Interdisciplinary Description of Complex Systems 21(3), 214-229, 2023

PHILOSOPHY OF INTERDISCIPLINARITY: JAN CORNELIUS SCHMIDT'S CRITICAL-REFLEXIVE PROBLEM-ORIENTED INTERDISCIPLINARITY

Demian Papo* and Hrvoje Potlimbrzović

Josip Juraj Strossmayer University of Osijek – Faculty of Humanities and Social Sciences
Osijek, Croatia

DOI: 10.7906/indecs.21.3.1
Regular article

Received: 13 June 2023.
Accepted: 26 June 2023.

ABSTRACT

Philosophers were reluctant to address interdisciplinarity during the 20th century. But things have changed in the 21st century, since a two-level relationship between philosophy and interdisciplinarity has been established: philosophy *of* interdisciplinarity and philosophy *as* interdisciplinarity. Thus far scholars have shown more interest in exploring the first level of that relationship.

The aim of this article is to closely examine the developmental path of a *philosophy of interdisciplinarity* envisioned and constructed by Jan Cornelius Schmidt in the past two decades. In our opinion, it has reached two milestones. The first (2008) being the one in which he clarified the vague notion of *interdisciplinarity* and classified its four types with the help of philosophy of science, and the second (2011) being the one in which he opted for problem-oriented interdisciplinarity. Schmidt's *philosophy of interdisciplinarity* has reached its (current) peak (2022), resulting in a philosophical framework which promotes problem-orientation and critical-reflexivity in interdisciplinary endeavors. Thereby Schmidt has created prerequisites for the construction of philosophy *as* interdisciplinarity.

KEY WORDS

philosophy *of* interdisciplinarity, problem-oriented interdisciplinarity, critical-reflexive interdisciplinarity, Jan Cornelius Schmidt

CLASSIFICATION

JEL: I23

*Corresponding author, η: dpapo@ffos.hr; -;
Sveučilište Josipa Jurja Strossmayera u Osijeku, Filozofski fakultet, Lorenza Jägera 9, 31000 Osijek

INTRODUCTION

Specialization, professionalization, disciplining and departmentalization were some of the main outcomes of the establishment of the modern university in the 19th century, and these outcomes have not, expectedly, circumvented philosophy. Ever since, academic philosophy has been on a quest of finding its own disciplinary identity, as well as discovering its relationship with other disciplines. The latter has especially been so in the past 50 years, since new scientific paradigms or approaches have been presented to the general academic public in the 1970s, namely multi-, pluri-, cross-, inter-, and transdisciplinarity [1-3].

Here we shall offer a brief history of the relationship that academic philosophy has established with one of the aforementioned scientific paradigms: interdisciplinarity. Unfortunately, philosophers have not sufficiently considered the role and relationship of philosophy towards it. Evidence to support this claim is abundant. On this occasion we shall mention just one of them: e.g., Michael H.G. Hoffmann, Jan C. Schmidt and Nancy J. Nersessian state that "in general, philosophers have remained reluctant to address 'interdisciplinarity' " [4; p.1858]. However, in spite of the inattention of philosophers towards interdisciplinarity and the fact that "until quite recently the field of interdisciplinary studies has attracted few philosophers," Julie Thompson Klein and Robert Frodeman rightfully argue that the situation is changing today [5; p.150]. This change has been going on for at least 15 years.

The development of a more intense relationship between philosophy and interdisciplinarity can be traced to a series of international workshops and conferences, starting with a workshop held in Atlanta in 2009 and ending with a conference held in Tübingen in 2012. According to a report from the Atlanta workshop, the primary purpose of it was to "reflect on interdisciplinarity – for the first time – from a philosophical point of view" [6; p.42a]. Two outcomes have emerged from this workshop: (1) it developed "the idea of philosophy not as a metadiscipline, but as an engaged participant and partner in interdisciplinary discourses"; (2) it resulted in establishing a network of philosophers and other scholars interested in interdisciplinarity named *Philosophy of/as Interdisciplinarity Network* (PIN-net) [7; pp.169-170].

Therefore, the mentioned workshops and conferences stimulated the progress of the relationship between philosophy and interdisciplinarity. Moreover, two levels of that relationship have been identified and defined during the Atlanta workshop: philosophy *of* interdisciplinarity and philosophy *as* interdisciplinarity. According to Hoffmann and Schmidt, philosophy *of* interdisciplinarity encourages "philosophical inquiry into problems regarding the practices and theories of interdisciplinary research in the style of traditional philosophy of science." On the other hand, philosophy *as* interdisciplinarity is focused upon "initiating a new philosophical practice of reflective and reflexive engagement in the world – one that questions and overcomes the boundaries that have constituted philosophy as a discipline in the 20th century," with its leading idea being that "philosophers leave the study and enter the field, integrating their work with scientists, engineers, and policy makers" [7; p.170].

Besides the mentioned workshops and conferences, other proof of the ongoing progress of the relationship between philosophy and interdisciplinarity can be found elsewhere. One of them is provided by the 2010 edition of *The Oxford Handbook of Interdisciplinarity*. As the handbook's editor-in-chief Robert Frodeman claims in the introductory text, this edition "heralds the centrality of philosophic reflection for twenty-first century society," since interdisciplinarity is "inherently philosophical, in the non-professionalized and non-disciplined sense of the term" [8; p.xxxi]. This

edition of the Oxford's handbook contains a short yet noteworthy textual addendum on prospects for a philosophy of interdisciplinarity authored by Schmidt [9]. The handbook's 2017 edition contains only one contribution which discusses not the relationship between philosophy and interdisciplinarity, but the one between interdisciplinarity and a single philosophic discipline, i.e., ethics, authored by Carl Mitcham and Wang Nan [10]. The other two hallmarks in the history of considerations on philosophy *of* and *as* interdisciplinarity we would like to point out are two special issues of scientific journals: (1) issue 11 of the 190th volume of *Synthese* (2013) edited by Hoffmann, Schmidt and Nersessian; (2) and issue 3 of the 6th volume of *European Journal of Philosophy of Science* (2016) edited by Uskali Mäki and Miles MacLeod.

Due to the fact that more literature regarding the first level of the relationship between philosophy and interdisciplinarity has recently emerged, e.g., Choudhary [11, 12] and Curis [13], we shall examine what we consider as the peak of its development. Thus, we shall analyze the opus of the German physicist and philosopher Jan Cornelius Schmidt, who has been developing his *philosophy of interdisciplinarity* for the past 20 years. Special attention will be given to Schmidt's latest monograph *Philosophy of Interdisciplinarity. Studies in Science, Society and Sustainability* (2022), which we perceive as his intellectual crown on the matter.

THE TRAJECTORY OF SCHMIDT'S PHILOSOPHY OF INTERDISCIPLINARITY

In this chapter, we shall shed light upon the development of Jan Cornelius Schmidt's thought on *philosophy of interdisciplinarity*. For that purpose, we have selected two of his articles which we consider to be milestones in the trajectory of his theory. These articles from 2008 and 2011 were, in our opinion, crucial for constituting his capital work published in 2022. Thus, we divided our article into three sections. The first section includes Schmidt's conceptual sketch of *philosophy of interdisciplinarity*, in which he clarified the role of philosophy in considering interdisciplinarity and elucidated the vital components of *philosophy of interdisciplinarity*. The main topic of the second section of our article is problem-oriented interdisciplinarity, that is, the dimension of interdisciplinarity which will turn out to be central for Schmidt's *philosophy of interdisciplinarity*. The third section is focused upon the realization of Schmidt's goal in the form of a comprehensive *philosophy of interdisciplinarity*, which has a critical-reflexive and problem-oriented variant of interdisciplinarity at its core.

BLUEPRINT OF A NEW APPROACH

In our opinion, the first milestone of Schmidt's thoughts on philosophy *of* interdisciplinarity is his article entitled "Towards a philosophy of interdisciplinarity. An attempt to provide a classification and clarification" (published online in 2007 but printed in 2008) [14]. It stemmed from his unconcealed intellectual irritation by the widespread and often perverted usage of the term *interdisciplinarity*, and the frivolous characterization of projects, as well as research and education programs as being *interdisciplinary*, which often reduce the term to a mere fund-acquiring catchword, a vague concept deprived of meaning. In order to 'right the wrong,' Schmidt reached towards distinctions established in philosophy of science in approaching interdisciplinarity as a multi-faceted phenomenon with regard to four dimensions: (a) *ontological dimension*, (b) *epistemological dimension*, (c) *methodological dimension*, and (d) *problem framing* and *problem perception dimension* (*problem-oriented dimension*).

Yet the birth of Schmidt's considerations on these four dimensions can be traced back to the early 2000s. Namely, he applied them in the context of an inherently interdisciplinary scientific field of bionics [15], used them to pave a new way in the jungle of interdisciplinarity [16], then to address questions of technological reductionism in another interdisciplinary scientific field, i.e. nanotechnology [17], and his considerations culminated in an article entitled "Dimensionen der Interdisziplinarität. Wege zur einer Wissenschaftstheorie der Interdisziplinarität" in which he evoked *Interdisziplinaritätsphilosophie* for the first time [18].

Each of the four dimensions, according to Schmidt [14], could be matched with corresponding traditional philosophical stances. The ontological dimension of interdisciplinarity would therefore refer to objects and entities, hence being advocated by (a) *realists* who mainly deal with "given or constructed objects of a human-independent reality"; the epistemological one refers to knowledge, theories and concepts, so the corresponding philosophical stance would be that of (b) *rationalists*; the methodological dimension, i.e., the one which refers to knowledge production, to the research process, the rule-based action of scientists, and to the languages in use, thus matched with (c) *methodological constructivists* and *pragmatists*; the problem framing, problem perception or problem-oriented dimension, hence the one which includes considerations on "how to handle and solve problems pragmatically; the impact, effect and outcome of knowledge is of utmost relevance"; thereupon resembling the stance supported by (d) *instrumentalists*, *utilitarians* and *critical theorists* [14; pp.59-62]. After identifying the four dimensions and their respective philosophical stances, Schmidt illustrated them by using some examples of popular research programs which are labelled as interdisciplinary: (a) nanoresearch and neurosciences (object-oriented – realism); (b) complex systems and chaos theory (theory-oriented – rationalism); (c) biomimicry/bionics and econophysics (method-oriented – methodological constructivism and pragmatism); (d) technology assessment and sustainability research (problem-oriented – instrumentalism, utilitarianism, and critical theory) [14; pp.62-66]. Finally, Schmidt concluded that "*a minimal philosophy of science* is the prerequisite in order to understand (and probably to promote) 'interdisciplinarity' ". Even though Schmidt claimed that philosophy is "effectively helpful in analyzing and classifying interdisciplinarity", he emphasized that "*philosophy of interdisciplinarity* still remains a desideratum" [14; p.66].

Inappropriate use of *interdisciplinarity* led Schmidt to writing another article or, as we called it earlier, a textual addendum on the topic. The addendum was published in Frodeman's 2010 edition of *The Oxford Handbook of Interdisciplinarity* in the form of a box entitled "Prospects for a philosophy of interdisciplinarity." Even though it does not offer anything new in comparison to the article from 2008, Schmidt's box fills its purpose "to foster the debate on ID," since it "presents elements of pluralist *philosophy of interdisciplinarity*," and in it Schmidt exclaims once again that he may have proposed "some elements for a philosophy of ID" [9; p.39; p.41]. More importantly, this box is significant on a symbolical level, being the only textual contribution devoted to the relationship between philosophy and interdisciplinarity in Frodeman's handbook, therefore indicating an ongoing change.

A STEP CLOSER TOWARDS A PHILOSOPHY OF INTERDISCIPLINARITY

After elucidating the plurality of different dimensions of philosophical approach to interdisciplinarity in the earlier phase, thus offering a conceptual framework for its analysis, the focal point of this section of our article will be what we consider the second milestone of Schmidt's theory which contains his thoughts on problem-oriented interdisciplinarity, i.e., its fourth type.

The most detailed and thus exemplary instance of Schmidt's reflections on problem-oriented interdisciplinarity is undoubtedly the article entitled "What is a problem? On problem-oriented interdisciplinarity" published in 2011. Schmidt's urge for writing such an article came out of the same source as his article we discussed in the first section of our article. Namely, it again came out of intellectual irritation, which was caused this time by the buzzword *problem.* The term itself, according to Schmidt, "plays a major role in the various attempts to characterize interdisciplinarity or transdisciplinarity", and it seems that the discourse and practice of interdisciplinarity have "problems with the 'problem'," since they can "also be found in traditional disciplinary sciences as well as in the life world," which made him exclaim that: "Problems seem to be everywhere and nowhere!" [19; p.249; pp.251].

Recognizing the vagueness of the notion of *problem* as the cause of misunderstanding of problem-oriented interdisciplinarity, Schmidt insisted on clarifying the terms *problem* and *interdisciplinarity*, and on finding demarcation lines between problem-oriented and other types of interdisciplinarity. In order to clarify the notion of *problem*, he reached for and combined integrative approaches of Dietrich Dörner (an *undesired* or *initial state*; *desired* or *final state*; *barriers* between the two) and Roland W. Scholz (*target*, *system*, and *transformation knowledge*), concluding that the notion of *problem* includes "(i) the assessment of the actual or future state – from the angle of an anticipated target state – as being undesired or negative (*negativity thesis*) and (ii) the barrier to reaching or avoiding the target or anticipated state (*barrier thesis*)" [19; pp.259-260]. From that emanates his definition of problem-oriented interdisciplinarity, which offers "system, target, and transformation knowledge, including a time-sensitive, temporal dimension, and an *ex ante* reflection on prospective future states," and which produces *problem knowledge* that is "intrinsically interlaced with action knowledge." [19; p.260] Therefore, the role of problem-oriented interdisciplinarity is threefold: to constitute, frame and clarify a problem, and to anticipate it and prevent it, or to suggest actions for its solution.

When it comes to Schmidt's differentiation between problem-oriented and three other iterations of interdisciplinarity, he drew demarcation lines as follows: (1) object-oriented interdisciplinarity does not "mainly refer to knowledge, methods, or problems, but to an external, human-independent reality;" (2) theory-oriented interdisciplinarity refers to "meta-disciplinary – or at least non-disciplinary – abstract knowledge;" (3) method-oriented interdisciplinarity refers to answering the question of "whether there are special canons or methods, rules, empirical settings, and hermeneutic forms which typify ID and positively determine it." [19; pp.254-255] Therefore, these iterations of interdisciplinarity are insufficient, since they do not "cover the whole breadth of the notions of ID" [19; p.256]. On the other hand, problem-oriented interdisciplinarity, or as it is sometimes called *transdisciplinarity*, focuses "on the starting points, goals, and purposes of interdisciplinary research activities – in other words, on the constitution, identification, and framing of problems," and interdisciplinary problems are considered as "being external to disciplines or to academia. They are primarily societal ones that are (pre-) defined by society, e.g., lay people, politicians, and stakeholders" [19; pp.256-257]. From a methodological standpoint, this type of interdisciplinarity tries to transgress the existing boundaries between science and society. It does that in two ways: it takes up "*external* (to science) societal problems, works on them *internally*, and transfers the results to the societal domain in order to contribute to *extra*-scientific societal problem solving" [19; p.261]. Seen from an epistemological perspective, this type of interdisciplinarity is the place in which constructivism and realism converge, asking for an epistemological position Schmidt calls *constructivist realism*, in which "based on real situations and matters of fact, problems are constituted according to normative criteria" [19; p.263]. Accordingly, Schmidt deemed that it was not enough to describe reality and the criteria of its

cognition, but that both reality and the criteria should rather be normatively defined or, to be more precise, constructed in accordance with the interdependence of natural objects, humans, and technology. Thus, he criticized previous tendencies in science, i.e., inclinations towards conducting a unilateral analysis of these three constituents from a non-dynamic perspective.

SCHMIDT'S PHILOSOPHY OF INTERDISCIPLINARITY

Schmidt's blueprint for a new, philosophic approach towards interdisciplinarity in 2008 and commitment to its problem-oriented version in 2011 enabled him to construct the desired *philosophy of interdisciplinarity*. His thoughts on the matter have undoubtedly reached their (current) peak in his monograph *Philosophy of Interdisciplinarity. Studies in Science, Society and Sustainability* published in 2022. It is the outcome of his long-lasting intellectual endeavor, his scientific venture through the wastelands of the interdisciplinary jungle.

Once again portraying his reluctance to accept the current state in academia which is depriving *interdisciplinarity* of its semantic core, Schmidt opens the book with a reminder to the roots of interdisciplinary discourse which dates back to 1960s and 1970s, and which emerged from discussions on environmental issues. By recognizing the weaknesses of a widespread *instrumentalist* or *strategic* approach to interdisciplinarity, he advocated one which would complement and upgrade it, namely its *critical-reflexive* variant. Schmidt clearly expressed his intention of departing from the Baconian, Cartesian and Kantian philosophical heritage regarding the human-nature relationship, aligning his thought with the critical theory and cultural critique of the Frankfurt School, especially with that of Theodor W. Adorno, Max Horkheimer, and Jürgen Habermas. The essence of Schmidt's understanding of the relationship between philosophy and interdisciplinarity in the form of *philosophy of interdisciplinarity*, as well as his clarification of both of its constituents, is best shown in the following lines: The *Philosophy of Interdisciplinarity* is thus interdisciplinary *and* genuinely philosophical: "In comparison with the disciplinary mainstream of 20th-century philosophy with its subdisciplines, its reductionist approaches and regional ontologies (Frodeman 2014), the *Philosophy of Interdisciplinarity* can be characterized as truly interdisciplinary. Furthermore, it is genuinely philosophic because it is based on the rich and colourful intellectual tradition of philosophy that addresses fundamental metaphysical questions and develops frameworks of orientation. In other words, the *Philosophy of Interdisciplinarity* aims to (re)open the academic discipline of philosophy towards other disciplines and, beyond that, to society at large. It resonates with an interdisciplinary-oriented philosophy and therefore could also be called *interdisciplinary philosophy"* [20; pp.7-8].

Therefore, Schmidt made it clear that his *philosophy of interdisciplinarity* is not another philosophical subdiscipline, merely a "philosophy of X" as was the trend during the 20th century due to overspecialization. It is rather an overarching critical-reflexive variant of a problem-oriented interdisciplinary framework which is deeply rooted in philosophical heritage.

It is worth noting that chapter 2 of his book on philosophy of interdisciplinarity relies upon in two of his articles which we have previously discussed [14, 19], but it also provides proof of the further advancement of his considerations on the matter. Novelties presented in the chapter, when compared to the abovementioned articles, largely contribute to the constitution of *philosophy of interdisciplinarity*, so we shall focus only on the points of divergence.

Before constituting his *philosophy of interdisciplinarity*, Schmidt pointed out the plurality and diversity of the views on knowledge and (inter-)disciplinarity taken by different philosophic traditions who

deemed knowledge unity and integration of disciplines as an overall aim of academic inquiry, starting from Ancient Greek philosophy to German Idealism up to the 20th century philosophy of science and analytical tradition. Furthermore, Schmidt tackled another plurality. Namely, the one of motives, values, or underlying goals of interdisciplinary research, which were often misinterpreted, and which resulted in viewing interdisciplinarity merely as a means for technological innovation and for achieving economic growth, thus being exclusively instrumentalist in nature. That lead Schmidt to the conclusion that interdisciplinarity is a "double-edged sword," because it can serve "as a point of access and key catalyst for recognizing and reflecting on goals and motives of science and research in society," but it can simultaneously conceal these goals and motives [20; p.22]. He recognized four motives pursued by interdisciplinarians and their respective values: (1) *epistemic motive* stems from the attitude that science is guided by the value of truth; (2) *economic motive* comes from the belief that utility is the base value of scientific research; (3) *ethical-societal motive* centers on the value of the human and nature's well-being; (4) *personal motive* is driven by the value of sense-making and self-understanding. The task of *philosophy of interdisciplinarity* is, in Schmidt's words, to consider and reflect upon that ambivalence, because interdisciplinarity has "the potential to spark deeper reflection on science and research in society," thus creating its guiding idea to put that potential into practice [20; p.22].

However, classification of motives and values can lead to a limited, mainly descriptive understanding of interdisciplinarity. That is why Schmidt proposed that *philosophy of interdisciplinarity* aims "to critique, complement, and widen the view," while one of its central objectives is to "reveal underlying philosophical assumptions and fundamental convictions regarding the notion of 'interdisciplinarity' – and on this basis it advances a critical perspective that opens up avenues towards sustainable knowledge within the academy" [20; p.24]. Acknowledging the fact that the existence of disciplines is a *conditio sine qua non* of interdisciplinarity, Schmidt presented the unavoidable dilemma that arises from such a situation. At the core of interdisciplinary endeavors there is the so-called *boundary paradox*, i.e., the simultaneous tendency to conserve and eliminate disciplinary boundaries. Schmidt suggested a philosophic view of that paradox, naming it the *boundary dialectic*, which would include both separation *and* integration of disciplines, and which would enable us to reject dominant conception of interdisciplinarity as being solely integrative to the extent of dissolving disciplinary boundaries, hence dissolving its own roots [19; pp.252-253, 20; p.25]. The dialectic view of disciplinary boundaries is offered by *philosophy of interdisciplinarity* which possesses the ability to, as Schmidt concludes, "explicitly address boundaries and provide a conceptual framework encompassing both (a) separation or differentiation and (b) transgression, transcendence, or integration" [20; p.26]. As we have already mentioned in an earlier chapter, he designed that conceptual framework in the early 2000s, and it consisted of four interchangeable views of a multifaceted phenomenon of interdisciplinarity: object-oriented, theory-oriented, method-oriented, and problem-oriented interdisciplinarity.

The whole of Schmidt's monograph is interwoven with his bias towards problem-oriented interdisciplinarity, since he was convinced that it transcends the other three views of interdisciplinarity. That can be seen from his statement that problem-oriented interdisciplinarity, compared with the other three types, "frames science and research from a more comprehensive perspective," and that it "centres on problems and issues, and it includes the goals, purposes, initial conditions, and research agendas of scientific activities" [20; p.29]. As we mentioned earlier, Schmidt [19; p.256] wrote that that type of interdisciplinarity is sometimes called transdisciplinarity, because the two share many common features, e.g., they both deal with societal, ethical, real-world, extra- and trans-scientific problems. That is why it was of utmost importance

to him to distinguish between them in his monograph. As is shown in a figure and elaborated upon in the text, transdisciplinarity is a comprehensive concept which encompasses all four forms of interdisciplinarity but only its problem-oriented type in its entirety. Namely, certain interdisciplinary objects, methods and theories fall out of the transdisciplinary scope. Therefore, problem-oriented ID (including its critical-reflexive subtype) is a subset of transdisciplinarity, and thus always transdisciplinary.

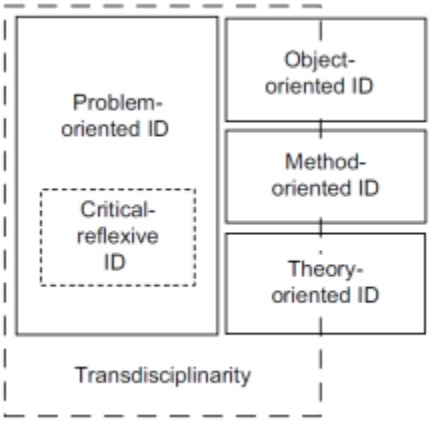

Figure 1. The four types or dimensions of interdisciplinarity, including transdisciplinarity and a central subtype, namely critical-reflexive interdisciplinarity [20; p.30].

When he discussed knowledge politics and research programs in his book, Schmidt further developed his thoughts on the topic he previously expressed in a article entitled "Knowledge Politics of Interdisciplinarity. Specifying the Type of Interdisciplinarity in the NSF's NBIC Scenario" [21]. In both cases he challenged the prevalent understanding of interdisciplinarity advocated in the NSF's (*National Science Foundation*) NBIC (*Nanotechnology, Biotechnology, Information Technology and Cognitive Science*) report from 2002. He did so by analyzing the report from the perspective of the four types of interdisciplinarity, recognizing that it advocates a weak type of interdisciplinarity: techno-object interdisciplinarity [20; pp.50-51, 21; p.322]. Given the fact that he criticized the report because of the lack of the other three types of interdisciplinarity and taking the nature of his critique into consideration, it is, in our opinion, justified to conclude that Schmidt would like the report to contain each of the four types with an emphasis on the problem-oriented one, more precisely on its critical-reflexive subtype. The conclusion we put forward is based upon Schmidt's critique of today's *knowledge society* which does not take consequences of technological advancement and its impact on humanity and environment into consideration. Schmidt's vision of *philosophy of interdisciplinarity* provides a conceptual framework, based on the *minimal* philosophy of science, which should be used to consider and judge interdisciplinarity present in the dominant *knowledge politics*, which largely impacts and builds the society of the future. Therefore, the role of *philosophy of interdisciplinarity* is to encourage criticism and foster reflection on interdisciplinarity, thus creating a *reflexive society* [20; p.53].

Besides detecting the state of interdisciplinarity studies which dominates today's scientific discourse and suggesting how we can improve it in the chapter on NSF's NBIC report, Schmidt went to determine the historical roots of such a view on science. He found them in the work of Francis Bacon, the early Modern philosopher and the founding father of modern science, recognizing him as the precursor of today's technoscience which does not reflect on the implications produced by scientific progress and technological advancement. Schmidt already did

so in 2011 in two articles entitled "The Renaissance of Francis Bacon" [22] and "Toward an epistemology of nano-technosciences" [23], in which he postulated that Bacon's program is now experiencing a rebirth (renaissance), reaching its full potential and nominally being put into action in various research programs: "*Bacon-I* in the 17th century is now followed by *Bacon-II*, supporting the well-known vision or fiction of an epochal break" [22; p.38]. Both in his articles and his monograph, Schmidt claimed that Bacon's vision of science, and consequently the one that is present in today's technoscience (object-oriented interdisciplinarity), was mostly instrumentalist, since it only dealt with means of achieving progress, and not on its consequences. In Schmidt's words, Bacon's instrumentalism and his materialist real-constructivist epistemology are "now, in essence, more powerful than ever before, especially in the growing field of interdisciplinarity and interdisciplinary technosciences" [20; p.72]. In order to overcome such a situation, *philosophy of interdisciplinarity* comes into play. According to Schmidt, it should be put to use in the sense of acknowledgment and awareness of the subsiding Baconian elements of modern technoscience, and the predominant type of interdisciplinarity, which enables us to assess it critically especially from the perspective of the relationship between humans, technology, and nature. Put succinctly, *philosophy of interdisciplinarity* helps us "to go through Bacon and deal with his program – in order to go beyond him" [20; pp.72-73].

Unlike object-oriented interdisciplinarity which dominates the technoscientific neo-liberal era we live in, Schmidt expectedly advocated interdisciplinarity which would be oriented towards wicked societal problems and their resolvement. That can be seen in the chapter entitled "Society and Societal Problems" of Schmidt's monograph, which has a lot in common with the theses he presented in a article we discussed earlier, namely "What is a problem?" published in 2011. Since we have already analyzed that article in detail, we shall focus on the differences between it and the book chapter. Special emphasis will be put on *philosophy of interdisciplinarity*'s contribution to the discussion on problems in general, and societal problems in particular. The first difference between the article and the chapter lies in the involvement of *philosophy of interdisciplinarity* in recognizing types of interdisciplinarity present in two reports: NSF's NBIC report from 2002 and the European Commission's CTEKS (*Converging Technologies for the European Knowledge Society*) report. The CTEKS report, in Schmidt's opinion, "shifts the perspective away from object-oriented interdisciplinarity [advocated by NSF's report] towards problem-oriented interdisciplinarity, which, by means of detailed specification of each component, aims to achieve a framing of the problem, a convergence of goals, and critical reflection on and the potential revision on purposes" [20; p.88]. Furthermore, the second difference lies in the central place *philosophy of interdisciplinarity* should hold in correct understanding of and orientation on a problem, since it is "a key term in both the political and epistemological discourse and the practice of interdisciplinarity," and therefore *philosophy of interdisciplinarity* becomes indispensable for giving substance to problem-oriented interdisciplinarity [20; p.90].

Although an advocate of problem-oriented interdisciplinarity, Schmidt saw that today, scarce as it is, even such an approach to interdisciplinarity has many shortcomings. He recognized that it is most often characterized by instrumentalism, which is oriented exclusively on solutions to problems, rather than on their roots and prevention, and he called such an approach *solutionism*. That caused him to devote an interlude in his monograph to the clarification of what problem-oriented interdisciplinarity should be and, to be more precise, he promoted its critical-reflexive subtype. That subtype, in Schmidt's words, contributes to "thwarting new problems at their very root," since it "scrutinizes the underlying dynamics of scientific/technological advancement,"

having both the emerging problems and, even more so, the prevention of problems in the early phases of scientific progress in focus [20; p.93].

The interlude actually reveals the direction and the main message Schmidt tried to send in next three chapters in which he presented three case studies from a critical-reflexive perspective on the following topics: ethics and environment, nature and the sciences, technology and the future.
When he dealt with ethics and environment, Schmidt largely relied on the philosophical approach taken by the German philosopher Hans Jonas. His inclination towards Jonas' thought is apparent in an article "Die Aktualität der Ethik von Hans Jonas. Eine Kritik der Kritik des Prinzips Verantwortung" [24], and in an article "Defending Hans Jonas' Environmental Ethics: On the Relation between Philosophy of Nature and Ethics" [25], as well as in the sixth chapter of his monograph on *philosophy of interdisciplinarity*. In all three cases, Schmidt approached Jonas' philosophy in a similar fashion. He aspired to critically assess the applicability and actuality of Jonas' philosophy in the 21st century, in order to find out whether his philosophy can prove useful in a critical analysis of the current state of affairs and the relation between society and environment. Schmidt used scholastic precision in analyzing the four objections (*diagnosis objection*, *origin analysis objection*, *argumentation and justification objection*, and *practice objection*) and arguments put forward by Jonas' critics in an effort to repudiate his theses. His defense of Jonas and his theses can be brought down to the following two conclusions Schmidt expressed in the introductory part of the chapter: (1) "Jonas is a pioneer in driving the idea of critical-reflexive interdisciplinarity […] in order to shift the direction of scientific advancement onto an environmentally friendly path" [20; p.103]; (2) Jonas' public philosophy "can be can be regarded as interdisciplinary in a (self-)critical-reflexive sense – an interdisciplinary philosophy that is part of any good reflexive and reflective practice" [20; p.104]. So, Jonas' philosophy served Schmidt as an illustrative example of how critical-reflexive *philosophy of interdisciplinarity* should look like, since Jonas considered philosophy of nature and ethics twin sisters, therefore being requisite for facing life-world problems. In line with Jonas' thought, Schmidt's practically relevant environmental *philosophy of interdisciplinarity* would be the one "in which ethics, anthropology, metaphysics, philosophy of nature, philosophy of science, as well as politics and the life-world are conceptualized as a converging domain in a critical-reflexive fashion" [20; p.119]. He concluded his considerations on the relation between ethics and environment by first taking an *ex negativo* approach in showing what philosophy in general, and *philosophy of interdisciplinarity* in particular should be like. He is convinced that it should not be "apathetic or indifferent about the world," since it should concern "the world's state of affairs – especially environmental issues and global change problems," hence it should not be "value-free." It should, in Schmidt's opinion, rather be "engaged in changing the situation," and should achieve it by "fostering people's awareness, the responsibility of scientists or, in general, humans' stewardship for nature," by providing "a reflexive fundament for the betterment of societal praxis – and for a good life." However, in order to achieve such a philosophy, it is necessary for humans to develop a different mindset towards nature, a mindset which would "govern our approach to the natural environment and change our societal relations to nature." [20; p.120] In conclusion, Schmidt was a strong supporter of Jonas' philosophy and therefore a proponent of an ethically responsible human approach towards nature. Schmidt deemed a critical-reflexive *philosophy of interdisciplinarity*, which should be problem- and future-oriented, as key for achieving such an approach.

The contents of Schmidt's chapter on the relation between nature and the sciences can be reformulated in a question: What kind of science do we need in a world marked by instability and complexity? The topics of instability and complexity occupied a large part of his scientific

endeavors from the early 2000s. His thoughts on the matter reached their peaks in two of his previous monographs: *Instabilität in Natur und Wissenschaft: Eine Wissenschaftsphilosophie der nachmodernen Physik* [26] and *Das Andere der Natur. Neue Wege zur Naturphilosophie* [27]. Science of the second half of the 20th century has challenged the perspective in which the world was considered as being stable and static. It had shown that the world around us is mainly characterized by instabilities and complexities which stem out of them. Schmidt's view on the matter was, of course, a critical-reflexive one. In his opinion, such a view "opens avenues for exploring new directions within the sciences and for fostering a change in the way sciences conceptualize (*ex ante* and *ex post*) nature and our societal relations to nature," and it can also "encourage scientists (and all of us) to question what counts as legitimate science, entailing a cultural critique of present-day fragmented knowledge production, the institutionalized research system, and the related (Cartesian dualistic) worldviews." [20; p.123] He advocated and used it in order to find an alternative to the mainstream sciences by means of critical-reflexive interdisciplinarity. That type of interdisciplinarity involves four aspects: (1) *self-enlightenment* which encompasses a critical stance towards one's own approach to the world and to the boundaries of our framing of the world's objects; (2) *synthesis* or *synopsis* of disciplinary and non-disciplinary knowledge which would be used for creating a new and comprehensive understanding of nature and societal relation between humans and nature; (3) *change* or *transformation* in the orientation of science and scientific advancement; and (4) *problem orientation*, since it is related to grand societal changes. [20; pp.123-124] Accordingly, Schmidt's analysis concerned the fact that the sciences of the second half of the 20th century recognized instabilities, which was followed by the emergence of self-organization theories and shook the foundations of thus known science. In turn, Schmidt saw instabilities as an opportunity for a new synthetic-synoptic view on scientific findings which would shed a different light on nature, and he did so with the help of *philosophy of interdisciplinarity* which aims to unify various perspectives and create a scientific common ground [20; p.130].

In Schmidt's opinion, despite offering a new view on nature, instabilities simultaneously reveal limitations of and in the sciences. This dialectic relation is central to critical-reflexive interdisciplinarity. Instabilities have posed new methodological challenges to sciences by deconstructing the methodological dogma of reproducibility, predictability, testability, and describability which arose out of the Baconian scientific program. Hence a critique of the Baconian program is indispensable for a problem-oriented perspective. Instabilities turn out to be paradigmatic for a critical-reflexive orientation in interdisciplinarity and philosophy as an academic discipline [20; p.143]. In given circumstances, quantitative methodology became insufficient and had to be complemented by its qualitative counterpart, which involves methods such as processuality, modelling and contextualism. Schmidt deemed self-organization theories a prominent example of a new methodological orientation which produces and tests holistic models and offers explanations rather than (re)producing rigorous scientific laws. The dominant instrumentalist approach to science, according to Schmidt, addresses problems only at a superficial level, whereas late-modern science requires it to be complemented by a critical-reflexive dimension which would facilitate problem prevention. Moreover, Schmidt is convinced that late-modern sciences "open pathways to a more contextual and democratic understanding of sciences" [20; p.151]. In his opinion, self-organization theories, as a form of problem-oriented late-modern scientific paradigms, deal with problems on a deeper level. He argues that the emergence and wide recognition of instabilities do not "drive sciences into a dead end and render scientific inquiry impossible," but they rather "engender a different concept of science and a change of view regarding what counts legitimately as science" [20; p.152]. Finally, the new, appropriate scientific approach to phenomena in the

world of instabilities and complexity is the one which is critical-reflexive, problem-oriented, future-oriented, synthetic, synoptic, holistic, and methodologically contextual.

Schmidt concluded his monograph on *philosophy of interdisciplinarity* with a chapter on technology and the future. It is a topic on which he wrote in, for example, the article "Towards a prospective technology assessment: challenges and requirements for technology assessment in the age of technoscience" [28] and in the article "Prospective Technology Assessment of Synthetic Biology: Fundamental and Propaedeutic Reflections in Order to Enable an Early Assessment" [29].

Due to challenges related to environment, sustainability and global change, and since they are mostly caused by reckless use of technology, in the 1960s in the USA and in 1980s in Europe a new interdisciplinary approach to dealing with these challenges emerged: Technology Assessment (TA). The main goal of TA is to foster and facilitate societal and political shaping of technoscientific advancement by politicians and legislation, with its basic purpose being early identification and assessment of new technologies, as well as influencing their development. However, TA faced criticism. Schmidt was one of the authors who criticized the current state of TA. His remarks aimed at TA's lateness in reacting to problems produced by emerging new technologies, urging it to address "underlying technoscientific knowledge dynamics with its inherent tendency to continuously produce new problems," as well as at TA's lack of criticality in considering "the background of the issues we face today" [20; p.158]. Besides being critical towards it, Schmidt and his colleague Wolfgang Liebert [28] created a new concept of a critical-reflexive interdisciplinary approach in TA which should diminish TA's shortcomings: *Prospective Technology Assessment* (ProTA). Such a concept encompasses self-enlightenment "in the sciences and engineering, in the academy and the research system, and furthermore in science politics and society at large," which intends to "hinder the creation of new problems" and which "matches perfectly with the concept of critical-reflexive interdisciplinarity". Schmidt considered ProTA paradigmatic for his *philosophy of interdisciplinarity*, since he perceived it as a "normative-descriptive hybrid at the interface between science, society, and politics," moreover he was convinced that it can be "deemed to truly epitomize the concept of critical-reflexive interdisciplinarity" [20; p.158; p.178].

Schmidt's vision of ProTA involves four dimensions or orientations which sets it apart from TA: 1) *early-stage orientation* or timeliness in addressing emerging novel kinds of technology and in acquiring technoscientific knowledge; 2) consideration of purposes and options for realizing technoscientific potentials; 3) *shaping orientation*, since it aims to shape technoscientific knowledge production; 4) examination of technoscientific knowledge produced at the technoscientific core [20; pp.158-160]. ProTA turns out to be crucial because "technical systems, devices, things, and objects based on instabilities and showing self-organizing phenomena are beginning to populate our life-world," and from it stems the necessity to address "instability-based, late-modern type of technology and undertake the task of developing procedures either to restrict and contain or to shape and deal with it" from an ethical perspective [20; p.177]. In order to illustrate the applicability of ProTA, Schmidt used the example of synthetic biology which he considered to be a key technoscience of the future. The major essence of its technoscientific core being the "idea(l) of harnessing self-organization – including the ability to set off complex dynamical phenomena – for technical purposes" [20; p.177]. Being a relatively new technoscientific field, Schmidt claimed that societally relevant ethical issues arise from synthetic biology and that they should be addressed as early as possible, especially due to the fact that its further development and realization would cause us to enter "a new technological era in which

technical systems possessed high levels of autonomy and agency properties" [20; p.163]. Therefore, critical-reflexive approach which would facilitate early prevention, consideration of purposes, shaping and examination of technoscientific knowledge is of the essence. Furthermore, Schmidt's conception of ProTA needs to be founded on solid ethical basis, similar to the one put forward by Jonas in his seminal work *The Imperative of Responsibility* [30]. Schmidt argued that if ProTA would be "in alignment with Jonas's ethics," it could truly offer "an interdisciplinary, critical-reflexive approach that enables us to analyse and assess the technoscientific core of this new wave of emerging technologies" [20; p.177].

CONCLUSION

Philosophy was often criticized for not being involved in the discourse on interdisciplinarity. However, discussions on the relationship between philosophy and interdisciplinarity have intensified in the last two decades. Moreover, two levels of that relationship have been established in 2009: philosophy *of* interdisciplinarity and philosophy *as* interdisciplinarity. While philosophy *of* interdisciplinarity refers to a philosophical approach towards interdisciplinarity in the manner of philosophy of science, philosophy *as* interdisciplinarity encourages philosophical practice characterized by both reflective and reflexive engagement in the life-world, investigating and transcending academic philosophy's disciplinary boundaries and doing integrative fieldwork with scientists, engineers, and decision makers. Scholars have thus far shown more interest towards the first level, that is towards philosophy *of* interdisciplinarity.

The aim of our article was to thoroughly investigate the development of a specific *philosophy of interdisciplinarity* conceptualized by Jan Cornelius Schmidt, who devoted the past two decades to reflection on the first level of the relationship between philosophy and interdisciplinarity. We have traced the evolution of his *philosophy of interdisciplinarity* from a conceptual blueprint to its (current) peak, i.e., from his first utterance of the notion *Interdisziplinaritätsphilosophie* in 2005 to his monograph on the matter in 2022. We have recognized and emphasized two milestones in the evolutionary trajectory of Schmidt's *philosophy of interdisciplinarity*.

The first of them was his article "Towards a philosophy of interdisciplinarity. An attempt to provide a classification and clarification" from 2008. Schmidt was convinced that the first step towards a *philosophy of interdisciplinarity* is to approach the complex phenomenon of interdisciplinarity using a four-dimensional framework stemming from philosophy of science. The second milestone was his article "What is a problem? On problem-oriented interdisciplinarity." Inspired by Dörner and Scholz, Schmidt defined problem-oriented interdisciplinarity as the one which serves for constituting, framing, and clarifying a problem, anticipating and preventing it, as well as suggesting actions for its solution. Besides naming the problems of today and identifying the lack of answers provided by contemporary science's selective and incomplete, theoretical and practical understanding and use of interdisciplinarity, Schmidt gave priority to its problem-oriented type with the corresponding philosophical stance immersed in the critical theory of the Frankfurt school.

The development of Schmidt's *philosophy of interdisciplinarity* has reached its (current) peak in 2022 in the form of a monograph entitled *Philosophy of Interdisciplinarity. Studies in Science, Society and Sustainability*. As we have shown, it is a theory he has been meticulously building for two decades and gradually exposing in numerous articles and books published in that period. The leitmotif of the whole monograph is Schmidt's criticism aimed at mainstream science, which is unaware of or ignores the true meaning of interdisciplinarity, from an ontological, epistemological, methodological, and problem-oriented perspective. His criticism was founded and done with the

help of *philosophy of interdisciplinarity*, which he saw as a possible catalyst for improving the current relationship between philosophy, science, technology, society, and nature, as well as a possible pathway towards constituting new science for the future. In his opinion, the nanotechnoscience we witness today originates from and still largely resembles the thought of Francis Bacon. Such science promotes instrumentalism, neglecting negative implications and consequences of technological advancement. Schmidt's response to that is the critical-reflexive subtype of problem-oriented interdisciplinarity, which aims to prevent problems from emerging, thus being future-oriented. He recognized Hans Jonas as the precursor of such an approach, since Jonas promoted the imperative of responsibility in human conduct towards nature – their scientific endeavors included. Accordingly, Schmidt's *philosophy of interdisciplinarity* should be involved in the world's state of affairs, offering a critical-reflexive fundament for a responsible, value-laden, practically relevant philosophical consideration of the life-world. That implies the adaptation to the new science largely characterized by complexity, dynamics, and instability. Schmidt considered ProTA to be the embodiment of a responsible relationship towards technological advancement, involving problem prevention and critical reflection on the purpose of technology and science.

Schmidt's monograph represents the realization of one of two capital tendencies exposed at the Atlanta *Philosophy of/as Interdisciplinarity* workshop in 2009, the fulfilment of Schmidt's *desideratum* he evoked in many of his articles. However, Stephan Lingner rightfully noticed that Schmidt's monograph does not explicate "how its critical reflexive ambition might be carried-out in practice and how it could *effectively* enter research policies and related techno-scientific innovation," and that it opens the following question: "which incentives or organizational changes could nudge the actors in a competitive world to more responsible innovation beyond volatile appellative considerations." [31; p.79] But that was not the aim of Schmidt's monograph. From our point of view, his *philosophy of interdisciplinarity* presented in his monograph is the prerequisite for constructing a philosophy *as* interdisciplinarity which would practically tackle the problems of life-world and thus answer Lingner's questions. While Schmidt's monograph covered the missing theoretical *of* gap, philosophy *as* interdisciplinarity is still a practical *desideratum*.

REFERENCES

[1] Jantsch, E.: *Inter- and Transdisciplinary University: A Systems Approach to Education and Innovation*.
Policy Sciences **1**(4), 403-428, 1970,
http://dx.doi.org/10.1007/BF00145222,

[2] Jantsch, E.: *Towards Interdisciplinarity and Transdisciplinarity in Education and Innovation*.
In: Apostel, L., et al., eds.: *Interdisciplinarity. Problems of Teaching and Research in Universities*.
Organisation for Economic Cooperation and Development, Centre for Educational Research and Innovation, Paris, pp.97-121, 1972,

[3] Apostel, L., et al., eds.: *Interdisciplinarity. Problems of Teaching and Research in Universities*.
Organisation for Economic Cooperation and Development, Centre for Educational Research and Innovation, Paris, 1972,

[4] Hoffmann, M.H.G.; Schmidt, J.C. and Nersessian, N.J.: *Philosophy* of *and* as *interdisciplinarity*.
Synthese **190**(11), 1857-1864, 2013,
http://dx.doi.org/10.1007/s11229-012-0214-8,

[5] Thompson Klein, J. and Frodeman, R.: *Interdisciplining Humanities: A Historical Overview*.
In: Frodeman, R.; Thompson Klein, J. and Pacheco, R.C.S., eds.: *The Oxford Handbook of Interdisciplinarity*, 2nd ed. Oxford University Press, Oxford, pp.144-156, 2017,
http://dx.doi.org/10.1093/oxfordhb/9780198733522.013.13,

[6] Gerstberger, H.: *'Philosophy of interdisciplinarity.' Workshop report (Atlanta, September 28-29, 2009)*.
Natures Sciences Sociétés **18**(1), 42-45, 2010,
http://dx.doi.org/10.1051/nss/2010005,

[7] Hoffmann, M.H.G. and Schmidt, J.C.: *Philosophy of (and as) Interdisciplinarity. Workshop Report (Atlanta, September 28–29, 2009)*.
Journal for General Philosophy of Science **42**(1), 169-175, 2011,
http://dx.doi.org/10.1007/s10838-011-9150-4,

[8] Frodeman, R.: *Introduction*.
In: Frodeman, R.; Thompson Klein, J. and Mitcham, C.: *The Oxford Handbook of Interdisciplinarity*. Oxford University Press, Oxford, pp.xxix-xxxix, 2010,

[9] Schmidt, J.C.: *Prospects for a philosophy of interdisciplinarity*.
In: Frodeman, R., Thompson Klein, J. and Mitcham, C.: *The Oxford Handbook of Interdisciplinarity*. Oxford University Press, Oxford, pp.39-41, 2010,

[10] Mitcham, C. and Nan, W.: *Interdisciplinarity in Ethics*.
In: Frodeman, R., Thompson Klein, J. and Pacheco, R.C.S., eds.: *The Oxford Handbook of Interdisciplinarity*, 2nd ed. Oxford University Press, Oxford, pp.241-254,
http://dx.doi.org/10.1093/oxfordhb/9780198733522.013.20,

[11] Choudhary, R.K.S.: *Towards a Philosophy of Interdisciplinarity*.
Journal of Educational Planning and Administration **32**(3), 173-182, 2018,

[12] Choudhary, R.K.S.: *Integrating Interdisciplinarity through Philosophy*.
D.K. Printworld, New Delhi, 2021,

[13] Curis, C.: *Philosophy of Interdisciplinarity*.
International Journal of Educational Sciences **3**(5), 48-52, 2021,
http://dx.doi.org/10.26520/peijes.2021.5.3.48-52,

[14] Schmidt, J.C.: *Towards a philosophy of interdisciplinarity. An attempt to provide a classification and clarification*.
Poiesis & Praxis **5**(1), 53-69, 2008,
http://dx.doi.org/10.1007/s10202-007-0037-8,

[15] Schmidt, J.C.: *From life to technology? Cultural and scientific-philosophical aspects of the nature imitation thesis in bionics.* In German.
Dialektik. Zeitschrift für Kulturphilosophie (2), 129-142, 2002,

[16] Schmidt, J.C.: *Wundstelle der Wissenschaft. Wege durch den Dschungel der Interdisziplinarität*.
Scheidewege. Jahresschrift für skeptisches Denken **33**, 169-189, 2003,

[17] Schmidt, J.C.: *Unbounded Technologies: Working Through the Technological Reductionism of Nanotechnology*.
In: Baird, D.; Nordmann, A. and Schummer, J., eds.: *Discovering the Nanoscale*. IOS Press, Amsterdam, pp.35-50, 2004,

[18] Schmidt, J.C.: *Dimensions of interdisciplinarity. Paths to a philosophy of science of interdisciplinarity.* In German.
Technikfolgenabschätzung. Theorie und Praxis **14**(2), 12-17, 2005,
http://dx.doi.org/10.14512/tatup.14.2.12,

[19] Schmidt, J.C.: *What is a problem? On problem-oriented interdisciplinarity.*
Poiesis & Praxis **7**(4), 249-274, 2011,
http://dx.doi.org/10.1007/s10202-011-0091-0,

[20] Schmidt, J.C.: *Philosophy of Interdisciplinarity. Studies in Science, Society, and Sustainability*.
Routledge, London and New York, 2022,
http://dx.doi.org/10.4324/9781315387109-1,

[21] Schmidt, J.C.: *Knowledge Politics of Interdisciplinarity. Specifying the Type of Interdisciplinarity in the NSF's NBIC Scenario*.
Innovation: The European Journal of Social Science Research **20**(4), 313-328, 2007,
http://dx.doi.org/10.1080/13511610701760721,

[22] Schmidt, J.C.: *The Renaissance of Francis Bacon. On Bacon's Account of Recent Nano-Technoscience*.
NanoEthics **5**(1), 29-41, 2011,
http://dx.doi.org/10.1007/s11569-011-0109-z,

[23] Schmidt, J.C.: *Toward an epistemology of nano-technosciences. Probing technoscience from a historical perspective: on today's surprising prevalence and relevance of Francis Bacon*.
Poiesis & Praxis **8**(2-3), 103-124, 2011,
http://dx.doi.org/10.1007/s10202-011-0104-z,

[24] Schmidt, J.C.: *The topicality of ethics by Hans Jonas. A critique of the critique of the principle of responsibility.* In German.
Deutsche Zeitschrift für Philosophie **55**(4), 545-569, 2007,
http://dx.doi.org/10.1524/dzph.2007.55.4.545,

[25] Schmidt, J.C.: *Defending Hans Jonas' Environmental Ethics: On the Relation between Philosophy of Nature and Ethics*.
Environmental Ethics **35**(4), 461-479, 2013,
http://dx.doi.org/10.5840/enviroethics201335443,

[26] Schmidt, J.C.: *Instability in Nature and Science: A Philosophy of Science in Postmodern Physics.* In German.
Walter de Gruyter, Berlin and New York, 2008,

[27] Schmidt, J.C.: *The other of nature. New paths to natural philosophy.* In German.
S. Hirzel Verlag, Stuttgart, 2015,

[28] Liebert, W. and Schmidt, J.C.: *Towards a prospective technology assessment: challenges and requirements for technology assessment in the age of technoscience*.
Poiesis & Praxis **7**(1-2), 99-116, 2010,
http://dx.doi.org/10.1007/s10202-010-0079-1,

[29] Schmidt, J.C.: *Prospective Technology Assessment of Synthetic Biology: Fundamental and Propaedeutic Reflections in Order to Enable an Early Assessment*.
Science and Engineering Ethics **22**(4), 1151-1170, 2016,
http://dx.doi.org/10.1007/s11948-015-9673-x,

[30] Jonas, H.: *The Imperative of Responsibility. In Search of an Ethics for the Technological Age*.
University of Chicago Press, Chicago, 1984,

[31] Lingner, S.: *Book review: Schmidt, Jan Cornelius (2022): Philosophy of Interdisciplinarity*.
TATuP – Zeitschrift für Technikfolgenabschätzung in Theorie und Praxis / Journal for Technology Assessment in Theory and Practice **31**(3), 78-79, 2022,
http://dx.doi.org/10.14512/tatup.31.3.78.