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The Responsibility of Technoscience: the Contemporary Challenges

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Abstract
The paper shows ethical problems connected with the development of science and technology and the implementation of their results. The problem of responsibility in this area is of key importance as it evolves alongside the development and transformations of science and technology. The paper examines the issues related to the new requirements of responsibility which are combined with technoscience, the current formation of which, is one of the main factors of civilization changes.

Key words: civilization changes, philosophy of technology, responsibility, technoscience

Responsibility is one of the categories on which a variety of problems and attitudes are centered and the understanding of which is subject to certain changes at present. One of the significant areas where the problem of responsibility occurs is the area of science and technology and their civilization consequences resulting from the application and implementation of scientific and technological discoveries. Traditionally, the areas of science and technology used to be considered as separate and generally, science was viewed as subject to perceptive aims while technology was associated with practical objectives. The separation itself also affected the way of understanding the relationship of both areas with ethics, or, to a wider extent, it had an impact on their placement in the social and cultural (axiological) order. The latter was related to the

progressive institutionalization and professionalization of either science or technology. The institutionalization and professionalization of science and technology, which originated in the modern tradition, was at the same time combined with their autonomization and, consequently, with the perception of both areas as ethically neutral and axiologically independent (Lizut, 2014). The convictions held in the 20th century by the positivist tradition began to give way to change and, as a result, the so – called normative turn appeared at the turn of the 1960s and 1970s changing the way one perceives science and technology into ethically neutral domains (Kiepas, 2000, pp. 11 and next). On the other hand, another approach also appeared, according to which, the portrayal of science and technology as ethically neutral and autonomous, has never been substantially compliant with reality because, in practice, science and technology have functioned as the areas which are not fully and instrumentally enclosed within themselves and abiding by the rules of instrumental rationality (Latour, 1993). In practice, the instrumentalization was of limited character, which was reflected by, characteristic for the modern tradition:

a) Differentiation and separation of the orders of the social and natural world, but, at the same time,
b) Maintaining their unity, i.e. remaining in certain relationships.

Either the separation or remaining in certain relationships were reflected in the area of science and technology. We used to be faced with the analogous situation throughout the emphasized separation of science that keeps achieving goals and cognitive values, from technology aiming at achieving objectives and practical (useful) values. Technology, on the other hand, was referred to as applied science, which, in relation to the problem of responsibility, led eventually to:

a) The limitation of science responsibility, often narrowed down only to the necessity to comply with relevant regulations and methodological principles characteristic for particular sciences;
b) The limitation of the responsibility of technology, because as applied science it was subject to determinations stemming from science and its results and, consequently, the responsibility for the implementation of certain technologies was transferred upon its users.

The conviction that what science recognizes technology will use also had its double consequences, namely, on one hand, we are faced with the kind of inner determinism leading to the occurrence of relevant results conditioned by the interrelationship of science and technology, and the results themselves, on the other hand, are subject to being popularized in a society – which is caused by more or less subjective and particular decisions and choices. What is to a

certain extent objective, though not deprived of subjectivity elements proper to the scientific method and even more appropriate to technology, clashed with what is subjective and dependent on proper decisions and choices. As a result, science and technology were perceived as ethically neutral areas and at the same time the processes of creating knowledge and things were separated from the ways of their usage, which led to their placement in the area of right ethical and axiological resolution. E. Bińczyk, referring, in a similar context to B. Latour's idea of *actor-network*, writes: "Modernity remains blind to the practices of constructing reality and to the mobilization of new actors, it introduces the division into facts and fetishes, 'the pure theory' (of scientific discoveries) and practice (of technological applications). The specific unconsciousness facilitates effective and intensive fabrication. Thanks to the rhetoric of 'discovering objective facts' the modern science can retain its apparent neutrality." (Bińczyk, 2012, p. 78 [own transl.]) The coupling of science and technology does not only make them remain in specific relationships and dependencies but it also makes them frequently indistinguishable. Traditional divisions which used to function in that respect, retain their validity only partially, the example of which might be the division into the so-called basic (cognitive) and applied (application) research. Nowadays in the scientifically predominant sphere of the so-called research and development (R+D) these divisions do not occur, and the fact that the sphere is traditionally associated with the area of applied, not basic research, is of no significance. Also, the traditionally separated educational domains such as university and polytechnic ones, have a more symbolic, rather than real character. One of the consequences of this state of affairs is the peculiar relativization of the concept of truth and truthfulness in science, which also raises the question of the condition of its rationality.

The traditional scientistic approaches, mainly related to the modern and positivist tradition, treated science as the paragon of rationality, however, the following assumptions were made:

a) The relative independence of certain cognitive procedures was assumed and relevant actions were separated from the targets which were to be achieved by means of these actions; the use of scientific method implied the separation of facts and values, description and evaluation, independence, non-contradiction and axioms' completeness in deductive systems, the necessity of measurement reproducibility and elimination of random errors etc.;
b) Moreover, the relative methodological autonomy and axiological independence of science and its subjects were assumed, whereas the maintenance of the maximum

level of objectivity was one of the fundamental norms of the subject. (Amsterdamski, 1994, pp. 133 and next)

The rationality thus understood might be depicted as naturalist, which is manifested by acceptance of the following:

a) "Scientific knowledge is – or at least might be – the result of the sole application of rational procedures;
b) Knowledge development is – or at least might be – reconstructed as the result of procedures' application, which means that ,at the same time, the scientific method constitutes the logic of epistemological development;
c) The logic of epistemological development is invariable, it does not succumb to historical transformations." (Amsterdamski, 1994, p. 37)

These convictions have been questioned by the representatives of the modern philosophy of science, e.g. by T.S. Kuhn and P.K. Feyerabend. The above understanding of science rationality is particularly strongly rejected by T.S. Kuhn and P.K. Feyerabend, for whom a lot of factors of subjective nature come into being in the science development, and eventually, they are also of big importance. Henceforth, one may accept the factors which are irrational from the point of view of traditionally understood rationality, even though it does not mean regarding science as irrational. In the end, e.g. according to T.S. Kuhn, these are the paradigm considerations that decide about the rationality of relevant science results. The standards of this rationality are not universal, nevertheless one cannot regard them as something random or arbitrary. The choice of a paradigm is neither random nor arbitrary and therefore the scientific representations of the world are rational. The dispute over science rationality seems to be apparent only, because, generally, rationality is not questioned – these are only its requirements which are understood differently and that was rightly highlighted by S. Amsterdamski who wrote that: "what all science definitions aiming at settling the problem of its rationality a priori have in common – is the ideological defense of the ideal of scientific knowledge, as it is the ideal itself which implies such a concept of rationality." (1994, p. 38 [own transl.]) As a result truth and truthfulness lose their objective meaning, primarily expressed by means of cognitive and methodological criteria and as S. Amsterdamski writes in this respect: "Truth ceases to be the autotelic value for everyone, the true knowledge is, first and foremost valued for its usefulness, and usefulness, in turn, unlike truth, is a gradable value, relative in regard to the recipient and the situation, where the institution employing a scholar and financing the research is the recipient. And even when the values are not contradictory as a rule, not any true knowledge remains equally useful to a recipient in a certain situation." (Amsterdamski, 1994a, p. 111 [own transl.]) What is

important, as J.F. Lyotard writes, is: "who decides what knowledge is, and who knows what needs to be decided? In the computer age, the question of knowledge is now more than ever a question of government." (1984, p. 9) The result is not only knowledge acquisition, knowledge loses its clearly homogenous character, which is expressed by the mingling and mutual dependence of science and technology and the process itself was initiated in modernity. Knowledge is by far not only the collection of information but it is also the factor shaping man's strength and possibilities.

On one hand E. Bińczyk combines the status of modern technoscience with the postconstructivist approach but on the other hand with the so-called strong program of knowledge sociology. (Barnes, Bloor, 1993) In this aspect postconstructivism is combined, among other things, with the recognition that "in the field of latest studies on science and technology, the constructing is not perceived as social endeavor only. The constructing processes are rather multidimensional occurrences which also take place in the dimension referred to as 'material'.[...] A given constructed object is usually constituted by the entire network of mutually dependent and ontologically different elements. And these are not only social relations. The factors depicted as neutral/material (non-human), normative, organizational and symbolic are bound together and stabilized in a gradual process of objectivization of what is regarded as facts." (Bińczyk, 2012, pp. 69-70 [own transl.])

The above mentioned attitudes and related processes of science and technology transformations leading, in consequence, to the formation of technoscience, display a variety of meanings referring, among many others, to:

a) The status of technoscience in a society and culture, not only in varied local or national dimensions, but also in a global dimension, the functioning of which is to a high degree the result of technoscience development;
b) The status of results being the technoscience product , further subject to social implementation processes which bear certain consequences;
c) The factors of regulation, control and formation of what is happening in the area of technoscience and what is later popularized in a global or local scale. (Lenk, 2007)

One can mention ethics as one of the probable factors of technoscience regulation, control and formation, or, to a wider extent, the factors displaying normative character leading, eventually, to the legitimization of technoscience and its results alongside with the effects of their implementation. The role of ethics in this matter might be seen in two ways as:

a) The factor of inner regulation – that is the role various ethical codes were to perform, including those associated with science and technology (engineering ethics); (Kiepas, 1992, pp. 56 and next)
b) The factor of external regulation, or legitimization being justification (more weakly) and validation (more strongly) of what is the result of technoscience functioning and what also requires proper validation of effects of its results' implementation.

In both cases responsibility, the meaning of which surpasses the moral (ethical) dimension, plays a significant role. (Kiepas, 2000, pp. 100 and next)

Traditional understanding of responsibility bound it to the originator being either the subject of given actions or the one who is, at the same time, aware of the consequences of actions. Responsibility was contained within knowledge boundaries and an intentionally acting agent. The subject of responsibility is an individual aiming at the appropriate intention and consciously contributing to the appearance of what is the effect of this actions. H. Jonas (1985, pp. 90 and next) describes it as the ex post responsibility, i.e. responsibility for something that has been done. And when one intends to either ascribe or take the responsibility, knowledge of the following is essential:

a) What were the effects of a certain action
b) What actions caused these effects
c) Who was the causative subject of that action.

Responsibility was contained here within the area of the human being's causative power, conditioned, at the same time, by their range of knowledge about what they can do and what they really did. The field of responsibility was depicted here by the relationships between the subject, object and the instance of responsibility. And only individual subjects were the subject of responsibility in this aspect (Ingarden, 1987, pp. 97 and next). However, nowadays such understanding of responsibility seems inadequate on account of the changed nature of human activity and the correlated change of the status of technology and science in a society. At present human actions acquire new features because:

a) They become collective and institutionally organized actions and it is the collectivity, not individual subjects, that becomes the subject of actions, and this , in turn, bears certain consequences when it comes to the actions' effects, or more precisely, to cooperation
b) The effects of certain collective actions might display cumulative character as the effects of individual actions add up and eventually they yield certain results; the final

aftermath is the outcome of effects' accumulation, the effects being the result of conscious intentions of each individual subject

c) The effects being the result of cooperation in structures which display the network (hetearchic), not hierarchical character. The effects are the outcome of certain processes' progress and do not have an intentional character, i.e. they do not stem from conscious intentions of individual subjects; nowadays a lot of global consequences take on the casual, random and unintentional character.

In this way conscience ceases to be the main instance of responsibility and henceforth the issue of co-responsibility becomes one of the most vital problems , the same applying to co-responsibility requirements and its implementary conditions in the present situation giving way to new conditions of activity and responsibility. In this aspect, according to K.-O. Apel, it is combined with the fact, that:

1. Actions' range is so big that their effects and side-effects go beyond "every *face to face encounter* with the affected human persons, it becomes very difficult to compensate for this *loss of proximity* to one's fellow human beings, say, through imagining what they might have to *suffer* from our actions or activities" (1993, p. 11); eventually conscience as the instance of responsibility remains dormant to a considerable degree and cannot perform its originally designated role;
2. The need of specialist knowledge (scientific information) in order to take certain moral decisions; knowledge ceases to play emancipatory functions only, on the contrary, it becomes the factor of man's uprooting because knowledge formulated by experts is always relative in character; knowing something we are always subject to some kind of unawareness which characterizes the current situation as the situation of risk and not only does it require appropriate procedures of knowledge use but it is also followed by the necessity of managing and controlling the area of unawareness. (Giddens, 1991, pp. 23-34, 109-143)

The necessity of surpassing the reduction of responsibility subjects to the causative ones was reflected e.g. in the preventive responsibility suggested by H. Jonas (1985, pp. 108 and next) – ex ante type of responsibility, responsibility for something to be done. Responsibility is determined, on one hand, through the subject's range of strength and possibilities, relatively stronger than the subject's weakness exposed to the strength. The matter of responsibility is not only something which has been done but, most of all, something which can be done. In case of preventive responsibility we still deal with what is within knowledge range. And in this case it is prospective knowledge related to the possible future consequences of our activity the aim of

which is to avoid and eliminate negative effects of this activity. The functioning of preventive responsibility is supposed to be the means of fostering control over certain actions and decisions before they become real. However, various doubts arise – whether the preventive type of responsibility can effectively play the ascribed roles and whether it can meet expectations bound to that responsibility. At least in the shape suggested by e.g. H. Jonas, according to whom, it is to be constructed on the knowledge foundation related to the possible future consequences of a variety of actions and decisions. One of the tools of thus understood realization of preventive responsibility might be the realization of technology assessment idea (technology assessment – TA) (Zacher, 1975). The development of technology assessment idea was, among other things, connected with the so-called experts' crisis and with the lengthy discussion on the relationships between technology and society that has been going on for many years. The decline of confidence in experts and the loss of faith in the authority of science and technology had a significant impact on the emergence of diverse concepts of technology assessment which gave rise to two models of utmost importance:

1. TA models as political counseling – they were based on the task division between science, technology and politics, the technology assessment, in turn, was perceived as an implement supporting certain political decisions regarding technology and its implementation.
2. Participatory technology assessment – this model is based on the assumption that there are various conflicts in the area of technology and TA is seen here as a way of conflicts' resolution; what is assumed here is the participation of the society and its groups in the process of making technological choices. (Grunwald, 1999, pp. 12 and next)

Technology assessment comprises, among other things, procedural, argumentative (cognitive) and axiological (normative) aspects and each of them has the designated development boundaries of TA as specific scientific knowledge. They also manifest themselves in the course of realization of technology assessment respective models. Moreover, a variety of optimalization procedures have limited significance and application owing to the nature of the world of values which are combined with the evaluation of relevant technology development consequences. The limitations appearing here are characteristic of consequentionalist and axiological ethics. What is aimed at here, among other things, is the finding of such universal and commonly accepted values that will make the consensus possible and, at the same time, they will facilitate unequivocal evaluation of technology and its diverse effects. The ethics of values is faced with the boundaries not only connected with the nature of values itself, but also with the pluralism of their

preferences by different individuals and social groups. The possibilities and means of control over various consequences resulting from science and technology discoveries' development and implementation are exposed to the normative, rather than procedural, limitations. The participatory models imply the necessity of participation of all concerned in the technology assessment process, and especially those who are, or will be, under the influence of various negative consequences of technology development. The principle of preventive responsibility is embedded in the concept of technology assessment, and its foundation is knowledge of certain consequences of developing particular technologies; knowledge acquired as a result of the application of assessment procedures. The preventive responsibility is also based on a certain view of the human being as a subject who thanks to appropriate reflection is able to fulfill the requirements of thus understood preventive responsibility.

In case of technoscience the situation becomes more complex due to:

a) The complexity and inner differentiation of its subject – the subject comprises a variety of institutions and organizations forming, as a result, the conglomerate of heterogeneous character (e.g. the result of coalescence of the basic and applied research);
b) The cumulative, and not only intentional but also random and unintentional, indirect character of numerous consequences triggered by the implementation of technoscience consequences.

In this case the peculiar dispersion of subject and object of responsibility makes it also relate obligatorily to the instance of this responsibility. The preventive responsibility must take the form of co-responsibility where the roles of subject and the instances of responsibility will be specifically intertwined and they will frequently remain undistinguishable. The problem of co-responsibility and related challenges also remain in a relationship to the contemporary social and cultural challenges which, in general, are referred to as 'reflexive modernization.' The modernization processes are most commonly associated with the role of risk in the contemporary technological civilization and e.g. U. Beck, referring to that, claims that the vital feature of reflexive modernization means that the interrelated risk primarily affects indirect (random, unintentional) consequences of the implementation of scientific and technological discoveries (Beck, 1992; Beck, Giddens, Lash, 1994; Beck, 1999). The necessity of maintaining control over the side effects resulting from the development of science and technology, until recently treated as uncontrollable and therefore remaining beyond the sphere of man's strength and possibility, has to be included within the area of what might be disposable at least to a certain degree. In the situation of reflexive modernization, in the meaning proposed by U. Beck, the focus shifts from

the pursuit of knowledge use and acquisition to proceedings and action in the situation of unawareness – as he writes in this context: "the 'medium' of reflexive modernization is not knowledge, but – more or less reflexive – unawareness." (2005, p. 349) Reflexive modernization is combined here with the occurrence of risk, the global one included, which subsequently triggers the following:

1. Unawareness becomes an element of contemporary life situation – the human being is deprived of the power of judgment alongside with the reduction of the importance of sensuality; first of all, one has to bring out the primary trait of living in the society of worldwide risk: the disinheritance of the senses and, at the same time, the *common sense* as the anthropological prerequisite of self-conscious life and judgment; the question of human subjectivity acquires new and additional dimensions in this case;
2. The bigger the threat, the greater the unawareness, the more indispensable and, at the same time, a less probable decision (paradox of decision); in this context one has to differentiate between the unintentional unawareness (what one cannot know) and the intentional unawareness (what remains unknown because of some reasons); and what is generally aimed at when it comes to intentional and unintentional unawareness is not compensating for the possible losses but, on the contrary, it is about preventing something that does not exist and we are not aware of; what one cannot know needs to be prevented. As a result a new threat over threats arises: preventive measures against disastrous risks unleash the risks which are even bigger than the disaster one wanted to avoid. (Beck, 2005, pp. 342-347)

In this way the relationship between knowledge and ignorance keeps changing (Tarnopolski, 2010), which also bears some consequences for the contemporary status of technoscience. It seems that this way of perceiving reflexive modernization reflects the social, cultural and civilizational status of technoscience much better and it also seems to be more adequate to search for the requirements and conditions of its co-responsibility. Unawareness is also something which is subjected to appropriate structuralization, where the knowledge of unawareness might refer here to:

1. Knowledge of something that one cannot know – possibility/necessity of resigning from the implementation of individual technical solutions;
2. Knowledge of something we do not know but we might know – obligation of research and theory formulation;
3. Knowledge of something we do not know in reference to a given case – the requirement of inter- and transdisciplinarity;

4. Knowledge of unawareness in reference to subjects responsible – the requirement of co-responsibility. (Zimmerli, 1987, pp. 92 and next)

In the first case we deal with what was previously defined as unintentional unawareness, and with intentional unawareness in the remaining ones. The rule of preventive responsibility is constructed here not only on the basis of a certain knowledge range, its foundation is also made up of different kinds of unawareness.

The area of co-responsibility does not only comprise what the human being knows but it also includes the awareness of ignorance which the particular solutions presented above are combined with. Knowledge and unawareness overlap and not as a result of their separation and pointing at knowledge boundaries can we define simultaneously the boundaries of various subjects' co-responsibility[1]. The situation of risk makes knowledge comprise not only what we know but what is also important is the knowledge of what we do not know and the awareness of what we cannot know. Following the prevention rule in the area of ignorance we do not eliminate threats and risk but it becomes co-constructed and therefore it is also the subject of co-responsibility. These are the additional requirements which, alongside with the implementation of technoscience discoveries, are to be met by the man being the rational subject of certain actions and decisions and the subject of co-responsibility. One of the tools alleviating the problems connected with the realization of co-responsibility is the idea of Responsible Research and Innovations (RRI) allowing for the inclusion of various social actors into each stage of the innovative process. The latter of the concepts presented was targeted at the innovativeness upgrading of the European Union societies, taking into consideration the fact that the popularized innovations not only will be characterized by novelty, but it will also be possible to regard them as responsible innovations. The RRI idea comprises the following, co-constructing aspects:

1. Joint choices – inclusion of all the social actors (science, technology, industry, politics, civil society);
2. Activating the full potential – gender equality, promotion of women's activity on different stages of innovation process;
3. Scientific education – increase of the number of scientists who are equipped not only with the up-to-date knowledge but also with the skills of creative but responsible thinking; the growth of interest in technical sciences, mathematics and STS (science, technology and society) issues among young people;

[1] Problem of co-responsibility also refers to the so-called institutional (corporate) problems, and that problem requires a separate and more in-depth discussion going beyond the boundaries of this paper.

4. Open participation – transparency of innovative process, data and findings' publishing which should eventually aim at their effective use by all social actors;
5. Think good and do it well – ethics perceived not only as something imposed in the area of science and technology, but as a means of maintaining a high quality of results; ethical standards, fundamental human rights etc.
6. Managing science "for" and "with" the society – it is a kind of umbrella comprising the remaining key ideas; policy of responsibility targeted at the prevention of harmful and unethical practices and their social effects.[2]

The idea of RRI thus understood might now appear to be utopian in many aspects, nevertheless, its related potential of responsibility building seems to be one of the answers to the contemporary civilizational and cultural role of technoscience. The realization of co-responsibility and the fulfillment of its requirements is the process that entails meeting numerous conditions, even those that seem to be impossible today, and this is also one of the elements of unawareness we are exposed to in this area. The above shown challenges and below:

Table 1. Responsibility of science and technology – types, ranges and transformations

Type of responsibility	**Subject**	**Object**	**Instance**
Traditional	Individuals	Direct action results (theories, projects etc.)	Other representatives of science and technology; scholars and engineers' conscience
Modern science and technology	Individuals within institutions and organizations	Foreseeable results (economic, political, social etc.)	Economic, political and social instances, TA institutions
Technoscience	Network of organizations and institutions	Intentional and side effects	Co-responsibility of various subjects, RRI

[2] See: www.ec.europa.eu/research.

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