Armin Grunwald

Technology assessment – between sociological systems theory and philosophical ethics

1. Technology management, technology assessment, and technology ethics

The development of technology was rarely if ever perceived as a social problem as long as new technology seemed to show mainly economic or practical advantages in a progress-optimistic attitude. Although undesirable consequences were sometimes obvious, e.g., in the working world of the 19th century, they did not lead to a broad social or scientific discussion about the justification conditions for technical action. It was only when the identification of the new with the good (or at least the better) was widely denounced in the wake of the awareness of the "limits to growth"[1] and ecological dangers, including apocalyptic scenarios, i.e., with the end of optimism about progress, that questions about the design of technical change became the focus of public, and later also scientific, discussions. The concept of "technology control," the attempt to steer technical developments in the direction of what society wanted ("control optimism"), emerged. However, initially optimistic expectations, for example, in the "finalization debate" in the 1970s, that undesirable developments and technological consequences could be completely or at least partially avoided through state control, informed and advised by technology assessment (TA), turned out to be irredeemable. Thus, the history of TA itself can be interpreted as a tentative experimentation and constant learning process, in which each new approach claims to avoid certain shortcomings of the previous approaches, but in doing so raises new questions and produces other shortcomings (for an overview, see Gethmann/Grunwald 1996).

In terms of technology design, control optimism represents a late form of the general planning euphoria that characterized the 1960s and 1970s (Grunwald 2000). In satirical exaggeration: "as a universal remedy [...] for mastering the future, [...] for the formation of a (planned) new human being in a planned

1 *Editors' note*: "Limits to growth" here refers to the well-known publication by Meadows, D. et al. (1972): *The Limits to Growth; A Report for the Club of Rome's Project on the Predicament of Mankind*. In the decades that followed, the issues raised in the report and its findings attracted considerable public interest regarding global environmental issues.

planning paradise" (Schelsky 1966, p. 160ff.). Behind the planning euphoria is the image of a central planning and planning-executing authority within society, embodied by the state. An important tool for this society-wide control is empirical social science research, which should provide the necessary knowledge in the form of impact research, technology impact research or technology genesis research in order to be able to control in a targeted manner. When TA is assigned the task of "systematically recording and evaluating the overall context of technological and social change as a complex system of mutually dependent causes and effects" (Deutscher Bundestag 1987), this is essentially based on trust in empirical social sciences, which, following the example of the natural sciences, promised to provide complete legal knowledge about society (criticism of this can be found, for example, in Grunwald/Lingner 1999).

Sociological systems theory (Luhmann 1984, 1990a, 1997), on the other hand, has rejected planning optimism for reasons of principle. The functional differentiation of society into autopoietic subsystems (science, economy, law, etc.), each of which operates *autonomously* on the basis of its own guiding distinction (true/false, pay/not pay, right/wrong, etc.), leaves no room for a central social authority. In particular, the state cannot assume this role because the political system is also only a social subsystem that processes its own key distinction and cannot dominate the other systems. This system-theoretical diagnosis of modernity has massive consequences for the relationship between ethics and the practice of technology design, at least from the point of view of its advocates (Luhmann 1990b; Bechmann 1993).

Philosophical ethics reacted relatively late to the challenges of modern technology with its own initiatives and concepts. It took the "principle of responsibility" (Jonas 1979) as an initial spark to trigger a broad ethical discussion of technology. Since around the beginning of the 1980s, there has been a veritable boom, which is reflected in a large number of publications, conferences and case studies, the founding of new institutions, the establishment of ethics commissions on a wide range of topics and, last but not least, a differentiation of technology ethics according to technology areas and concepts (Grunwald 1998). The frequently used addition "*new* ethics" marks the pressure of expectation on technology ethics in a particularly accentuated way.

Interestingly, the two reflective strands of discussion surrounding the problem areas of technology development, technology design and technology consequences – technology ethics and TA – have remained largely separate, seemingly

even in partial ignorance of each other.[2] While the social science view of TA has found its place primarily in TA institutions in the intermediate area between science and politics, the area of the ethics of technology has tended to remain the more remote area of university discourse. In addition to its – quite understandable – rejection of planning optimism, systems theory has now declared ethics to be largely obsolete for technology issues (Luhmann 1990b; Bechmann 1993; cf. Stegmaier 1998). In turn, philosophical ethics has accused systems theory of failing in normative questions (DLR 1993; Gethmann 1994). This article is dedicated to explicating this dispute, the reasons for the conceptual tension between systems theory and ethics, and its significance for an assessment of the possibilities and limits of TA.

In the following, this will be done on the basis of various key questions related to the control problem. It is assumed as undisputed that there are problems with undesirable and unintended consequences of technology and technologization, that at least in some areas there is a lack of orientation or even helplessness in society about how to proceed, and that there is a need for concepts to deal with this situation. Furthermore, it is assumed that the current technology policy practice is in fact constantly being steered, e.g., through research funding, by promoting technology transfer or through regulations (think of the steering mechanisms that led to the widespread introduction of first lead-free gasoline and then the regulated catalytic converter). However, if steering is actually taking place, then it is undoubtedly a legitimate task to develop and test theoretical concepts for improving and safeguarding this actual steering practice, *without* having to succumb to any kind of steering optimism.

In principle, however, what Luhmann said about ethics also applies to other TA concepts in this area: "In any case, political need alone is not enough, nor is the good will of those who strive for it" (Luhmann 1990, p. 42). Instead, in a selection situation – and the competition between different scientific concepts for dealing with a problem also represents a selection situation – an appropriate

2 An example from the field of medical technology: A monitoring report by the Office of Technology Assessment of the German Bundestag (Petermann/Sauter 1996) complains that TA studies in this area are economistic and technicistic and neglect legal and ethical concerns. In addition to the "actual" TA on these issues – to which the accusation may apply – there is, however, an extensive international discussion on medical ethics, which seems to be completely ignored in the TA context. A sectoralization of the discussion can be observed here, which runs counter to the purposes of *comprehensive* assessment necessities of modern technology and urgently needs to be overcome.

or optimal concept must be selected rationally from a means-ends perspective. Successful management in this sense requires:

- *Diagnostic* knowledge about the situation in which steering measures are to be implemented in order to achieve something (situational knowledge) and the subject area of steering (the "what" of steering),
- *Instrumental* knowledge of means-ends relationships, regularities, processes, laws: the "how" of controlling (means-ends knowledge),
- *Orienting* knowledge about the purposes of steering, metaphorically speaking, about the direction in which steering is to take place: the "where" of steering (orientation knowledge).

Even this small, differentiating consideration makes it clear that neither normative considerations alone can be used in technology design – they would lead to a "normativist" fallacy by dispensing with an empirical basis – nor that instrumental and diagnostic knowledge alone can be sufficient – this would entail a descriptivist fallacy and a lack of direction in steering. The obvious thesis is therefore that we should not speak of a relationship of confrontation between normative ethics and descriptive systems theory, but rather, at least in certain respects, of a *relationship of complementarity*.

In order to develop this thesis, the mutually raised and sometimes serious objections must first be questioned with regard to their tenability and presuppositions (Part 2), so as not to produce superficial gestures of reconciliation prematurely. The result is that the suspicion of the irrelevance of systems theory to ethics can be constructively rejected by demonstrating its practical relevance; however, the systems-theoretical diagnosis of modernity has consequences for the practical relevance of technology ethics (Part 3). It can be seen that in modernity, not only the *setting* of limits to technological development is placed at the disposal of society; society must not only decide *which* limits it wants to set, but *whether* it wants to do so at all. In this way, the discussion between ethics and systems theory leads to the constitutive features of modern society's self-description and self-understanding.

2. Systems theory or ethics for technology design?

In the following, the main arguments of systems theory and ethics against the other side are listed and briefly assessed or rejected in their relevant aspects (cf. Grunwald 1999).

2.1 The suspicion of irrelevance in systems theory vis-à-vis ethics

Sociological systems theory has raised a number of objections to ethics, which lead to the conclusion that in the modern age ethics can only be applied to direct face-to-face communication, but not to socially relevant control problems (see Luhmann 1990b; Bechmann 1993). In the following, the essential aspects for the context of technology control are highlighted: (1) ethics, unlike morality in traditional societies, can no longer have a socially integrating effect in modernity, (2) ethics is in need of justification due to social plurality, (3) ethics suffers from the loss of its object because the consequences of technology are unpredictable, and (4) ethics has lost its addressee due to functional differentiation.

(1) Ethics and the integration of society

Traditional societies are essentially held together by moral concepts that are binding for everyone. This mechanism of social integration is no longer available in a functionally differentiated and pluralistic society. Luhmann now accuses ethics of being unable to fulfill its supposed claim of being able to integrate society by establishing universally valid norms. Max Weber already warned against making ultimate principles binding for everyone; it is precisely these that should remain controversial. Luhmann's concern is that moral communication, by correlating with the self-esteem of those involved, is always close to conflict and violence: The moralization of conflicts does not promote understanding, but rather hardening fundamentalization.[3]

An answer presupposes the explication of the underlying understanding of ethics. Ethics is understood as the theory of reflection on the "right" morality (cf., e.g., Luhmann 1990b; Gethmann 1994): Morals are factually action-guiding maxims and rules of an individual, a group or society. Ethics, on the other hand, is concerned with the justification of rules of action that can claim validity beyond the scope of merely particular morals. In particular, ethics serves the understanding-oriented management of conflicts arising from the actions of actors on the basis of different moral concepts. If moral concepts are direct guidelines

3 Some current technological conflicts (Castor transports, genetic engineering) quickly show that this thesis is anything but implausible.
Editors' note: The transport of Castor containers was politically controversial in Germany in the 1980s and 1990s and became a symbol of social conflict in the field of nuclear energy. The Castor containers were transported on special wagons for nuclear freight from the Grafenrheinfeld nuclear power plant to the La Hague reprocessing plant in France. These transports were regularly accompanied by massive protests.

for action and decision-making, ethics should provide additional guidance *in the event of conflict*. Morals have *factual validity*, but only ethical reflection can generate *legitimacy* in the sense of *normative validity*.

In the sense of this description, it is not clear that ethics should be burdened with the integration of society. Conflict resolution in individual cases may contribute to the integration of society. However, to derive from this the demand that ethics should assume the former function of binding morals in order to then argue that this demand cannot be met is not tenable. It is clear that Luhmann says ethics, but ultimately only means a special variant, namely the Habermasian or Apelian variant of discourse ethics with its intentions of ultimate justification and strong claims to universalization. Ethics understood pragmatically in the above sense is therefore not subject to the above accusation (Stegmaier 1998).

(2) Ethics, technological conflicts, and pluralism

The above-mentioned definition of ethics as a discipline of reflection on factual morals is only meaningful in matters of technologization if decisions in technology discussions are *subject to moral conflicts*. Insofar as technical design processes are carried out exclusively from a cost-benefit perspective and these criteria are accepted by those involved, technology design is carried out under purely economic, business or macroeconomic aspects. Without conflicts over moral issues, there is no need for ethics: Technology conflicts with their moral implications form the thematic center of ethics in technology design. They are not only conflicts about technical means, but also or even primarily conflicts about ideas of the future, about images of man and concepts of society. Discussions and controversies about new technology quickly become surrounded by the questions of what kind of society we *want to* live in, what images of humanity we assume and whether or under what conditions this in turn is desirable. Conflicts over technology are therefore always also ethically relevant political conflicts (Grunwald 1999).[4]

This emphasis on the existence of conflicts for the practical relevance of ethics makes it clear that moral pluralism does not speak *against* the possibility of ethics, as claimed by systems theory (Beck 1986; Luhmann 1990b; Bechmann 1993), but is in fact its precondition: If morality were binding, there would be

4 One thinks here of "data protection" or "safeguarding intellectual property" in the information society, of "residual risk" and "worst-case scenario" in the nuclear energy debate or of new biological or medical techniques in reproductive medicine, human genetics or the neurosciences (right up to the current debate on human cloning).

no need for a discipline of reflection on conflicting morals. The task of ethics is therefore a *constructive* one: Namely, to develop and offer possible solutions to technological conflicts beyond the actual fronts of discussion. This does not imply that ethical reflection *can* provide answers to all relevant questions or resolve all moral conflicts, nor that the results of ethical reflection are actually implemented in the design of technology. As soon as participants in technology design engage in ethical reflection by searching for possible solutions to moral conflicts in an argumentative and consensus-oriented manner, they ensure the practical relevance of ethics (Grunwald 1999).

(3) Ethics and the uncertainty of predicting the consequences of technology

It is well known that the consequences of technology, both as systemic cumulative effects of many individual actions and as the occurrence of incidents, are often unpredictable or can only be estimated with a certain degree of probability. Systems theory emphasizes this unpredictability of consequences and side effects of technical action. Functional differentiation means that the consequences of technology must be tracked across several subsystem boundaries; however, due to the autonomy of the subsystems, their reactions cannot be predicted. As a result, the *object* of technology ethics is in danger of disappearing (Bechmann 1993). However, only known, or at least reliably assessable, consequences of action can be reflected upon ethically. The fact that many actual technological consequences were not known to their originators (this applies, for example, to the consequences of the use of chlorofluorocarbons for the ozone layer until the 1980s), and that this certainly also applies to current actions in many areas, is used as an argument against the possibility and relevance of technology ethics (Bechmann 1993).

However, without wishing to trivialize forecasting problems, this is only a sham argument. Many aspects of technological development can certainly be predicted or rationally anticipated. This applies in particular to the *purposes* of technological development. Insofar as these are controversial (e.g., in questions of manned space flight, cf. DLR 1993), an ethical discussion is in any case possible without forecasting problems of the kind mentioned. Above all, however, technology policy action is then always *action under risk* and as such is *by definition* of explicit ethical relevance, because dealing with the reasonableness of risks will probably always lead to moral conflicts. Talk of the unpredictability of the consequences of technology rightly draws attention to the cognitive problems of TA. However, it cannot be used as an argument against the possibility of technology ethics; *on the contrary*, it can be used *as an argument for its necessity*,

since dealing with ignorance or uncertain knowledge always raises the question of the ethical justification of actions in a special way (Gethmann 1994).

Conversely, however, competing conceptions of technology design must also face the question of how they deal with the lack of predictability of the consequences of technology. In the case that systems theory usually raises in its objections to ethics, namely that the consequences of technology are completely unpredictable, other conceptions do not help either. Without empirical or analytical knowledge – which may well be knowledge about probabilities – it is not possible to reflect on the design of technology.

(4) The lack of addressees of ethics

According to the systems theory diagnosis, technology development in the modern age is decentralized and based on a division of labor. The subsystems of society involved (above all science, business, law and politics) operate autonomously and only register the achievements of the other subsystems as "irritations," which they process according to their own mechanisms. Accordingly, there is no central social authority that has an overview of technological development and can control it from this perspective. According to the central and most serious criticism of systems theory, this "subjectlessness" leads to ethics losing its addressee. However, ethics without an addressee can only consist of empty appeals and can no longer claim any practical relevance, because moral communication finds no connection in the structure of functionally differentiated social subsystems, but only leads to a noise without an echo: "One calls loudly for a new ethics – and there is not even an echo, but only communicative noise in society" (Bechmann 1993, p. 215). In view of the reality of technological development, ethics is in danger of turning into mere appealing *rhetoric* of responsibility and diffusively disappearing.

With regard to this objection of systems theory, it must be said that systems theory rightly points out practical relevance problems of ethics and makes partly accurate diagnoses of modernity. Ethics must deal with the tenable parts of these arguments (cf. Hastedt 1991; Grunwald 1999). For example, the relativization of the significance of individual actions in the development of technology massively affects the ethics of responsibility as a special ethical approach to technology, and here in particular engineering ethics (Grunwald 1999). For other approaches, the "loss of the subject of responsibility" is a fact that is associated with structural changes in the social construction of technology. However, this fact does not provide an argument against the possibility and relevance of an ethics of technology that does not concentrate on the responsibility of individuals and

its distribution, but on the procedural facilitation of rational decision-making processes in technology controversies.

The argument of the loss of addressees assumes as a *necessary condition* for the practical relevance of ethics the existence of central controlling actors who are responsible for technology development and could therefore be addressees of ethics. Their loss of significance in modern technological development is then stated in favor of a shift to anonymous "systemic processes," from which the conclusion is then drawn that ethics is obsolete for the control of technology. However, this line of argument already fails because the premise cannot be justified. Why should ethical reflection require a central addressee? This speaks to an understanding of ethics that is oriented toward the moral instances of pre-modern societies. Ethics in the sense defined above – actually very close to Luhmann's view of ethics – as a discursive management of moral conflicts can also develop its reflexive potential *in a decentralized* manner, namely at the various levels of technology design and in the functionally differentiated subsystems. Functional differentiation may well mean that no single center of society can assume the steering function in one place; for ethics, however, this only means that it should also differentiate itself functionally in order to be able to offer ethical reflection within the social subsystems. This is precisely the process that characterizes the movement toward "domain ethics" (Nida-Rümelin 1996): Ethical reflection follows functional differentiation, but does not become obsolete as a result.

2.2 The accusation of normative deficits in systems theory

The main criticism in the opposite direction (see DLR 1993; Gethmann 1994) can be summarized in general terms as follows: (especially system-theoretical, but also other) sociological approaches can provide relevant knowledge about the "what" and the "how" of technology control, but not about the "where." The first two aspects mentioned are necessary but not sufficient conditions for rational technology management. There are two ways of dealing with the "where": Either reference is made to factual acceptance, after which the direction of control is obtained from currently accepted attitudes of the population, or the question of "where" is not asked at all because it is of no interest from an "evolutionary" system perspective.

To the extent that systems theory only includes empirically ascertainable, i.e., factual, recognition relationships in its analyses, it only ever leads to naturalistic false conclusions from factual being to ought, according to the accusation of ethics. It is undisputed that political decision-makers need to know which value

preferences actually exist in order to implement technology policy programs. However, the factual acceptance of values says nothing about their moral *legitimacy*, which can only be decided by means of an ethical examination. Here, factual acceptance is confused with normative acceptability.

The second – and for systems theory probably more characteristic – approach is to refer to the evolutionary development (self-organization) of society in contrast to its ability to be planned. Here, ethics poses the critical question of what use an evolutionary "system rationality" (Luhmann 1990a, 1997) is to those who are faced with a (e.g., technology policy) decision. According to the criticism, the evolutionary perspective is of no use to the decision-maker because it does not allow any statement to be made about the direction of control. For example, from the perspective of a technical planner, Luhmann's definition of planning as influencing future decisions (Luhmann 1971), which only makes sense from the observer's perspective, is at best cynical and at worst irrelevant to him. A planner of technical systems, for example, who is trying to find some kind of "optimal" solution in a specific situation and has to solve selection problems and make decisions, for example, is obviously not helped if he is told that his planning will change the basis for future decisions, because – and this is crucial – this would be the case *regardless of* how he interprets his planning. Precisely the most important element of decision-making for the planner, the "best choice," is eliminated by system theory: According to this, it is simply completely irrelevant "where" technical development evolves – the main thing is that social evolution continues. The normative element – the root of which will be pursued further – of controlling technological development, namely the generation of orientation knowledge, is not taken into account by systems theory. Therefore, according to the criticism, systems theory can hardly offer any assistance to decision-makers in technology design.

As a result, it should be noted that systems theory cannot provide certain forms of knowledge required for technology management, namely orientation knowledge. It lacks a connection to decision-making situations – the normative deficits are also the result of its great distance from the practice of planning and decision-making, caused by the "evolutionary" perspective. Thus, the apparent paradox arises that systems theory, which accuses ethics of lacking practical relevance, cannot itself take sufficient account of the requirements of practice. This paradox deserves closer examination.

3. Ethics and the control of technology development

In the following, the above-mentioned disagreements between systems theory and ethics will be expanded to include a reflection on the foundations of both with regard to the necessary conditions for their practical relevance.

3.1 Practical relevance of ethics in technology design

The best way to refute a suspicion of irrelevance is to prove relevance. This is briefly outlined below, whereby the *conditions* of this relevance must also be examined. The demand for the practical relevance of technology ethics – without which it would obviously be meaningless – must be specified to the effect that ethics should have *potential* consequences for the practice of technology design, a "chance of implementation," so to speak (Grunwald 1999). Its duty is to ensure that its results *can* be reflected in the relevant decisions and actions in practice. Practical relevance thus does not mean *factual*, but *potential* effectiveness. It is a *necessary*, but not the sole condition for the factual effectiveness of ethics. To conclude that ethics is meaningless (Beck, Luhmann) from its supposed factual ineffectiveness is a false conclusion.

The practical relevance is justified by specifying the *pragmatic places* where ethical reflection can be incorporated into decision-making processes. Ethics must be integrated into existing or newly established "practices" of technology design in society. This can be done, for example, by implementing ethical reflection in means-ends contexts, decision-making complexes, political regulations, planning procedures and other procedures of technology design. Ethics is always relevant in practice when *participants* in technology design engage in ethical reflection in such conflict situations.[5] The accusation of a lack of practical relevance is obsolete here: Ethical reflection, if it is undertaken, is always *potentially* effective because otherwise it would not be undertaken by the participants at all. As soon as participants in technology design engage in ethical reflection, they enable potential effectiveness and ensure practical relevance.

However, the question of practical relevance arises in an intensified form – and systems theory rightly points this out – when it comes to ethics brought to technology design from outside, for example, from the "academic ivory tower." The ethical standards provided there are no longer relevant to practice *per se*

5 Participants in shaping technology are not limited to politicians, managers, and engineers. There is also room for the participation of those affected (Renn 1998).

because they were not developed from the perspective of the participants. What is needed is a transfer into practice and an effort to *appropriate* them by the practice in question. It follows from these considerations that practice-relevant ethics must enter into the concrete contexts of technology design. Its competence would then consist in providing methodological advice to the participants in technology design, but not in establishing general propositions and calling for their observance. Ethics in this sense would not be *merely appellative* (as Bechmann 1993 accuses), but literally *advisory*.

Apart from the role of the citizen as technology consumer, pragmatic places of ethics in technology design can be represented in the tension between, on the one hand, ethical advice on regulatory issues in direct proximity to political ethics and, on the other hand, ethical reflection on the morals of the professions involved in technology design, companies and engineers. Traditionally, in the ethical reflection of technology design, significant importance is attached to the actions of engineers (e.g., Lenk/Ropohl 1993; Ropohl 1996). Although this is trivial to a certain extent, because without engineers technology would not come into being at all, the conclusion that engineers are therefore the primary addressees of ethics in technology design is nevertheless a false conclusion. The ethical relevance of engineers' actions for technology design must already be relativized in relation to corporate actions. It is not the technical "pizzazz" of an *invention*, but the economic success of an *innovation* that determines the actual course of technology development, although in many cases the invention is a necessary precondition for an innovation. If the "traditional" position of technology ethics tends to place excessive expectations on engineers, it is equally unjustified, on the other hand, to completely absolve engineers of moral responsibility for technology development, e.g., because they are merely a largely uninfluential "cog in the machine." Technology design is a complex process in which engineering action is only one type of action among many others and which, even if it may be methodologically primary, is often not, or not solely, decisive for the actual course of technology development. It is precisely in view of this complexity that the question arises of an *appropriate* attribution of responsibility to engineers relative to the responsibility of other groups of participants in technology design (Grunwald 1999). If, from a systems theory perspective, technology design is the result of the unpredictable interaction of different functional systems (political system, legal system, economic system, scientific system), it follows from this understanding that ethical reflection itself must be decentralized: It takes place as a reflection effort *within* the respective systems. The practical relevance of ethics and the functional differentiation of society are by no means mutually exclusive.

A further question would be the conditions for the practical relevance of ethics, in particular the mechanism that can prevent normativist false conclusions with mere appellative content. This question leads into the area between prescription and description: What must be *factually* recognized in order *for counterfactual* ethical prescriptions to be legitimized? There must be a connection between the intended and the factual, because otherwise the intended would have no prescriptive legitimacy; on the other hand, however, this connection must not lead to a naturalistic fallacy (which should actually be called descriptivist), which would also have no legitimacy. Ethics is possible and relevant to practice, according to the thesis only briefly hinted at here, if this is *intended*, i.e., if the counterfactual assumptions of ethics are not merely the imagination of philosophers, but are rooted in practice itself and are *factually effective* there. If participants in technology design do not want to engage in ethical reflection, but prefer to let the practical constraints take their course and disregard the moral respect of persons, the active purpose of shaping the future, and much more, then this can no longer be countered discursively. However, the prediscursive agreement of ethics is permeated by such counterfactual assumptions and cannot simply be revoked because it extends into society's self-image. The conditions of the practical relevance of ethics are part of the presuppositions of our lifeworld and social practices and actions; they are, as it were, inscribed in it.

Requirements and expectations of ethics in technology design must be justified against the background of what is desired with regard to normative conflict resolution or what is assumed to be desired in practice. In this way, expectations of ethics are linked back to the willingness to give ethical reflection practical relevance: A kind of self-consistency obligation. It is not enough to call for ethical orientation – this call is cheap insofar as the caller is not prepared, as a participant in the design of technology, to contribute constructively to the practical relevance of ethical reflection in accordance with the role he has assumed there.

3.2 Observer or participant perspective?

Systems theory is a theory of observations; it understands science *a fortiori* as the feedback system of observations of observers, i.e., a second-order cybernetics (Luhmann 1990a). Systems theory is always practiced *from* an *observer's perspective*: The theorist observes social processes and interprets them against the background of a theoretical foil, in this case the system concept. In relation to contexts of action, this results in a preference for *evolutionism* over the planning or decision-making perspective: Evolution can only be observed, but not planned.

Talking about evolution only makes sense relative to an observer's point of view.[6] The suspicion of irrelevance of systems theory vis-à-vis ethics is to be understood relative to this choice of observer perspective; the observer perspective is part of the chain of reasoning that led to this suspicion. Since the observer perspective always talks about *factual relationships of recognition* – this is accepted, that is not, a change in values has occurred here, etc. –, it is not surprising, but a direct consequence of this approach, if there is no room for ethical reflection, which could question the factual relationships of recognition.

The point, however, and this is probably the center of the field of tension between systems theory and ethics, is that the restriction of social reality to that which one believes to observe in an evolutionist or causalist way represents a *reductionism*. Systems theory and ethics differ in their description of society: Description from the perspective of the participant or the observer? According to this analysis, the system-theoretical conclusion on the irrelevance of ethics is not based on empirical results, but is the result of a basic decision that is necessarily linked to the choice of observer perspective, namely the *restriction to the observation of factual recognition relationships*. This conclusion therefore says nothing about desirable or rejectable directions of technology control, but rather about the methodological frame of reference of systems theory and thus forms *a self-constructed result*.

The arena model, which is widely used in TA (although not purely system-theoretical), can be used to illustrate this because it models the difference between the observer and participant perspectives very well (see Renn 1998, p. 20ff. and the literature cited there). The arena model is based on the *observer perspective* and is created by observing the factual behavior of conflict interaction from the outside under the premise of interpreting the action from a *purely strategic* perspective. This occurs, for example, when behavior is interpreted behavioristically as the use of resources to assert one's own position. The counterfactual element of ethics, that a moral obligation exists for reasons of mutual recognition, appears naïve at best from this perspective and is probably completely incomprehensible in theory. From an ethical perspective, however, the obligation to justify does not only exist for situations that have not already been decided ("social-Darwinistically") in terms of power politics or the factual distribution of resources. The metaphor of the tournament chosen by Renn characterizes this divide: Here, it

6 When Luhmann assumes that "there really are systems" (1984, p. 30), he represents an epistemologically highly vulnerable realism that completely ignores the "constructivist" parts of his own position.

is precisely *not* an intention of consensus or understanding that is decisive, but rather thinking in terms of winner-loser categories. This is a strategic, not an ethical perspective.

Modeling social processes from the perspective of external observers is useful and indispensable for many purposes. However, reducing it to this point and ignoring the participant perspective is inadmissible. "What may appear to be a subsystem from the observer's perspective remains an action-like execution of practice from the participant's perspective" (Ott 1997, p. 99). In fact, actions, decisions, plans and considerations are constantly being made – regardless of whether an outside observer interprets this from an evolutionary perspective. The improvement of practice through ethical reflection can therefore, for analytical reasons so to speak, only take place from the participant's perspective: "The relationship between practice and ethics is not an external relationship; rather, normative *questions* are inherent to practice" (Ott 1997, p. 124f.). The *planning and decision-making perspective* consists precisely in asking in concrete situations whether certain ends are achievable and justifiable and what the optimal use of means is. The fact that this can be described as an evolutionary process from the observer's perspective does not contradict this in any way – but this description does not replace the rationality of planning and decision-making.

Of course, planning as *flexible* planning must always remain provisional in its normative premises, the knowledge used and the purposes pursued (Grunwald 2000). Social technology design under the aspect of planning rationality cannot be an algorithmic production of fixed development strands or final states, but can only represent future-shaping action under a permanent obligation to reflect. Of course, only individual "projects" can ever be planned. The question of whether the entire history can be planned, on the other hand, is pragmatically pointless. It would presuppose the existence of an observer and planner who has an overview of the whole. However, and here we must follow systems theory, this is not available. Talk of planning and decision-making rationality in no way presupposes the existence of a central planning or controlling authority. Like ethics, planning also has a pragmatic place as a decentralized effort in the functionally differentiated practices of society.

4. Ethical limits of technology?

As a normative endeavor, ethics also has an acceptance component that protects it from normativist fallacies. Certain counterfactual assumptions must be factually

accepted in society; this is the tightrope walk between a mere acceptance orientation with the consequence of a naturalistic fallacy and an ivory tower ethics without anchoring in social practice; the tightrope walk between the Scylla of the descriptivist fallacy (reference only to the factual) and the Charybdis of the normativist fallacy (no reference to the factual) (Grunwald 1999). If everyone agrees to be treated exclusively from the observer's perspective, e.g., as cybernetic machines, and to renounce their recognition as moral persons, then the counterfactual ceases to exist, leaving only the description of the factual and its relations of recognition. This would lead to a society that is very far removed from ours, perhaps to a society in which the self-description as autopoietic would not be a reduction, but the full reality. This thought experiment makes it clear that the practical relevance of ethics can vary culturally. Ethics as a discipline of reflection is therefore only ever an *offer* to realize practical rationality. The practical relevance of these ethical boundaries for technology depends on whether they are intended. Ethical limits to technology are possible if they are wanted. Whether or not this is the case is not culturally invariant.

Systems theory points to important structural changes in society. Some of its diagnoses in this regard can be shared, even if not all of the theory's components are adopted. The functional differentiation of society as such a diagnosis does not make ethics in technology design impossible, but only the possibility of central addressees for technology control. Systems theory and ethics are complementary to each other in terms of their contributions to rational technology control: If systems theory is descriptive and explanatory from the observer's perspective, ethics is normative. Technology management requires factual knowledge about technology and society as well as reflexive orientation knowledge. This emerging "division of labor" between the social sciences and ethics is, incidentally, laid out by Luhmann himself (Luhmann 1990b, p. 17; cf. also Stegmaier 1998).

Literature

Bechmann, Gotthard (1993): Ethische Grenzen der Technik oder technische Grenzen der Ethik? In: Geschichte und Gegenwart (4), pp. 213–25.

Beck, Ulrich (1986): Risikogesellschaft: Auf dem Weg in eine andere Moderne. Frankfurt am Main: Suhrkamp.

Deutscher Bundestag (1986): Bericht der Enquete-Kommission "Einschätzung und Bewertung von Technikfolgen; Gestaltung von Rahmenbedingungen der technischen Entwicklung" Zur Institutionalisierung einer Beratungskapazität für Technikfolgen-Abschätzung und -Bewertung beim Deutschen Bundestag. BT-Drucksache 10/5844. Bonn: Deutscher Bundestag.

DLR (ed.) (1993): Technikfolgenbeurteilung der bemannten Raumfahrt. Systemanalytische, Wissenschaftstheoretische und ethische Beiträge: Ihre Möglichkeiten und Grenzen. Köln: Deutsches Zentrum für Luft- und Raumfahrt.

Gethmann, Carl Friedrich (1994): Die Ethik technischen Handelns im Rahmen der Technikfolgenbeurteilung. In: Grunwald, Armin; Sax, Hartmut (eds.): Technikbeurteilung in der Raumfahrt. Anforderungen, Methoden, Wirkungen. Berlin: Edition Sigma, pp. 146–159.

Gethmann, Carl Friedrich; Grunwald, Armin (1996): Technikfolgenabschätzung: Konzeptionen im Überblick. Bad Neuenahr-Ahrweiler: Europäische Akademie.

Grunwald, Armin (1998): Technikethik. In: Korff, Wilhelm; Beck, Lutwin; Mikat, Paul (eds.): Lexikon der Bioethik, 3 Vols. Gütersloh: Gütersloher Verlagshaus, pp. 508–516.

Grunwald, Armin (1999): Ethische Grenzen der Technik? Reflexionen zum Verhältnis von Ethik und Praxis. In: Grunwald, Armin; Saupe, Stephan (eds.): Ethik in der Technikgestaltung. Heidelberg: Springer, pp. 221–252. https://doi.org/10.1007/978-3-642-60033-3_11

Grunwald, Armin (2000): Handeln und Planen. München: Fink.

Grunwald, Armin; Lingner, Stephan (1999): Systembegriff und Systemanalyse. In: Grunwald, Armin (ed.): Rationale Technikfolgenbeurteilung. Konzeption und methodische Grundlagen. Heidelberg: Springer, pp. 132–156.

Hastedt, Heiner (1991): Aufklärung und Technik: Grundprobleme einer Ethik der Technik. 1st ed., Frankfurt am Main: Suhrkamp.

Jonas, Hans (1979): Das Prinzip Verantwortung: Versuch einer Ethik für die technologische Zivilisation. Frankfurt am Main: Insel-Verlag

Lenk, Hans; Ropohl, Günter (eds.) (1993): Technik und Ethik. 2nd, rev. and ex. ed., Stuttgart: Reclam.

Luhmann, Niklas (1971): Politische Planung. In: Luhmann, Niklas (ed.): Politische Planung: Aufsätze zur Soziologie von Politik und Verwaltung. Wiesbaden: VS Verlag für Sozialwissenschaften, pp. 66–89. https://doi.org/10.1007/978-3-663-07662-9_6

Luhmann, Niklas (1984): Soziale Systeme: Grundriss einer allgemeinen Theorie. 1st ed., Frankfurt am Main, Alexandria, VA: Suhrkamp, Alexander Street Press.

Luhmann, Niklas (1990a): Die Wissenschaft der Gesellschaft. 1st ed., Frankfurt am Main, Alexandria, VA: Suhrkamp, Alexander Street Press.

Luhmann, Niklas (1990b): Paradigm Lost: Über die ethische Reflexion der Moral; Rede anläßlich der Verleihung des Hegel-Preises 1989. Frankfurt am Main: Suhrkamp.

Luhmann, Niklas (1997): Die Gesellschaft der Gesellschaft. 1st ed., Frankfurt am Main: Suhrkamp.

Nida-Rümelin, Julian (1996): Angewandte Ethik: die Bereichsethiken und ihre theoretische Fundierung; ein Handbuch. Stuttgart: Kröner.

Ott, Konrad (1997): Ipso facto: zur ethischen Begründung normativer Implikate wissenschaftlicher Praxis. 1st ed., Frankfurt am Main: Suhrkamp.

Petermann, Thomas; Sauter, Arnold (1996): Stand der Technikfolgen-Abschätzung im Bereich der Medizintechnik. TA-Monitoring. Berlin: Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag.

Renn, Ortwin (1998): Die Austragung öffentlicher Konflikte um chemische Produkte oder Produktionsverfahren – Eine soziologische Analyse. In: Renn, Ortwin; Hampel, Jürgen (eds.): Kommunikation und Konflikt. Fallbeispiele aus der Chemie. Würzburg: Königshausen & Neumann, pp. 11–51.

Ropohl, Günter (1996): Ethik und Technikbewertung. 1st ed., Frankfurt am Main: Suhrkamp.

Schelsky, Helmut (1966): Planung der Zukunft: Die rationale Utopie und die Ideologie der Rationalität. In: Soziale Welt 17 (2), pp. 155–172.

Stegmaier, Werner (1998): Niklas Luhmanns Systemtheorie und die Ethik. In: ETHICA – Wissenschaft und Verantwortung 6 (1), pp. 57–86.