent to which they already correspond to the socio-epistemic framework of foresight presented in this chapter.

8. The Socio-Epistemic Framework and Three Cases of Quality Criteria

In the following sections, I will describe different forms of quality criteria. Section 8.1 focuses on outcomes and stakeholders, placing special emphasis on validity. Section 8.2 focuses on knowledge assessment, while the criteria in the third section, 8.3, focus on method and field scenarios from the energy sector. The guiding questions of the discussions are the following: Which aspects do the criteria refer to? Have all epistemic features been considered, or are any missing? Which aspects could be added to contribute to socio-epistemically valid criteria? In the context of the framework presented in the previous chapter, these cases may serve as shared standards developed on the scientific reflection base. However, it should be noted that these three examples operate on different levels. The first deals with scientific futures research in general while the third example reflects quality criteria for energy scenarios which can be used for foresight, TA and FTA. Only the second one is explicitly dedicated to foresight criteria. This circumstance underlines once more the difficulty in delimiting foresight from other concepts of futures research, as there is significant overlap with forecasting and TA.

8.1 Quality criteria for scientific futures research

Description

The first example is the "quality criteria for scientific futures research" developed by Kuusi et al. (2015a, 2015b, 2015c). The authors argue that the suggested quality criteria are connected to the "Futures Map" frame (Kuusi et al. 2015a: 60). More concretely, they are supposed to check the validity and usefulness of futures maps for the customer. Thus, the sense-making process plays a crucial role in their concept. Moreover, they claim that "the key task of scientific futures research is to improve the pragmatic validity of Futures Maps" (Kuusi et al. 2015a: 65). In all futures research practice, 'futures maps' are produced. The authors define them as follows:

> A Futures Map is the comprehensive description of the outcomes of a futures research process. It comprises all relevant pictures of the future identified during the process and all relations between these pictures and between them and the present state as well as assessments about time frames, desirability and possibility of these pictures. (Kuusi et al. 2015a: 62)

Hence, ‘futures maps’ refer both to the processes and the outcomes of a futures project. The authors also emphasize that “the Futures Map depends on the capacities and purposes of actors” (Kuusi et al. 2015a: 63). A futures map may have a ‘planning horizon’ and a ‘mapping horizon’. The latter refers to the cone of scenarios, encompassing the acceptable future images within the possible ones. It stands for the long-term view into the future, while the ‘planning horizon’ refers to those future images which can, for example, be developed as roadmaps for acceptable futures.

For each futures map, validity can refer to either internal or external aspects. Validation relies on quality criteria which ought to check both the ‘internal’ and the ‘external’ validity. This approach is meant to enhance pragmatic validity, that is, the validity of forward-looking activities by using criteria related to internal aspects (scientific method and process) and external aspects (sense-making concerns and usefulness for the customer). The underlying foresight process framework the authors refer to is the strategy process developed by EFFLA (European Forum on Forward Looking Activities 2013). It frames the process in forward-looking activities as follows: (1) Strategic Intelligence, (2) Sense Making, (3) Selecting Priorities, (4) Implementation. The following illustration shows an overview of the EFFLA framework that has been designed for European foresight processes.

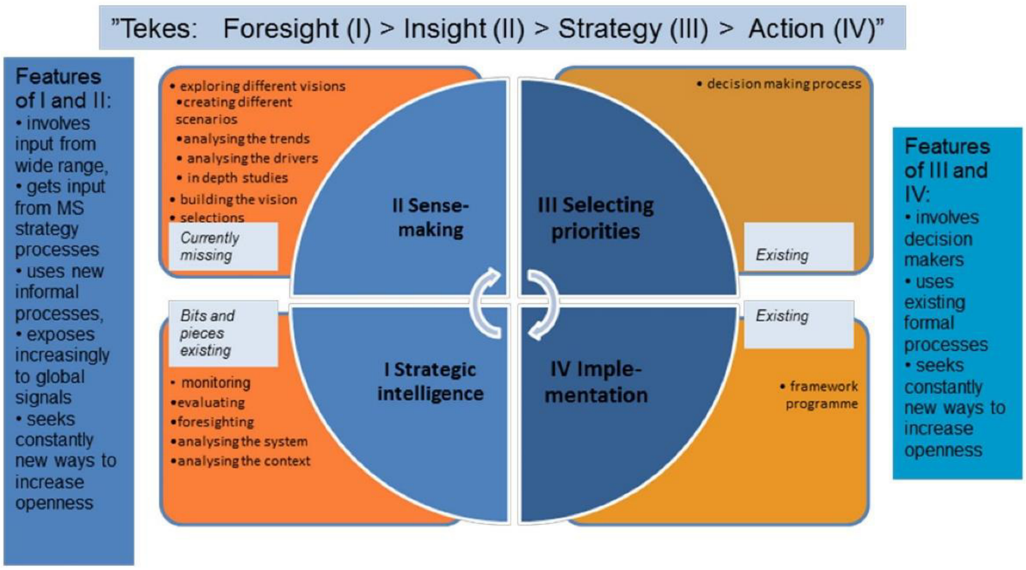

Figure 16: Necessary elements of the future EU strategic process (EFFLA 2013: 2)

Alongside this EFFLA framework, Kuusi et al. develop five questions that relate to the internal validity of futures research projects (2015a):

a) What is the objective of the whole foresight activity?

b) What type of activity has to be considered for what type of issues/time spans/ knowledge?

c) What is the scope of foresight? What is the scope of relevant intelligence and sense-making?

d) What is an appropriate set of/ combination of/ methods to make use of the strategic intelligence of the specific actors?

e) What are the intended outcomes of the different stages in the process? In general, reports are written but often, the activity as such is an outcome.

Using these questions as criteria for internal validity, it should be possible to assess the validity of the task's objectives, scope and outcomes. Validation also concerns the way methods are applied and chosen, and the way actors are involved in the process. Greater internal validity means greater external validity of futures maps. The authors insist that the purpose of the quality criteria is not merely to assess validity, but also to enable futures maps that are useful to the customer. In that respect, they further highlight that "[t]he pragmatic validity of the futures map increases if relevant actors are able to use it" (Kuusi et al. 2015a: 66). A simple way to check the external validity is to compare two futures maps alongside the following six external validity criteria:

(1) FM1 suggests more possible futures than FM2 that might be relevant from the point of view of the vision or acceptable futures (wide scope of possibly relevant paths)
(2) FM1 is able to identify most relevant futures better than FM2 (important relevant futures)
(3) FM1's scenarios are causally in line with more futures' relevant facts than FM2's scenarios (more interpreted causally relevant facts)
(4) FM1's number of facts that get causal interpretation in scenarios divided by the number of scenarios is higher than in FM2 (effectively with scenarios interpreted facts)
(5) FM1 is understood by more customers than FM2 (many understand)
(6) FM1 is better understood by those customers who understand FM2 (better understood)

FM1 and FM2 stand respectively for futures map 1 and futures map 2. The comparative structure of the criteria indicates that relevance for the customer is a crucial point for validity. While the internal criteria focus on futures research processes and a sound use of research methods, the external criteria should indicate if "there are sound reasons to generalize – or to make abduction – from past and present facts to futures relevant conclusions" (Kuusi et al. 2015c: 2). There are nonetheless connections between internal and external validity. The authors discuss these criteria as pragmatic validity criteria. Figure 18 summarizes them.

The first two criteria refer to the phase of strategic intelligence. Collecting futures-relevant facts and assumptions is also a task of strategic intelligence, but their interpretation is basically bound to the phase of sense making. Hence, criteria 3 and 4 should validate the interpretation and relevance of the outcomes reached during the strategic intelligence phase. Finally, criteria 5 and 6 "are related to all stages but they are especially important in the phases of Sense Making and Selecting Priorities" (Kuusi et al. 2015c: 2; 2015a).

Discussion

A first aspect for evaluating these criteria in the context of the socio-epistemic framework is whether they contribute to scientific objectivity on the scientific reflection base – that is, whether the criteria of transformative criticism adapted from Longino are met and how they were introduced as shared standards. The criteria were first published in a paper in *Futura* (2015a). They were discussed intensively in a session at the conference *Futures Studies Tackling Wicked Problems*.[174] In this session, further material explaining the concept of the quality criteria and the futures maps was published. In a special issue of the *European Journal of Futures Research*, the quality criteria were published once again (Kuusi et al. 2015b), alongside other papers discussing these quality criteria and other aspects of validation in futures research. Hence, with regard to scientific objectivity on a scientific reflection base, the authors have met the requirements – space is given to community response and criticism in papers and a conference session.[175]

Another point of discussion is whether the criteria are in line with the socio-epistemic framework. Can these quality criteria contribute to shared standards? The authors stress that the criteria should serve as "pragmatic validity criteria for futures mapping processes" (Kuusi et al. 2015c). Their futures maps framework aims at encompassing all possible futures thinking activities, either with a planning or a mapping horizon. Thus, the quality criteria may be used regardless of the method being applied. The pragmatic focus lies primarily on sound and useful results, which are validated by external criteria.

As a consequence, the pragmatic validity criteria are formulated in a general manner. But do they nevertheless cover the relevant epistemic issues in foresight identified in chapter 7, that is, the specific forms of knowledge, aims and procedures, values and objectivity, and finally validity?

[174] World Conference of Futures Research 2015: Futures Studies Tackling Wicked Problems: Where Futures Research, Education and Action Meet. 11–12 June 2015, Turku, Finland. (see https://futuresconference2015.wordpress.com/)

[175] In this session, I have also contributed by presenting first thoughts on connecting these quality criteria to Longino's rules for scientific objectivity by transformative criticism. See Shala (2015).

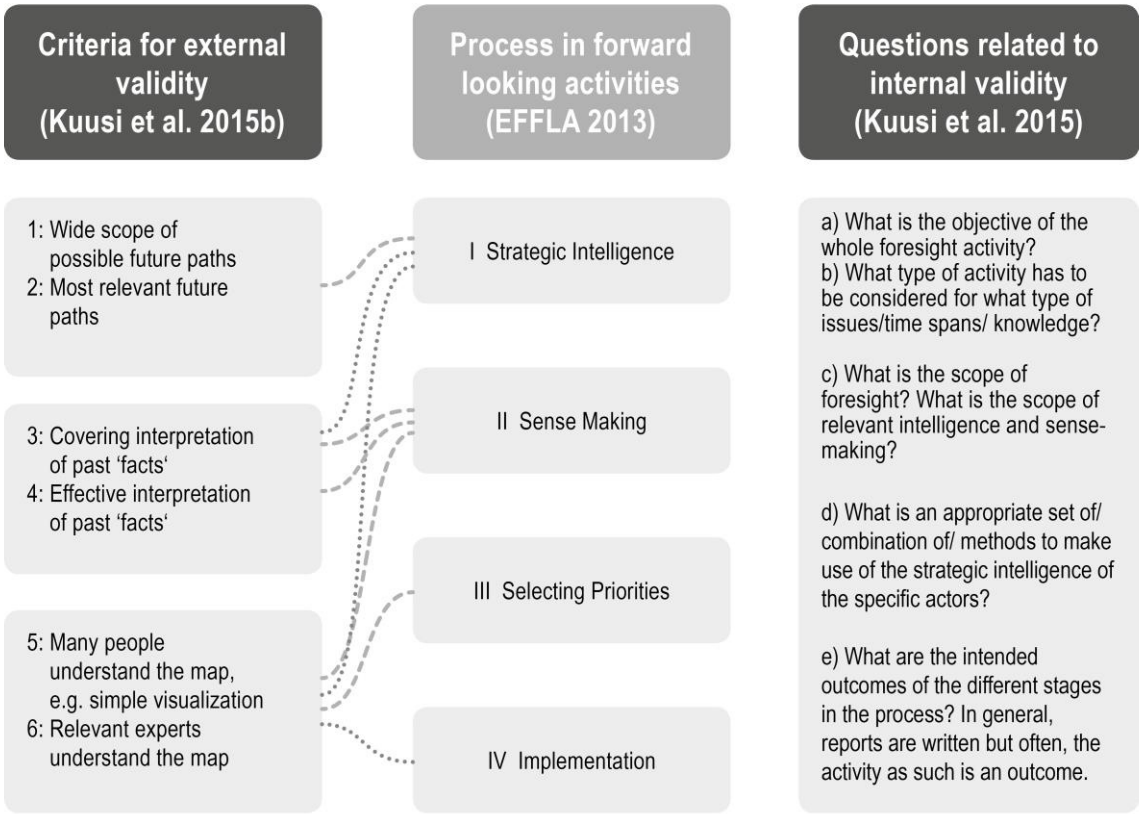

Figure 17: Connections between external and internal validity of futures research processes (own illustration)

Most of the issues are addressed in the questions referring to internal validity. Questions a) and b), for example, focus on the special forms of knowledge acquisition in future-looking activities. Questions c) and d) focus specifically on the appropriateness of the choice of method and emphasize the role of sense making. Both questions also relate to a reasonable use of project designs and methods for achieving a specific aim. Question e) discusses whether the aim has been reached and what the outcomes are. Finally, all questions related to internal validity relate to procedural aspects. Questions concerning objectivity are not explicitly raised, and the impact of values appears indirectly. Validity issues like credibility are addressed with emphasis on sense making.

Nevertheless, by aiming at pragmatic validity, the questions may also sensitize futurists to structure and conduct foresight in a way that is scientifically objective from a socio-epistemic perspective. In this regard, the questions are too condensed to encompass all relevant epistemic questions that could arise in the context of a scientifically objective approach. The knowledge question in a) is procedural rather than epistemic. This may need more specification. Validity issues concerning uncertainties and risk as well as the inter- and transdisciplinary aspects in forward-looking activities are not explicitly mentioned. Thus, they may be considered in questions a) and b) relating to the strategic intelligence phase. Particular questions concerning values could also be added to c) "What is the scope of relevant intelligence and sense-making?".

The authors indicate, however, that there are connections between internal and external validity. The six criteria, also designated as three "basic dimensions in validity evaluations", take up the same issues from the questions on internal validation. Therefore, the division into internal and external reflections seems redundant. For example, the first pair of criteria appear as a frame for procedural aspects, which may contain internal questions a) to e) as well. Within the first two criteria, which focus on strategic intelligence, more criteria should be included which reflect the role of values. Criterion 2 already contains the notion of relevance, which should be substantiated by more concrete questions on values that are permitted to enter the process and potentially shape considerations on relevance.

The issue of relevance is also repeated in criterion 4. Here, it is mentioned in the context of Sense Making. Interpreting the outcomes of the strategic intelligence phase is the main task of the sense-making phase. Criteria 3 and 4 should determine whether the sense-making activities in certain futures research activities are reasonable. From a social perspective, the authors are right to emphasize the need for validity in sense making. Especially with criteria 3 to 6, they stress the need for sense making in foresight at the different levels of the process and the impact of customers and stakeholders not only on formulating project aims, but also in selecting paths and the outcomes in general. Criteria 5 and 6 can be applied to the validation of all phases, but especially to the phases of Sense Making and Selecting Priorities. These criteria demonstrate that futures looking activities are social practices which have to validated, too.

Here again the authors emphasize the specific character of futures research. These activities pursue specific aims that are not a further step within a scientific discipline referring to previous scientific research. The aims of foersight refer to specific concerns of a client – be it a research or political organization – with a view to the future development of a certain issue in order to derive recommendations and actions for the present. Mapping and planning phases of such futures research activities need valid internal procedures regarding the objectives, the type of activity and its scope, the methods and the outcomes. These internal procedures are supposed to be the basis of scientific objectivity. The authors also argue for useful and target-oriented futures research. Yet, as I have in chapter 7, there are different kinds of values – cognitive, ethical and social – which enter all processes of foresight. Ethical and social values appear especially when judgments are made, that is, in sense-making and decision-making phases. Hence, due to their strong focus on sense making, the pragmatic validity criteria may profit from more specification regarding the different values in the socio-epistemic framework.

Finally, with the strong validation focus on sense making, these criteria emphasize the social character of foresight. They show that negotiation processes foster the validity of foresight processes. The catalogue proposed by Kuusi et al. (2015a) consists of only six criteria, yet nevertheless encompasses complete processes. With further refinement of values and forms of knowledge acquisition, the criteria could be adopted by specific stakeholders or regarding specific foresight methods.

8.2 The foresight knowledge assessment case

Description

Schomberg, Guimarães Pereira and Funtowitz propose an approach to foresight knowledge assessment that focuses on the quality of foresight knowledge retrieved by different levels of deliberation (Schomberg et al. 2005; Guimarães Pereira et al. 2007; Schomberg 2007). Their approach may be seen as a specific set of quality criteria. For example, Rader and Porter (2008) adapt this foresight knowledge assessment as quality criteria for technology foresight and use it as a starting point to discuss the application of FTA methods to different study types.

The structure of their assessment follows the knowledge flows between the different stakeholders. The deliberative nature of democracies in Western societies is taken as a point of reference for foresight activities. They describe foresight "as an interface between science and policy and concerned spheres of the society, implying flows of knowledge among these spheres" (Guimarães Pereira et al. 2007: 60). In consequence, the assessment of the quality of such knowledge flows should "enhance trust and commit those involved on [sic!]effective dialogue" (Guimarães Pereira et al. 2007: 60). Reference is made to the concept of an "extended peer community" (Funtowicz and Ravetz 1990) and a concept of "socially robust knowledge" (Gibbons 1999). This makes use of contemporary theoretical approaches to foresight, which refer to post-normal science (see chapter 5). Figure 18 shows the authors's view of knowledge flows in foresight processes.

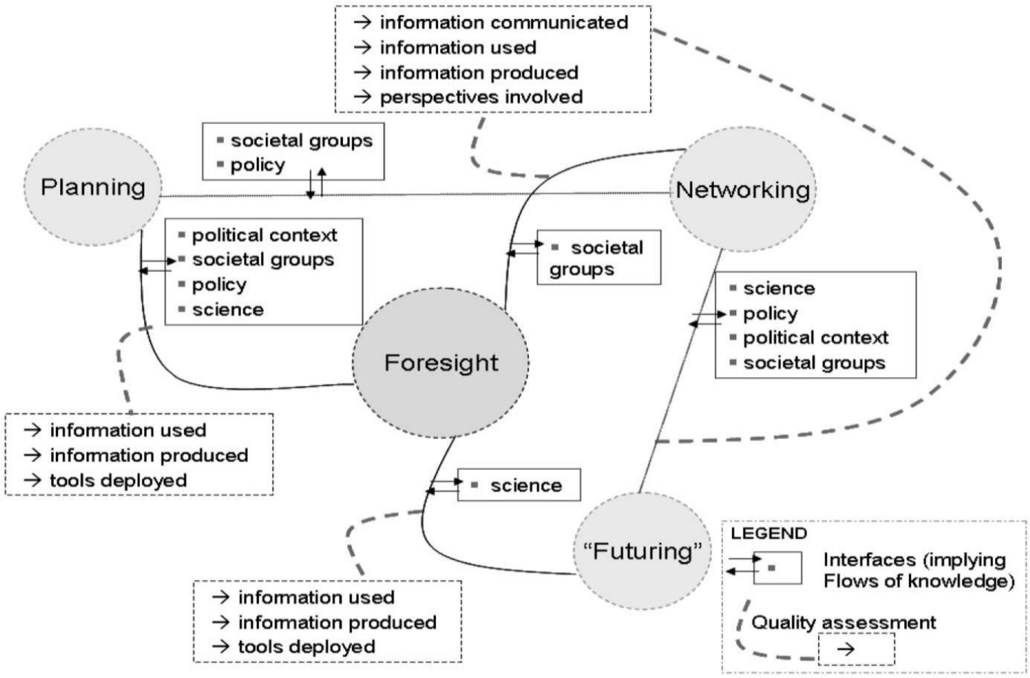

Figure 18. Foresight process, interfaces implying flows of knowledge and quality assessment requirements (Guimarães Pereira et al. 2007: 61)

Here, foresight is described as a "collective exercise", consisting of the basic activities "futuring", "planning" and "networking". Within and between the different activities, there are different knowledge flows connected to types of information, audiences and stakeholders. Deliberation takes place at the interfaces of the knowledge flows, which is where quality assessment is needed. Foresight deliberation takes place at the three levels of politics, science and policy, which are all shaped by normative boundaries.

(1) The first level "concerns a broad *political* deliberation, which assumes a political consensus on the need for long-term planning when it engages in foresight exercises." On this level, foresight is "a form for early anticipation and identification of threats, challenges and opportunities that lie ahead of us." As it is based upon (expert) opinions, its natureis unavoidably normative (Guimarães Pereira et al. 2007: 59).

(2) Deliberation at the policy level "immediately builds upon outcomes of political deliberation". This is achieved by mapping and identifying challenges and opportunities that are "(in) consistent with more particular shared objectives". The authors suggest that "[a]t this level a policy framework needs to be agreed upon for the implementation of foresight in a broad sense, at least by identifying insti-

tutions and actors which will take charge of foresight exercises." Such institutions are in charge of conducting foresight projects in accordance with drivers relevant at the policy level. (Guimarães Pereira et al. 2007: 59)

(3) The third deliberation level is the science/policy interface, which "qualifies the input of a diverse range of knowledge inputs, for example, those of the scientific community, stakeholders and possibly the public at large by applying foresight (scenario workshops, foresight techniques/studies/panels, etc.). . . . At the science/policy interface, the state of affairs in science needs to be identified in relation to the identified relevant threats/challenges and opportunities. A particular task lies in qualification of the available information by formulating statements on the available information in terms of sufficiency and adequacy – a preliminary form of *Knowledge assessment*." (Guimarães Pereira et al. 2007: 60, italics in original)

In an EU foresight context, a foresight project must pass the three different deliberation levels. At the political deliberation level, a technology foresight has the task of early anticipation and identification of threats and opportunities. Paramount is not technology assessment, but instead identifying new technologies, their impact and drivers, and determining shared objectives and needs. At the second deliberation level, the consistency of the identified technologies is tested, which involves the accompanying threats and opportunities with a view to shared objectives such as sustainable growth and economic competitiveness.[176] At the interface of science and policy, deliberation is needed for example to detect knowledge gaps and to formulate recommendations, to disclose uncertainties and use them for decision procedures (Guimarães Pereira et al. 2007: 59–60).

Hence, there are boundaries at the different levels of deliberation, which may also be perceived as indicators of quality. The authors note:

> The specific outcomes from each deliberation level can be fed into other levels of deliberation, which are constrained by yet another set of distinct normative boundaries. Most often these boundaries are not simple consensual assumptions, justly shared by the actors involved, but may be fundamental policy or constitutional principles which are the result of longer learning processes and which have to be shared in order to achieve particular quality standards of policies and decisions. (Guimarães Pereira et al. 2007: 56)

The authors stress the reflexive nature of knowledge, the way it is shared and discussed at different levels. Different values are involved at all deliberation levels. Definitions are established in the different deliberation processes, and perceptions concerning cer-

[176] Guimarães Pereira et al. (2007: 56) give another example on the deliberative relation between the politics and the policy level: "For instance, deliberation on risks and safety under product authorisation procedures within the European Union are guided by the policy objective, which is enshrined in the EU treaty, to aim at a high level of protection of the European citizen."

tain issues, features and procedures are shaped. The authors also argue that a definition of foresight knowledge must encompass its different purposes and relevant sources; it has different aspects and appears in different forms throughout a foresight process and at different levels of deliberation. They refer to foresight knowledge as strategic knowledge, and state that it encompasses explanatory knowledge, orientation knowledge and action-guiding knowledge:

> Strategic knowledge, as a scientific contribution to sustainable development, consists of targeted and context-sensitive combinations of explanatory knowledge about phenomena observed, of orientation knowledge evaluative judgements and of action-guiding knowledge with regard to strategic decisions (Guimarães Pereira et al. 2007: 56)

Strategic knowledge is descriptive, incomplete and affected by normative concepts. Consequently, in order to reduce the inevitable uncertainties, reflexivity and learning processes "become decisive features in providing strategic knowledge for sustainable development" (Guimarães Pereira et al. 2007: 56). With this definition they argue that, to assess foresight knowledge, it is necessary to distinguish between the production and the use of knowledge, which causes a knowledge divide:

> Whereas the former, relates to aspects of availability, accessibility, relevance, fitness for purpose and legitimacy, that is, the pedigree of information used, the latter relates to the diversity of interpretations inherent to diverse value systems and existing platforms for understanding, sharing, learning and communicating. (Guimarães Pereira et al. 2007: 62)

While the aim of the notion of a knowledge divide is to make the different levels of knowledge aggregation and knowledge flows visible, I will argue in the next section that this notion is a constructive insight, since all issues listed as features of the use of knowledge may also be ascribed to the production of knowledge. The "Knowledge Assessment Methodologies" (KAM) that the authors recommend are summed up in a table. These methods may also be read, following Rader and Porter (2008), as a quality criteria guide. KAM merges "the concepts of extended quality assurance and *extended peer review*"[177] (Guimarães Pereira et al. 2007: 64).

[177] The concept 'peer extended peer review' is taken from Funtowicz and Ravetz (1990).

Issues	Dimension	Considerations			
Information pedigree	*Fitness for purpose* 🟡🔵	Correspondence of information & issues: - Adequacy 🔵 - Relevance 🔵	Accuracy 🟡	Comprehensiveness 🟡🔵	
	Applicability 🟡🔵	Access & availability 🟡	Intelligibility 🟡🔵		
	Reliability 🟡🔵	Control - Sources - where from? 🟡 - Sources - method of generation 🟡🔵 - Verification 🔵 - Consensus 🔵	Confidence - Peer acceptance 🔵 - Legitimacy 🔵		
Quality of tools	*Fitness for purpose* 🟡🔵	Adequacy/applicability 🟡🔵	Relevance 🔵	Adaptability/flexibility 🔵	Transformation/ encoding 🟡🔵
	Transparency 🟡🔵	Model documentation 🟡	Sources of information 🟡	Arbitrariness - scientific set-ups 🟡🔵	
	Legitimacy 🟡🔵	Collegial consensus 🔵			
Information communicated throughout networking	*Intelligibility* 🟡🔵	Compliance with target audience 🟡🔵	Accessibility 🟡	Transparency 🟡	
	Communication of uncertainties 🟡🔵	Recognition 🟡🔵	Statement 🟡🔵		
	Pedigree statement 🟡🔵				
Information communicated from networking into the foresight exercise	*Acknowledgement of input* 🟡🔵				

Table 6: Rader and Porter (2008, 30), technology foresight quality criteria, based upon Guimarães Pereira (2007)

Discussion

Table 6 summarizes the technology foresight quality criteria by Rader and Porter (2008), which they adopted from Guimarães Pereira et al. (2007). To show which epistemic values affect the different dimensions and considerations, I have highlighted them with different colors. The yellow dots refer to dimensions or considerations affected by cognitive values, and the blue dots show where the appearance of ethical and social values may impede clear understandings of dimensions and considerations.

In the socio-epistemic framework, I have arranged (1) aims, (2) knowledge issues and (3) validity issues such as credibility, uncertainties and risk, inter- and transdisciplinary work in the circle between objectivity and values, as they all influence each other. In the quality criteria based on KAM, there are other criteria related to knowledge claims. These do not question, however, values involved in knowledge flow, even though all the dimensions and considerations are epistemically bound to values. As listed in the table, the criteria are structured according to four issues: information pedigree, quality of tools, information communicated through networking and information communicated from networking into the foresight exercise. The dimensions used to categorize the issues contain epistemic features which can all be reflected socio-epistemically. For example, the fitness for purpose is analyzed regarding the information pedigree as well as the quality of tools. Other dimensions relate to validity features such as applicability, reliability, transparency, legitimacy, intelligibility, communication of uncertainties, pedigree statement and acknowledgement of input. As the different colors in the table demonstrate, most dimensions and considerations are affected by ethical and social values.

While it would be relatively easy to define requirements for dimensions and considerations affected by cognitive values, the same is not the case with ethical and social values. Requirements concerning transparency, for example, which qualify as cognitive values, are easier to formulate because they relate to descriptive and quantifiable criteria of monitoring and documentation. The same applies to requirements for procedural criteria such as the control of sources, model documentation, sources of information or transparency. By contrast, to assess criteria affected by ethical and social values one needs to first distinguish between acceptable and unacceptable values. For example, with a view to adequacy and relevance: How do we determine which tools and information are relevant and adequate? As a consequence, criteria affected by ethical or social values are vague and difficult to use because they leave too much room for interpretation.

Note that the authors explain KAM and the deliberation levels alongside foresight projects conducted on the EU level. This means that all the dimensions and considerations could be defined more explicitly once ethical and social values are reconsidered in the context of EU-projects.

In building upon the concept of deliberation in democratic societies, the foresight knowledge assessment approach, or knowledge assessment methodologies, follow the rationale of social epistemology, though without making this rationale explicit. A central claim of socio-epistemic approaches, as Douglas and Longino demonstrate (see chapter 6), is that deliberation is needed where science, policy and the public meet, and epistemic features like values and different objectivity forms need to be taken into consideration. KAM recognizes different spheres of deliberation needed in foresight and proposes different criteria. The many issues that appeal to the knowledge divide may also be read as evidence for the claim that science is social knowledge:

> Knowledge is an asset to initiate issue framing, exploring uncertainty, possibilities and action; already within scientific practice, disciplinary integrations suffer from inherent differences of framing, methods, scales, etc. and therefore it is not surprising that attempts to represent knowledge as a coproduced outcome using scientific and societal inputs will have to depart from probably [sic!] efforts of conviviality . . . and of creating shared understanding and language. In foresight, networking implies precisely the creation of spaces where different types of knowledge eventually will constitute what Gibbons (1999) called socially robust knowledge. (Guimarães Pereira et al. 2007: 62)

The authors' point of reference in emphasizing the social character of knowledge is social constructivist theories of social knowledge. While they claim that "networking" within the field shall foster "socially robust knowledge", its epistemic status is still unclear. This gives rise to a question concerning the socio-epistemic foresight framework: Do the proposed criteria also encompass epistemic considerations to validate the acquired knowledge?

A first point that can be agreed upon regarding the above quotation is that the description of knowledge production resembles the socio-epistemic approach. The authors' notion that "within scientific practice, disciplinary integrations suffer from inherent differences of framing, methods, scales, etc." is a diagnosis that emerges from the different forms of objectivity that are present in the different scientific disciplines. Where collaboration is needed between stakeholders and researchers from different disciplines – as it is the case in foresight – the different forms of objectivity may lead to epistemic uncertainties and confusions concerning which values are permissible in the processes. To foster epistemic validity, it is important to be familiar with the different forms of objectivity and the different kinds of values.

The authors further state that "attempts to represent knowledge as a coproduced outcome using scientific and societal inputs will have to depart from probably efforts of conviviality" (2007: 62). This underpins the socio-epistemic claim that trans- and interdisciplinary work is an epistemic feature of foresight. They also argue that networking and participation is an important factor, and stress the need for “creating shared understanding and language” in order to promote networking and socially robust knowledge (Rader and Porter 2008: 31). This too may count as a feature of shared standards within the socio-epistemic framework. For example, when formulating quality criteria, one may be led to the following questions concerning the validation of knowledge: What are the requirements for shared understanding regarding networking? Are the requirements met in the foresight exercise? Finally, the notion of different deliberation levels and the need for networking may be seen as an alternative description of the two mutually dependent level in the socio-epistemic foresight framework – that is, the scientific reflection base and the practice level. Therefore, the criteria can be interpreted as a tool for shared standards.

It should be noted that the criteria of this second case are derived from literature and experience from other projects. It is not clear whether these criteria have been adopted in practice. Nevertheless, this case shows that, on the scientific reflection base, ongoing attempts have been made to use new scientific theories for foresight theory and, like in this case, for quality criteria. This case is also an example, then, of the ongoing discourse on epistemological and validation issues in foresight research.

8.3 Focus on method and the field – the case of the energy systems of the future

Description

The final example is based on the statement concerning requirements for energy scenarios developed by the German academies' project "Energiesysteme der Zukunft" ("Energy Systems of the Future"), working group "Scenarios" (acatech, ed. 2015b, 2016).[178]

In contrast to the previous two examples on quality criteria, the requirements formulated for energy scenarios have not been developed exclusively in reference to experience from previous futures studies, but also through workshops that involved scientists, practitioners and the public. These requirements for energy scenarios should be used for scientific political consulting and policy making. The position statement addresses scientific and public institutions and stakeholders that draft energy scenarios and also those who assess and judge them: NGOs, journalists, citizens. These quality criteria are more specific than those of the first two cases, as they are aimed at a clear audience, refer to a specific topic and employ a concrete foresight method. Due to the methodological focus, the quality criteria are applicable to energy scenarios in both the context of technology assessment and foresight.

There are three basic requirements for energy scenarios: scientific validity, transparency and unbiasedness (acatech, ed. 2016: 11–2).[179] Scientific validity applies to the methods and data that are used in research, and also to the models that are developed from it. Conclusions and recommendations need to be plausible, and uncertainties and risks must be made explicit. Transparency refers not only to plausible procedures and argumentations but also to the disclosure of information sources, the justification of findings and the documentation of the results. The requirement of transparency is especially vital in energy studies financed by public funding. The third requirement is that there be open results and that clients not impede the choice of method or open processes. Results

[178] The case is described in reference to the English translation, acatech (ed. 2016); reference is also made to the original German position paper, acatech (ed. 2015b). The first round of the project took place between 2013 and 2016; the second round is taking from 2017 to 2019.

[179] In German, the basic requirements are "wissenschaftlich valide", "transparent", and "ergebnisoffen", acatech (ed. 2015b). The word "ergebnisoffen" has no equivalent translation in English, as it may also be translated with "unprejudiced", "unbiased" or "open-ended". In the English version of the position paper, the requirement is called "unbiasedness", while a word-by-word translation would be "openness towards any results". Note that this requirement might be mistaken in the English version of the position paper, as "unbiasedness" may also be interpreted in reference to the claims of objectivity as a claim for value-free or value-neutral science.

should not be influenced inappropriately by certain stakeholders, for example with normative beliefs. As these basic requirements appear at different stages, they are grouped according to their function, that is, whether they are needed for

(1) the creation of energy scenarios,
(2) conclusions from energy scenarios,
(3) or the documentation of energy scenarios.

(1) Scientific validity is the most important requirement for the preparation of energy scenarios. The authors emphasize that the choice and application of methods should be accepted within the scientific community. They should meet the standards of good scientific practice of the scientific community. In this regard, they refer to the DFG standards for good scientific practice.[180] Especially when building energy scenarios, the question of validity arises due to uncertainties from the specific models and parameters that are being used. One way to mitigate this problem is through the comparison of models by calculation or sensitivity analysis. However, these forms of validation are only applicable to model-based energy scenarios. The concern of scientific validity also arises in the context of future assumptions in qualitative energy scenarios, or rather in qualitative parts of scenario preparation. Certain factors and assumptions may also impede open results. Certain undesirable results may be ignored when assumptions and normative convictions collide. For this reason, the authors insist that it is important to know to what extent normative criteria have influenced the choice of key factors and assumptions, and which group was most influential – the customer, the head of the project or scenario developers. Besides criteria for transparent documentation, they propose evaluation procedures for peer-review energy scenarios which are used for scientific policy advice.

(2) Results and recommendations of energy scenario studies should also meet criteria of scientific validity by means of transparent methods and outcomes. However, documenting procedures is not sufficient. Arguments must be clear and comprehensible, too:

> A simple documentation of the procedure, e.g. by describing how a model served to calculate certain results, will therefore not suffice. Rather, the reasoning based on and resorting to this procedure will have to be explained comprehensibly as well. This is the precondition to enable third parties to challenge the argumentation. (acatech, ed. 2016: 14)

This is needed because of the competency in interpreting energy scenarios between scenario developers and the client, but also between scenario developers and the public. While scenario developers may be proficient in deriving future paths and recommenda-

[180] *Vorschläge zur Sicherung guter wissenschaftlicher Praxis (Proposals for Good Scientific Practice)* Deutsche Forschungsgemeinschaft (1998/2013) has been provided by DFG (Gemany's largest independent research funding organization) as a guideline for scientific practice, especially in research projects.

tions from different scenario paths – that is, in sense-making processes – customers of scenario studies may also want to be involved in such phases. This is acceptable in aligning outcomes to the aim of the task. Nevertheless, the authors stress that deriving results and recommendations in energy scenarios is challenging as the same models and assumptions may give rise to diverse yet equally plausible future scenarios. While the possibility of scenarios is substantiated by descriptions, recommendations are normative statements. Hence, in terms of scientific validity, the different trajectories must not only be well argued, but also documented in a transparent way, so that normative premises are traceable. In this way, other affected parties, including the public, may comprehend the outcomes better.

(3) The main requirement for documenting energy scenarios is transparency. The authors point out that transparency is needed at two places. First, results must be comprehensible for the customer, and second, results must be traceable and replicable for independent scientists (acatech, ed. 2015b: 15). Documentary material should be appropriate for the target audience, as energy studies, especially public studies, may address different stakeholders (acatech, ed. 2015b: 16). Thus, they suggest dividing documentation processes into two levels, an outer level addressing the public and the customer, and an inner level addressing scientists:

> The outermost layer of a typical energy scenario study addresses the public as well as the commissioning organisation: They should be able to comprehend the study . . . The inner layer of such a study addresses individuals wishing to trace and thoroughly comprehend the genesis of the results, including the methods. In the case of energy scenarios, this typically refers to researchers from the fields of energy systems analysis and energy economics. This target group should be able to replicate the results. (acatech, ed. 2016: 16–7).

Transparency needed for clients and the public can be provided, for example, by disclosing information sources and empirical data, and by explaining the choice of method and its application, as well as the resulting models. The authors also stress that, for non-scientific stakeholders, it is also useful to compare the results with other relevant scientific studies. On the inner level, the replicability of results relates to possibilities of reconstructing the process of modeling and the lines of argument. For this purpose, other scientists need information about the relevant specialist literature and technical annexes.

All three stages are linked with each other by the same requirements of scientific validity. A crucial point in this framework is that clients and practitioners or scenario developers should reach a common understanding on requirements for preparation, results and especially documentation before a study is conducted. In this context, the authors emphasize that all parties involved share different responsibilities for meeting the requirement of scientifically valid energy scenarios to be used in public: the customer (“Auftraggeber”), the practitioners (“Auftragnehmer”) and the democratic general public (“demokratische Öffentlichkeit”) as an indirect addressee of energy scenarios (acatech, ed. 2015b: 19). While customers and practitioners are bound to requirements in steps 1 to 3, the general public that is affected by decisions made in the energy sector and by energy policies may be involved indirectly through political parties, NGOs and mass media (acatech, ed. 2015b: 19).

Finally, the authors also discuss which steps have to be taken and which instruments should be developed in order to institutionalize a common practice of valid, transparent and open-ended scenario studies.

Here are some options for improving scientific validity and open-ended procedures:

a) Peer-review of results in scientific journals and other publications (e.g. methods or models)
b) Peer-review of studies in journals
c) Scientific advisory boards for a critical assessment of preparation and documentation of a study
d) Permanent peer-review board as an assessor of energy studies (comparable to IPCC)
e) Advancement of methods for systematic uncertainties and risk analysis
f) Integration and adaption of further existing methods and tools for systematic uncertainties and risk analysis

Options for improving transparency include the following:

a) Developing practical guidelines for an addressee-specific communication of energy scenarios
b) Developing procedures for integrating diverse stakeholder interests
c) Promoting the systemic understanding of the energy system in the society
d) Developing practical guidelines for transparency of models and data
e) Establishing a basic set of reference data and key factors for the German energy system

For each of the points, the authors offer examples from international or national projects that have already tested some of the options. The purpose of these options is to implement all of them in a framework of quality criteria and requirements for scientifically valid and transparent scenario studies in the German energy sector which is shared by scientists, policy and the public.

Discussion

The third example of enabling shared standards by quality criteria differs from the first two by its focus on a specific topic and a specific method. The criteria presented here are thus much more concrete.

As mentioned earlier, the requirements elaborated in this example are developed for scientific policy advice with energy scenarios. They have been developed in the context of the German project "Energiesysteme der Zukunft" (energy systems of the future), which aims at providing scientific support to the transformation of the energy systems at a national level. Formulating these requirements is only one of several tasks and working groups of the overall project. The first question that one may raise is whether it is appropriate to treat this example as a foresight case. Even though foresight is not mentioned explicitly in this position paper, the study is a useful example because it focuses on energy futures and scenarios.

The position paper on requirements presented here and other publications from the project indicate that this case may also be regarded as an example of a functioning socio-epistemic framework. By the way the study has been conceived, it fulfils Longino's demand for scientific objectivity.

a) The process of creating these quality criteria has been deliberative and interdisciplinary. Within the overall project "Energy Systems of the Future", the working group on scenarios is one of eight working groups. Other partial projects and working groups reflect Germany's energy transition regarding energy technologies, energy economy, social and legal aspects and even policy options for a European strategy (acatech, ed. 2015a). To establish the requirements presented in this position paper, participants of other working groups have been involved and draft versions have been discussed in two transdisciplinary workshops. These working groups included guest scientists and representatives from politics and media.[181]
b) The purpose of the position paper is to summarize discussions and points of agreements of the project group, and of other expert opinions from the field on requirements for scientifically valid energy scenarios, which may also serve as general standards or quality criteria. Thus an important claim made by Longino is fulfilled: to discuss and provide shared standards.
c) It is repeatedly emphasized in the paper that cooperation between the commissioning and implementing organizations is essential. Practical guidelines help to

[181] Draft versions of the position paper were discussed in two expert workshops on 4 July 2016 and 9 March 2015, which I have attended, too. See appendix of acatech (ed. 2016) where participating persons and institutions are listed.

prepare and communicate aim-oriented scenarios. In this way, "[b]inding quality assurance mechanisms are the key to improving scientific validity" (acatech, ed. 2016: 26). This addresses the socio-epistemic claim for shared standards to foster scientific objectivity.

d) The authors explicitly stress the need for community response and exchange within the energy field. This arises especially because knowledge retrieved in energy scenarios disappears once the studies are finished. To address this issue, the "Research Network Energy Systems Analysis" (acatech, ed. 2016: 12) has been established.
e) The established requirements build upon earlier studies which have been used in German research in the energy field, as well as studies and position papers for good scientific practice (see acatech, ed. 2016: 11). Similar to the first two cases, experience from previous studies in the field is being considered.
f) Another point which can be interpreted as socio-epistemically motivated is the emphasis of the distribution of responsibilities in the implementation process among commissioning organizations, implementing organizations and the public (acatech, ed. 2016: 19–20). The emphasis of the role of the "democratic public" recalls Kitcher's idea of "well-ordered science" (Kitcher 2011).

Similar to the previous two cases, in this position paper explicit reference to objectivity and values is avoided, though both issues appear in the requirements. The requirement for unbiasedness[182] is strongly affected by values. This refers to the application of methods, but also when results are summed up:

> **Unbiasedness** implies that measures by which the commissioning institutions or other stakeholders influence the study are only permissible if they are openly communicated along with their possible effects on the results and conclusions (acatech, ed. 2016: 5–6)
> Incidentally, the implementing institutions are under an equal obligation to ensure that the results are not distorted on their end, for instance by taking precautions to avoid personal biases influencing the study without this being openly communicated. (acatech, ed. 2016: 12)

The mentioned "precautions" may include, for example, criteria for communication. From an epistemic view, these two passages indicate the need to identify which social

[182] Note that the claim for "unbiasedness" is controversial. The original German claim "Ergebnissoffenheit" does not imply the use or absence of values. In a rather open manner, it refers to unbiased as well unprejudiced results. Hence, the word per se already encompasses the definition given in the study: openness regarding modelling as well as judgments. So, it refers to processes where data, information and results are replicable as well as to processes where human judgments are needed, that is, to value-laden processes. Admittedly, in comparison to "unbiased", "openness towards results" is rather a stilted translation. But it takes account of the different forms of objectivity which encompass a reasonable use of values instead of implying the absence of values.

and ethical values are accepted in the process, that is, which kind of values are in accordance with the overall aim of the energy scenario study. This is also indicated with the notion of increasing transparency:

> Transparency is pivotal in this instance, as the choice of assumptions and the determination of target values narrows the number of calculations down to only a few of many possible scenarios. (acatech, ed. 2016: 6)

Social and ethical values may enter the process at different levels, as judgments are needed throughout the whole project. Requirements for energy scenarios show that values have a major impact on normative criteria, which may become part of the project aims and which also shape decision-making processes:

> Such normative criteria have, indeed, been defined, for example by the German Advisory Council on Global Change: In a study published in 2003, the Council established a number of normative guiding principles for a sustainable energy transition. They recommend, for example, that only scenarios be accepted in which poor households would have to spend no more than ten per cent of their income to cover their basic individual energy demand. (acatech, ed. 2016: 13)

It is also emphasized that normative implications need to be communicated throughout the process (acatech, ed. 2016: 13). The "normative criterion" may also be expressed by the social values of justice and social stability. Hence, once transferred to the socio-epistemic framework, the notion of the impact on normative influences could be resolved with a clear definition of acceptable and unacceptable social and ethical values. Nevertheless, the issue of social and ethical values is not discussed in greater detail. The social and ethical values listed in chapter 7 may be useful in discussing possible normative influences in scenario preparations.

The three basic requirements of scientific validity, transparency and unbiasedness may be seen as cognitive values that subsume scientific processes. For each of these requirements, options and means are given that might be adapted to fulfil the requirements.

8.4 Concluding comparison

As the three cases show, the relations between knowledge acquisition and aggregation, aim setting, and the parties involved are decisive. A further focus consists in making use of the results. Sense-making processes, communication and documentation are crucial criteria in all three cases. In each case, the criteria correspond to the following four points:

- Clear definition of aims
- Clear definition of the methodological approach
- Sense making and communication throughout the processes
- Documentation and communication of results

In the first example, there is a strong focus on quality criteria for sense making. This aspect is also addressed in the third case, in the section “Requirements for conclusions from energy scenarios”. Specific requirements and quality criteria for sense making are also useful in fostering credibility.

Still unsatisfactory is the vagueness of the concepts. The structure for describing futures-looking activities is basically the same: What Kuusi et al. (2015a) call “planning” and “mapping” is called “planning” and “futuring” in KAM. While the former emphasize validating sense-making processes, the latter emphasize the role of networking at different stages. Fuzzy use of futures terminology also poses a challenge for quality criteria formulation. The quality criteria suggested in this first case are not applied to foresight per se but to futures research in general. However, the definition of futures research provided in this case meets the socio-epistemic demands, for example, concerning knowledge claims. The authors offer the following definition of futures research (which appeared in chapter 2 of the present work):

> We reserve the concept futures research for those futures studies that are looking for pragmatically valid knowledge concerning possible futures. Validity means that this knowledge is based on facts, assumptions and reasons (including methodological approaches) that can be justified in discussions with other people, i. e. supported by well-founded argumentation. (Kuusi et al. 2015a: 61)

The authors also emphasize that the terms ‘futures studies’, ‘foresight’ and ‘futures research’ have no precise definitions. The starting point of their discussion of quality criteria addresses different challenges within the futures field, including the vagueness of its central concepts:

> The lack of common understanding about the quality of futures studies is connected to the lack of a coherent conceptual frame of the field that is vaguely defined by the concepts of ‘futures studies’, ‘Foresight’ and ‘futures research’. (Kuusi et al. 2015a: 61)

None of the examples is explicitly named ‘foresight quality criteria’. Clearly, the practical use of quality standards arises when they are embedded in a clear thematic environment. The third case shows that focusing on the German energy sector makes it possible to formulate topic-specific requirements and set up concrete community exchange platforms like “Research Network Energy Systems Analysis” (acatech, ed. 2016: 14). The first two cases offer many fruitful insights concerning how to foster networking and sense making in foresight activities. These are important issues that may further scientific objectivity in futures research, and should therefore be considered in different forms on the scientific reflection base.

Another still unresolved issue is that the conflicting conceptions of validity and scientific objectivity, which the different parties bring to the discussion, may collide. This is the case not only in projects, but also when establishing requirements, quality criteria, and shared standards. The main contribution of the socio-epistemic framework is to expose the different forms of objectivity and different values involved in futures thinking, and to develop the relation between the practice level and the scientific reflection base. Quality criteria may profit from the detailed analysis of the forms of objectivity and the different kinds of values that shape science.

9. Conclusion

In chapter 2, I described the historical changes in the perception of the future from a determined state to a field of progress and perfectibility and active planning. The future as a state of perfectibility, as it is seen through the concepts of progress in universal history, is rather a meta-analysis of the environment and therefore detached from future planning of every kind. Yet it marks the starting point for setting the arts and sciences in context for future research. The insight that research is a process that continues over generations, paired with its success in improving material and physical well-being through progress, enforces the blind belief in future perfectibility. But the enlightened belief in "linear and continuous amelioration of the human condition" (Wright 1997: 12) is a fallacy. The idea of progress and its achievements require a future thinking that can consider society, technology and economy and that is robust enough to accommodate progress. In the 20th century, this claim referred to progress with regard to growth, whereas today there is a need for robust, consistent and desirable scenarios to assist in decision making.

Chapters 2 to 6 attempted to show that there are parallels in the way we look into the future, as it is shaped by scientific and technological progress. Strong belief in scientific and technological progress is also reflected in philosophy of science, where the rule of falsification and the value-free ideal have long been dominant. By contrast, the emergence of holistic approaches meant setting scientific methods in the context of theory change and paradigm shifts. However, as I suggested in reference to Feyerabend's *Against method*, holistic approaches have also been used to defend relativist positions. Chapter 4 shows that the field of scientific methods is complex and partly contradictory. It has always been accompanied by scientific revolutions (Dascal and Boantza 2011), and in the 1990s even by profound disputes on scientific method and practice, resulting in the Science Wars (Sokal and Bricmont 1998), but also the rejection of the value-ideal (Douglas 2009).

Social epistemology assesses scientific methods and practice with a view to their usefulness for science and society, and claims that scientific knowledge is ultimately social knowledge. Contemporary philosophy of science has recognized the impact of values and different objectivity levels in science. In fields that have an impact on the future, such as climate engineering, robotics etc. the role of ethics, uncertainties and risk has been recognized, too. Each field that relies upon future assumptions and producing future-related recommendations should also be aware of the role of experts and authorities. Their judgments, which are highly influential in policy making and futures research, may be affected by values which are not acceptable in science. In contemporary philosophy of science, besides the structural issues on values and objectivity and scientific criticism that I have used as a point of reference for questioning the epistemic base of foresight, the argument-based inquiry of scientific results is gaining awareness (Hansson and Hirsch Hadorn 2016).

Yet the whole field of futures studies and foresight is driven by practice rather than by theory. Futures research underwent a paradigm shift from single to multiple futures, and to using more qualitative methods rather than relying on supposed accurate forecasting and planning, especially as a result of methodological failures in coping with the future. Ever since the inception of futures studies, practitioners have used their respective scientific background to draft theoretical accounts, emphasizing the social sciences or diverse interdisciplinary approaches. Relativist and constructivist theories have also contributed ontological clarifications of the distinct form of knowledge that belongs to futures studies. There is general agreement that alternative futures are not to be proven or falsified by further research; rather, they are images and narratives about the future that are created today, based on contemporary scientific knowledge and information, and translated into actions to solve future problems that we are now anticipating.

The fact that there are so many scientific methods to be considered opens up new paths for reflecting upon validation: knowledge acquisition in foresight that is regarded on a meta-level can provide new insights into the validation of foresight. The scientific character of foresight cannot be accounted for by progress or the aim to find truth, but rather as a discourse guided by scientific knowledge. Instead of trying to dissect the field of foresight and its methods into the different accounts of science – for example, by distinguishing between the epistemic foundations of qualitative and quantitative methods – I have tried to show that it is more fruitful to follow a comprehensive approach to epistemology: a socio-epistemic approach that builds upon scientific realism, yet also recognizes the impact of society on science.

From a socio-epistemic perspective, within the wider context of futures thinking as it has been practiced since the 1960s and with respect to the scientific community that has emerged around futures thinking, foresight may be defined as a field that deals with social knowledge. All structures needed for objectivity by scientific criticism are already available: recognized avenues for criticism, shared standards, community response, and equality of intellectual authority (see section 6.4.1). However, these venues for criticism have not all been established to the same degree, especially with regard to shared standards. Douglas's approach to objectivity has also shown that it is possible to follow the rule of interactive objectivity in foresight. The summary of the different forms of objectivity and the outline of paradigm shifts has shown how the commitment to a specific account of science may lead to misunderstandings and misinterpretations of scientific methods when people from different backgrounds meet in interdisciplinary work. This is reflected by the different approaches to foresight and futures theory (see chapter 5). In chapter 7 I argued that such misunderstandings can be overcome when it is made clear that interactive objectivity is the only viable path for foresight.

I have described the concept of a socio-epistemic framework principally with abstract concepts and argued that certain epistemic tasks have to be discussed or elaborated on the scientific reflection base. These tasks show that the socio-epistemic concept presented here can serve as a guideline for conducting valid foresight processes and for advancing the field, its methods and evaluation procedures in a way that is epistemically grounded, and hence scientific – at least from a socio-epistemic perspective. So the aim of this work has been to provide, within a socio-epistemic context, a conceptual framework of foresight as a scientific discipline that may serve as an epistemic baseline. With respect to the various functions of foresight, its different methodological schools, the numerous institutions and companies applying foresight, it is not possible to claim that this framework encompasses everything that may be called "foresight". Accordingly, it has not been my intention to examine in detail a methodological or theoretical approach to foresight that is "unscientific" and thus does not fit into this framework.

The socio-epistemic approach shows that it is impossible to formulate a general scientific foundation or set of rules for a scientific discipline from a sketchbook. Science as social knowledge needs the discourse between practice and theory. Values can enter scientific processes at any time, while new insights from scientific practice shape key theoretical assumptions and may lead to paradigm shifts. Every theoretical framework needs to be appropriated by the scientific community – that is, adapted, modified, validated and ultimately accepted or rejected. For example, the impossibility theorem reveals the epistemic problems of group knowledge; the socio-epistemic work of List and Pettit (2002, 2004) provides different solutions to validating the consistency of propositions about the future derived in groups. Their work may serve as a point of reference for further research in the social epistemology of foresight to determine whether institutions conducting futures research are actually contributing to the futures field with new group knowledge – in advances to the methodology or in epistemic or ontological questions – or if they are merely coordinating group rationality.

Yet in spite of its strengths, the proposed framework also faces numerous challenges. For example, it is possible that the specific, non-verifiable forms of knowledge produced in foresight are better accounted for on the basis of constructivism and not, following social epistemology, on the basis of scientific realism. Constructivist approaches have the disadvantage, however, of not being able to validate scientific practice as comprehensively as socio-epistemic approaches do. The latter manage to bridge theory and practice and provide rules for objectivity, values and criticism. Hence, we have to acknowledge that the use of a socio-epistemic foresight framework primarily serves to validate scientific practice in foresight, even though the aims and purposes of foresight do not correspond with the aims of classical epistemology. Since foresight's main aim is not to find knowledge or contribute to scientific progress but instead to fulfil future-oriented needs of a target group, it is a challenging task to formulate universal quality criteria for foresight practice. This is reflected in the different cases of quality criteria in chapter 8, which address specific topics and methods and different levels of abstraction. While the various quality criteria make the field appear initially unstructured and fuzzy, they are unavoidable from a socio-epistemic point of view. Quality criteria that may be useful for foresight practice and criticism need to be oriented towards certain target groups (like the EU) or methods and topics (like the energy scenario case), and they need to adapt to the socio-epistemic baselines to consider different forms of values and ways of reaching interactive objectivity.

The examples of quality criteria, which may be seen as a specific form of shared standards, also show that there are theoretical issues that need to be discussed further by the foresight community. This applies, for example, to the impact of values on foresight. Further research is also needed concerning the differences between group knowledge and group rationality.

Scientific reflection alone is useless without practical applicability. The aim of this work has thus been to describe how foresight may be considered scientific in light of contemporary philosophy of science, and to provide a framework with epistemic issues that have to be met. To be applicable to foresight as scientific practice, this framework should be used differently: institutions claiming that they apply foresight in a scientific manner should fulfil at least socio-epistemic requirements of objectivity and value claims, and they should be involved in scientific criticism by the four venues. In this context, this framework may be used to discuss new potentially useful methodological and technological advances.

The socio-epistemic criteria provide access to new tools and methods that can be integrated into a foresight process. They serve as a starting point in determining whether a certain tool can provide futures knowledge. In this case, the search for new tools is turned around: first, we look for new tools and methods of social knowledge acquisition; then, the socio-epistemic criteria are evaluated in order to determine whether the new tools and methods fulfil the basic requirements of social knowledge. If these socio-epistemic requirements are fulfilled, we can evaluate how the tool contributes to foresight in general. For example, in a recent paper, Saritas et al. (2014) revealed the misbalance of methods used in foresight. They claim that, in foresight, more qualitative than quantitative methods are used. However, there are also new methodological developments which aim at overcoming that deficiency by making use of new data-analyzing tools. Kayser (2016), for example, tests various ways of implementing text mining and Twitter in foresight processes, for instance, in scenarios or road-mapping.[183] Bas and Guillo (2015) and Guillo (2013) also give examples of how to enrich participatory foresight with social media,[184] and Dator et al. (2013) connect foresight to a gaming platform for generating alternative futures. By contrast, Davies and Sarpong (2013) suggest that new tools and sources in foresight are not inevitably technological in kind, as they describe how arts can contribute to foresight theory and practice. The usability and validity of these new approaches should be discussed within the foresight community.

The "people factor" is another important issue in foresight which calls for further research. This is the recognition that accounts of science are not separable from the people conducting scientific projects and applying the scientific method. This claim has been made not merely in social epistemology, but throughout the history of foresight since the middle of the past century: Hempel and Rescher have contributed not only to philosophy of science, but also to the early forecasting organizations. Today, people conducting foresight exercises work together in consortia. Schools evolved from forecasting to foresight. The same people who organize projects also evaluate and reflect upon the theoretical foundation of the field. Bradfield (2008), for example, has examined the cognitive barriers and biases in scenario development. Further research is needed on the relation between such insights from cognitive psychology and the socio-epistemic framework.

Finally, one should keep in mind that for the purpose of decision making, it is not necessary that foresight methods be scientific. In other words, in contexts where foresight is used for personal interests or small businesses and organizations – that is, in cases where the impact of future-oriented decisions is limited to single persons or small groups – the epistemic and ontological questions concerning the scientific foundation of foresight are not relevant. This is reflected by the broad range of trend analysis consultants and trend literature. Validity in foresight emerges from the need for a robust, reliable and credible science, which may serve as the foundation for decision making in policy contexts. This is also a reflected by the growing impact of RRI. In these contexts it is important that decision making and foresight be based on sound scientific practice. Numerous scholars have discussed the need for scientific practice to be based on social knowledge rules that are reflected upon by the scientific community. Kitcher (2001, 2011) proposes a value-sensitive approach to science in democratic societies, based on modest realism, while Douglas (2011) and Longino (1990, 2002) provide points of reference for scientific criticism and examples of science as social knowledge. Despite the

[183] See, for example, Kayser and Bierwisch (2016) for the use of twitter in foresight, or Kayser and Shala (2016) for the use of text mining in scenario development.

[184] See also Keller and Gracht (2014), who analyze the potential of different ICT for foresight practice.

many theoretical and definitional deficiencies, the results of this work lend support to the idea that foresight and futures research is an exemplary field for showing that science is ultimately a social endeavor.

Glossary: frequently used foresight methods

Delphi study, delphi method

The delphi method, developed in the 1950s at RAND, is based upon structural surveys for exploring complex topics to prioritize goals and reach consensus upon possible future developments (Helmer 1983; Ono and Wedemeyer 1994). Domain experts having knowledge and experience in the questioned field serve as an information source. Enzer (1971) defines: "The Delphi process can be viewed as a series of controlled conferences. . . . Individual contributions are requested from each participant simultaneously at each step, without knowledge of the inputs being submitted by the others for that step. Anonymity of the inputs (and, if possible, also of the participants) is maintained throughout the entire conference." Being based on expert knowledge, delphis can contain exploratory, predictive or normative elements likewise (FOR-LEARN 2005-2007). They are applied to different application fields such as healthcare, tourism, marketing and education (Ono and Wedemeyer 1994). (see also Helmer-Hirschberg 1966; Coates 1975; Bardecki 1984).

Expert and stakeholder panels

Expert panels are frequently used in Foresight; they can be conducted by using brainstorming, SWOT analyses, delphis and scenarios. Similarly to the delphi method, expert panels are used to elicit expert knowledge (FOR-LEARN 2005-2007). They are also used to synthesize the information gathered, reach new insights on certain future visions, create networks, diffuse the foresight process or to inform foresight teams for follow-up actions. A classical expert panel consists of "12-20 individuals who are given 3-18 months to deliberate upon the future of a given topic area, whether it be a technology (e.g. nanotechnology), an application area (e.g. health), or an economic sector (e.g. pharmaceuticals)" (FOR-LEARN 2005-2007).

Future(s) workshops

Future(s) workshops are a participatory futures practice introduced by Jungk to futures studies in the early 1960s (Bell 2003). Futures workshops involve 15-25 participants and can be applied to various issues (Bell 2003). A futures workshop basically consists of three phases: the critique phase where participants express knowledge, opinions or even emotions concerning the subject matter, the fantasy phase which is a brainstorming-oriented discussion collecting innovative and creative thoughts, solutions and alternative futures, and the implementation phase to create specific strategies and recommendations for a desired future (Jungk and Müllert 1996).

Gaming

Gaming can be used as a foresight method as it may offer simulations or models of a real life environment. Different types of models can be used to simulate realities: a) verbal models (e.g. scenarios), b) analytic or mathematical models, c) diagrammatic or pictoral models (e.g. maps and flow charts) d) analog models (e.g. testing in wind tunnels) or e) digital models like computer simulations (Bell 2003). Generally, Shubik (1975) lists six goals of gaming which are also useful in foresight contexts: teaching, training, operational gaming, experimentation or research, entertainment, and therapy and diagnosis. (see also Dator et al. 2013; Schwarz 2013).

Roadmapping, technology roadmapping

Roadmaps have a normative character and are used to show details of future developments. They provide an extended view of the desired future path building upon knowledge about chosen key factors and drivers of change of the subject matter. Most common are S&T roadmaps, (industry) technology roadmaps, corporate or product-technology roadmaps and product/portfolio management roadmaps (see Kostoff and Schaller 2001: 134). Technology Roadmaps "generally comprise multi-layered time-based charts that enable technology developments to be aligned with market trends and drivers" (UNIDO 2012: 129).

Scenario method, scenario techniques

Scenarios are stories which illustrate alternative visions of possible and plausible futures. The method reflects the foresight principle of creating alternative futures. Scenarios can be used in different ways: for exploratory tasks, as a tool for decision-making, and as a strategic planning tool. They are mainly used "to highlight the discontinuities from the present and to reveal the choices available and their potential consequences" (FOR-LEARN 2005-2007). For developping scenarios, alternative future projections of a set of key factors are combined to plausible stories. In the foresight community "the terms *planning, thinking, forecasting, analysis* and *learning* are commonly attached to the word scenario." (Bradfield et al. 2005) Scenarios have been introduced by Kahn in the 1960s (Kahn and Wiener 1967/1967). Since then, various institutions have developed different scenario planning techniques, see (Enzer 1980a, 1980b; Davis et al. 2007; Weimer-Jehle 2009; van der Heijden 1996; Ringland 2006). Scenario planning is often combined with SWOT, environmental scanning or roadmapping. For an overview see Kosow and Gaßner (2008) and Glenn and The Futures Group International (2009).

Simulations and models

Computerized mathematical models and simulations used in foresight aim at imitating the effects and behavior of a real-world process or system over time. They can provide insights into the operation of a system, be used to develop "operating or resource policies to improve system performance", test concepts and systems before implementation and for "obtaining information without disturbing the actual system" (FOR-LEARN 2005-2007). Bell lists four different schools of computer simulation and modeling which are relevant for futures studies: input-output analysis, econometrics, optimization, and system dynamics which “are applied to relatively long-term time horizons and more” (Bell 2003) (see also Meadows and Robinson 2002).

Supporting Tools and Methods

In foresight different analytic and creative methods are used to structure the field and to reduce complexity. They are not specific foresight methods but rather used as supporting tools for setting the aims of a foresight task, in the analysis phase for example in context of scenario planning or roadmapping, or in other methodology mixes in a foresight exercise.

Bibliometrics

Bibliometrics is a method used for assessing the impact of a certain topic by analyzing text and information. Bibliometric analyses show the impact of a field or topic by the impact of certain researchers, papers and publications. They also indicate the scientific publication performance of institutions, the integration into the scientific landscape and the international visibility of research results. (see Ball and Tunger 2005; Daim et al. 2006)

Brainstorming

Brainstorming is not a foresight method per se but rather a tool for promoting unfiltered group thinking, especially in early foresight phases. The principle of brainstorming is that “the quantity of ideas increases their quality.” (FOR-LEARN 2005-2007) Brainstorming exercises usually start with the collection of all ideas related to the topic that are present in the group. Subsequently, ideas are grouped and related points are brought together, and finally the ideas are prioritized jointly.

Cross-Impact Analysis

Gordon who has introduced the method together with Helmer in 1966, defines: “The cross-impact method is an analytical approach to the probabilities of an item in a forecasted set. Its probabilities can be adjusted in view of judgments concerning potential interactions among the forecasted items. . . . This interrelationship between events and developments is called “cross-impact” (1994/2009). Since the 1970s various other forms of Cross-Impact Analyses have been developped and are used e.g. in combination with scenario techniques and delphi (Enzer 1971; Dalkey 1971; see Weimer-Jehle 2009; Bell 2003).

Environmental Scanning

Environmental Scanning is not a stand-alone foresight method but rather used as an supporting activity, especially at the beginning of a foresight exercise. It reflects STEEPV issues and is used for summarizing current knowledge, detecting ‘weak signals’ or for providing early warning about important future changes. It is often conducted using bibliometrics, patent analyis, literature analysis, and more recently text mining (see Nanus 1982; Slaughter 1999).

Multi-Criteria Analyses (MCA)

Multi-critera analysis is used to compare different technologies or actions based on a variety of (environmental) criteria; actions are evaluated by means of a weighted average (FOR-LEARN 2005-2007). MCA is not a foresight-specific method; it is often used in combination with other scanning methods and increasingly in participatory processes, too (Janssen 2001; Salo et al. 2003; Paneque Salgado et al. 2009).

Patent Analyses

Patent analyses, also patent trend analyses, are used similarly to bibliometrics. Campbell (1983: 137) describes their use as follows: “Patent trend analysis is a management forecasting tool that can be useful in (1) acquisitions and divestitures, (2) R&D planning and (3) new product development. Patent analysis can indicate the growth pattern of a technology (emerging, maturing or declining) and the technological shifts that are occurring. It can also indicate which firms are about to enter or leave a technology, the age and type of each firm's technological base, and the relative technological strengths of the firms.” Nowadays it is also conducted using text mining. (See also Daim et al. 2006; Tseng et al. 2007; Lee et al. 2009).

SWOT

SWOT (strengths, weaknesses, opportunities, threats) is an analytical tool used for example in strategic management planning processes, but also in foresight, for categorizing significant crucial environmental factors both internal (strengths and weaknesses) and external (opportunities and threats), i.e. to the organization, region or technology (Pickton and Wright 1998; Nazarko et al. 2017).

Trend Intra- & Extrapolations

Trend extrapolations locate an apparent trend and “project it forward based on data concerning the rates of change and the extent of change achieved” (FOR-LEARN 2005-2007). FOR-LEARN describes further: “In shorter-term forecasts this is often a matter of extending a linear or exponential curve (e.g. economic growth, power or diffusion of a technology). In the longer-term, limits to growth will often be encountered – there may be a limit to the size of the population to which a technology or cultural practice can diffuse for example, and various other types of trend curve may be fitted to the data (for example, the well-known s-shaped logistic curve).”

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