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Toward Democratization of Science and Technology Spheres. Some Opportunities and Problems

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(...) The premier knowledge institution throughout the world is, still, science.
K. Knorr-Cetina, Epistemic Cultures (2000)

Controversies over science and technology are struggles over meaning and morality, over the distribution of resources, and over the locus of power and control.
D. Nelkin, Science Controversies (1995)

Abstract

The goal of this article is to review selected problems of science and technology in many contexts, e.g. production of knowledge, evaluation of technology, visions of future developments. However, the main focus is on the societal perception of science and technology and their applications and multifaceted effects and impacts from the point of view of our ability to influence them. Over time, this influence should become more and more democratic. Such is the citizens' demand in the advanced democratic countries. So postulates are formulated, methods and procedures are elaborated, and experiments are conducted. Some positive experience is cumulative and widespread. Participatory practices in science and technology decision-making are appreciated. However, there are many obstacles and barriers to be overcome. There are many optimistic expectations from citizens and social science as well. A rational approach, proactivity, and a 'cold' evaluation of political abilities and of cultural embeddedness are needed. The promising fact is that the language of the discourse has already been developed.

Introductory remarks and historic reflections

Democratization of science and technology as a timely postulate is justified for many reasons; one is simply practical: the R&D sector, its researchers and administrations, think tanks, various councils and committees, advisory bodies working for political institutions – they all have their own interests and want to secure contracts and research money, to be promoted, to

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organize new units, conferences and big research programs, to be invited by media and by political bodies for consultations and advice, and, not infrequently, to make political careers. As in every community, the people from this sector and from those around it fight for their interests, and they play various games with public administration, with business, and with the public as they form various lobbies (e.g. nuclear power, environmental). Competition for money (sometimes very big money), for prestige, and for administrative, advisory, and political positions is very keen within this sector. New programs, projects, and research institutions are fighting for their place in the science structures, in education, and in the state budget. The methods involved are often more rooted in ideological and political considerations than in 'truth' or citizen-oriented considerations. The history of science and technology shows frequent cases of mistakes, misconduct, fraud, excessive ambitions, personal interests, biased promotion of priorities, hiding information, political competition among scientific institutions, and so on, not to mention intellectual controversies presented by the sciences that are not well understood by the public (see e.g. Hamblin 2009). All these trends make the public increasingly sceptical and lead them to demand more information and more control over the use of taxpayers' money.

It should be added that the scientists have always relied on some ideologies to drive them and to justify their choices, priorities, and methods. An example of such an ideology was the *modernization theory* (Engeman et al. 2003; Latham 2000). The Promethean views and the idea of progress were its predecessors. This ideology became the official state ideology in many countries with dynamically developing technology. For almost half a century – the Cold War era – there was a predominant engagement by the world of science (i.e. of its leading actors) in military and paramilitary research and applications. In this period the collaboration between the state and corporations was close in the USA – the technological world leader. The big flow of federal money to companies and universities shaped educational policy, highway construction, nuclear power, electronics, computing, aerospace (NASA programs), and biomedicine. The result of this influx of money was that the standing of knowledge, both scientific and technological, was politically heightened.

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Some authors point out that the *modernization ideology* had to serve the Western technological hegemony, to promote the global expansion of global capitalism, to assist lesser developed countries (LDCs) in their transition to modernity, not to mention the American hegemonic interests and US foreign policy (see e.g. Adas 1989; 2006; Gilman 2003; LaFeber 2000; Nye 2003).

Obviously, the technological modernization promoted by the leading countries (mostly the USA) served overwhelmingly their national and hegemonic interests (to make the rest of the world dependent on their knowledge and technology and create an orderly and non-revolutionary transition). In the Soviet hemisphere the goals were similar but implementation was comparatively poor. Since the 1970s, however, the concept of the *scientific and technological revolution* was *de facto* treated as a new ideology of modernization linked to traditional communist ideas. Nevertheless, the R&D expenditures were high (as a percentage share of GDP). Lack of democracy (see e.g. Augustine 2007; Gerovitch 2008) and democratic traditions are even today a serious barrier to the development of participatory thinking and practice in Russia.

Another driving force – besides East-West competition and hegemonic ambitions – was the activity of many *international bodies*, mostly connected with the UN (e.g. FAO, UNIDO, UNESCO). They had big programs and financial resources which could be used for R&D on a competitive basis.

The promises and expectations connected with technological progress and technology transfer were not fulfilled. Imitation of the patterns of the leaders was not possible for most of the LDCs (the Soviet bloc was an object of the Western embargo of new technologies coordinated by COCOM – Coordinating Committee for Multilateral Export Controls). So the idea of 'catching the forefront of development' generally failed. In the late 1960s and 1970s E. F. Schumacher, critically assessing the mechanical transposition of advanced technology to LDCs, tried to spread the idea of *intermediate technology*. But it was no match for mainstream science and technological and industrial structures and interests. Nevertheless, looking for alternatives could help alert people who are seeking more information and greater influence on structural choices, on domestic

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R&D and on international programs. This should not be overlooked; democratization is an alternative to technocratic or authoritarian rules and decision-making in the sphere of science and technology.

A quest for democratization of the science and technology sphere

For more than a half century, science and technology has become an area of more intensive *public interest* and *public demand* for influence on their directions, applications, and consequences. Democratization of this area is progressing in spite of some difficulties and resistance, while more and more positive experiences can be noted.

Postulates and practices of the democratization of the relations between science, technology and society are multi-dimensional and multifaceted. Until quite recently this relation was treated in terms of a kind of contract between separate sectors – R&D, government, citizens. While the R&D sector was mainly academic and enclosed in the 'ivory tower' (the so-called Mode 1 of production of knowledge), the government agencies elaborated the scientific and technological policy, and the citizens were relatively passive consumers of commercial business products of technologies and had to obey technical requirements and appropriate legal regulations connected with the use of these products.

The aforementioned postulates, demands, and the growing number of experiments and practices can be summarized in a few points:

– Building and strengthening *relations* (partnerships) between universities and industry and also private *non-profit* institutions. The role of the state (parliament, government and its agencies), public-private partnerships, control of commercialization (often limiting of public space) and implementation of social goals (promised by politicians) should function under conditions of 'democratic balance' of influence by various stakeholders. The freedom of scientific research should be respected.
– Research *priorities* in the public sector of R&D (e.g. in agricultural and health care areas) should be specified using interactive (participatory)

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methodologies and procedures to ensure transparency, representation of the major stakeholders (e.g. scientists, employees of a given sector, patients), mutual learning and knowledge sharing (discussions, interviews, questionnaires), and also legitimization and rationality of priority choices and their translation into the language of future policies and actions (Caron-Flinterman et al. 2006). What is important here is that consensus-building is not the only outcome, but also that there is opportunity for mutual understanding and learning and improving participatory procedures as well. Democracy (participatory and deliberative) means representativeness, transparency, direct engagement, equality of participants, as well as mutual respect, openness, and constructive interactivity. A growing number of fields of science and technology are subject to such defined procedures (albeit mostly in the advanced Western democracies), for example, biomedical technologies, health care, biotechnologies, GMO technology, ecological planning, transportation, telecommunications, and energy. Other effects of such procedures and policy experiments have to be a shaping of the *scientific citizen* (Irwin 2001) in accordance with the fashionable vision of a *knowledge society*.

– Organizing *consensus conferences*. There are many cases and experiences in the area (see e.g. Chilvers 2008; Guston 1999; Harvey 2009; Kleinman et al. 2007; Rothstein 2007; Powell 2009; Rudinow Saetnan 2002). Practices of this type can by found in many countries (e.g. Denmark, Sweden, Norway, the Netherlands, the UK and the USA). Such conferences concern – as a rule – controversial (for science and politics) problems such as biomedical technologies and GMOs. The controversies are not really connected with the technologies *per se* (however some ethical questions are often raised – see Salter 2007), but with their costs, availability, effects, and impacts. Various models of these conferences are well described in the subject literature (Kleinman 2007; Lengwiler 2008). Such conferences resemble – on the one hand – scientific meetings (opinions and discussion of experts) and on the other – a court trial (consensus panel listening to expert witnesses, judging, and presenting a verdict at a press conference). In the consensus conferences the key role is played by scientific experts of the discipline analyzed and other disciplines (e.g. law, administration science, ethics). Apart from the

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opinions coming from the investigated area of research, other criteria are considered and applied, which are often important from a political standpoint. A consensus obtained may help in the formulation of policy recommendations and in setting technical standards. Usually the conferences are accompanied by questionnaires, interviews, and public debates. The question is to what extent the consensus-building is based on the scientific discourse and to what extent it is based on the citizens' discourse. There are many general as well as specific issues referring to fixing criteria and selecting experts from the field at stake and from other fields, not to mention conducting the whole conference and the discussion in particular (these issues are described by many authors, e.g. Clarke 2007; Chilvers 2008; Dryzek 2009; Ferber 2006; Hanschitz 2009; Hildebrand & Gutwirth 2008; Leach et al. 2005; Stirling 2008).

– Democratizing the *expertise* activity and simultaneously creating democracy 'expertised'. In societies that increasingly rely on knowledge (more or less scientific), the roles of experts, expertise, and governance have to be linked with knowledge. However, the question is how to make expertise activity more transparent, how to evaluate it, what should be the relation between sponsors and experts, what to do when the expert cannot decide in the place of decision-makers (a special edition of 'Science and Public Policy', June 2003, was devoted to these questions). Of course the answers are complex and sometimes controversial. This is the case because the logic of power and the logic of knowledge can be in conflict. Knowledge, represented by experts (e.g. in various councils, committees, or as advisers) happens to be assessed by highly specialized persons – by scientists and experts. Moreover, analysts and decision-makers are predominantly interested in governance. So if we reject the arrogant conviction that expertise constitutes a kind of self-referential and self-evaluating system, the possibility of a 'citizen factor' emerges. The democratization of the expertise activity should comprise such actions as ensuring that all procedures are correct, that citizens can participate in the deliberation process, and that the needs and rights of citizens are realized. The citizens ought to have a right to articulate their views every time a proposed technological solution generates a risk. Well-informed debate and bargaining should be linked with a

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pluralistic advisory group of experts made up of citizens and democratic institutions. Participation of all parties (Liberatore & Funtowicz 2003) cannot be limited only to patronage, marketing, or just passing along information on technological solutions, but it should be real and honest debate on formulating problems and on minimizing uncertainties and risks. Pluralistic expertise and well-informed debates create a *socially robust knowledge* (the term of H. Nowotny, Nowotny 2003). Needless to say, there are still many problems in this process. For example, it sometimes happens that the experts are politically recruited; sometimes they may have their own political ambitions. However, there is no 'intelligent democracy' without expertise activity, which should certainly be democratized (Liberatore & Funtowicz 2003). In matters of governance, it is necessary to consider the changing relation and strengths of the public and private sectors (the extreme case – advocated by some – could be the privatization of government), and also the relation between representative democracy (its institutions and procedures) and participatory democracy (its methods and requirements).

Some useful approaches and concepts

Apart from the demand for democracy and its practice (i.e. by including lay persons in the process of elaboration of expertise and arriving at conclusions and recommendations) a broad interactivity is postulated. A new model of so-called *interactive social research* (or even interactive social science) is promoted. There are four representations in the model: sponsor (ordering), research team, independent organizations (from the government sector, from non-governmental entities, and/or from business) and the interested public (i.e. citizens interested and/or impacted). The knowledge produced in this way is a result of the co-operation and interaction of researchers, actors (decision-makers) and partners (Robinson & Tansey 2006). Such a model overcomes the traditional division into 'producers' and users of technology. Moreover, all four sides must function interactively – to a varying extent – in the whole research process: from definition of an agenda, to task selection in a project, to its realization and finally to

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application of its results. So if an *influence on decisions* is the essence of democracy – which is our view – the described procedures are steps in its good implementation in the fields of research and application of results. Of course, technical and organizational dimensions of the above processes may vary. The authors cited presented the approach of *participatory integrated assessment* (or in other words – participatory integrated evaluation) applied in the five-year interdisciplinary and collaborative project concerning the bio-region of British Columbia, Canada. A computer model was used to evaluate the bio-geophysical constraints as well as the socio-economic consequences of the future development. The model enabled researchers to construct long-term (40 year) scenarios of regional development. All choices in the scenarios were made within the scientifically described 'space of possibilities'. The model makes it possible to evaluate the impacts of these choices, to evaluate their advantages and costs, as also to compare the future alternatives. The subsequent model simulations enabled researchers to achieve a desirable scenario in an interactive way. The model then allowed its users to 'play.' Thus even the non-expert users (e.g. independent organizations) played a direct role in the construction of the final scenario for regional development. It was important that there were not really users, but players in the model (constructed as a game).

The goal which could be possibly universalized is setting up the 'informed public' or in other terms, the voters who can support the social change, the voters whose engagement in the discourse on public policy could be enlarged. The other important task could be preparing a data base of social preferences, values, acceptability limits, and alternative scenarios of the future. This process is also a *learning of modelling* of procedures, making choices and evaluating their impacts, and *learning democracy* as the continuing process and mechanism of coming to a consensus on interests, expectations, and visions. This process can be described not only as participatory but also as a *learning democracy*, which may be practiced in many areas that are vital for societies (e.g. sustainability of development).

Growing knowledge and new technologies connected with it are problems of global dimensions and they require a kind of democratic governance. Three types of technologies are most often mentioned in this context: information and communication technologies (ICTs), bio-

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technologies, and nanotechnologies. So the question is how to govern (not just manage) them, in whose interest they should be managed, what institutions are needed, and how responsibility should be distributed among the various actors (both domestic and international). It is evident that these technologies are challenging the present mechanisms of politics. It is often proposed to treat the knowledge connected with them and the potential advantages for society as a *global public good*. There are proposals, for example, to treat the Internet as such a good and consequently to treat the right of access to the Internet as a *human right*. It is evident that justice, equality (equal access), freedom, human rights, responsibility, and ethics were always close to democratic discourse.

An interesting and important case is *genomics*, which as a science and a knowledge (result of science) has a tremendous potential for application, especially in health care. The bioethics group from Toronto University postulates a proper 'protection' of genomics knowledge – as a globally coordinated initiative – in order to make it widely accessible and to promote its use in the less advanced countries and to minimize its misuses (Dowdeswell, Dear & Singer 2005). The idea is to diminish the gap between the rich and the poor world in the field of access to the new technologies in the health care sector. This gap concerns the majority of mankind, despite global networking and the interdependencies of development with the rich minority that governs the world and science. Such a situation can lead to various dangerous tensions and open conflicts, even to a serious de-stabilization of the world. The initiative described above could make the world more healthy and more equal. The proposed model is *networked* and *inclusive* at the same time, stimulating a common understanding of the problem by governments and citizens, and their joint engagement, and also encourages a broad co-operation of industrial leaders, scientific experts, citizen activists, NGOs, government officials, and representatives of the less advanced world. This model can be a common forum for exchange of information, discussions, and reaching a consensus.

The importance of overcoming the *genomic divide* (this term is analogous to *digital divide*) is obvious, since the realization of the Millennium Development Goals has been delayed. Genomics as a new dynamic direction of the life sciences (the Genome Project was their great stimulator) creates

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revolutionary medical and health care technologies which – if applied – can significantly support the realization of these goals. Yet what is needed is a common understanding and engagement, joint strategies, and coordinated policies. It should be remembered that improving citizens' health will also bring economic benefits. However, proper directing (the bioethics group used the term *governance*) of the development of genomics and exploitation of its practical results is basic to the ability of governments, industries and citizens to overcome the barriers and resistance to its broad application. This resistance concerns both the highly industrialized countries and the less developed ones. It is important to stimulate proper solutions especially in the latter, where there is a lack of financial resources, qualified personnel, scientific and legal 'infrastructure', advanced education and research, and even political awareness and will, and public dialog.

Traditional models of management, concentrating on the issues of risk and various restrictions may not be stimulating enough for the creation by governments and industries of an environment conducive to genomics-based innovations. This is really a tremendously complex problem and is connected not only with issues of responsibility, of fixing priorities, of preparing proper regulatory systems, of elaborating a policy for the transfer of knowledge and technology, of protection against misuses of technologies, but also with various, often controversial, scientific, social, legal, ethical and other questions. This complexity is enhanced by globalization and by the difficult task to transform knowledge into marketable products (e.g. diagnostic devices). What is badly needed is a mechanism enabling the achievement of a *balance* between the global and the public character of genomics as a knowledge and as its applications which are *de facto* private goods. It is particularly important because for a majority of potential users of genomics, the practical applications may not create an encouraging and profitable market.

In order not to allow the emergence of the next divide or gap between the advanced and less advanced world it is necessary to establish a kind of mechanism for maintaining the *global and public* character of genomics. However, this would require a new understanding of international relations and foreign policy, and new legal regulations concerning intellectual property, not to mention a need for integrated policies and actions. The above-quoted bioethics group is convinced that the access to knowledge

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– the archetypal public good – should be democratized. The debates on these issues should lead to a common understanding and collective activities that transcend borders; they should be an element of a participatory process which engages many various actors and stakeholders. Access to knowledge and the policies stimulating its applications and public benefits thus need to be democratized.

To sum up: the democratization of science and technology, the applications of their results, and the relevant policies seems to be justified for many reasons. This is a list of the most important justifications:

– In a situation of growing complexity, controversy, and ambivalence of the effects and impacts of science and technology, it is more rational and politically right to include more actors in the decision-making processes concerning the development of science, technology and their various applications;
– The requirements of economic and social practice (or in other words of business, military, and consumers) are re-orienting the traditional academic science toward so-called post-academic practices oriented directly to the needs and interests of its various users;
– The immense costs and also consequences (especially detrimental) of science and technology are firmly connected with public finances and public responsibilities (e.g. social, environmental, educational) which are beyond the interests and possibilities of private actors;
– It is necessary – in the context of the future – to link expert knowledge with social values and public preferences; and knowledge useful for policies ought to be an effect of co-production and interaction of various sides or actors (academic, government, business, citizens);
– Contemporary science, having contextual sensitivity, is able to consider external values and knowledge from non-R&D sources, can function in public space, is apt to keep contact with citizens, and from its nature should be reflexive as to its research agenda and use of procedures (as reflected in so-called Mode 2 of the production of knowledge);
– The model and culture of academic circles should shift towards an interdisciplinary approach (real, not just declared), task orientation, partic-

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ipatory practices and entrepreneurship (a good positive example is the concept of so-called entrepreneurial universities that try to function beyond the traditionally understood mission of research and education);

– The democratization of expertise processes should be stimulated, as well as the 'expertization' of decision-making activities which must be supported by expertise;

– The democratization of science and technology can strengthen social cohesion and legitimatization of politics in the face of failure of representative democracy; moreover, it can stimulate political activity of citizens, their NGOs, and also their international networks. It can raise people's awareness of the role of science and technology and their effects and impacts (which are also risky and dangerous, not to mention very costly); it can also provide citizens with more information and knowledge (which is primordial for societies calling themselves knowledge-based).

The debate devoted to the problem has continued in recent years (see e.g. Colin 2009; Golding 2007; Holland 2009; Horst 2007; Irwin 1995; Irwin & Wynne 1996; Kleinman 2007; Knorr-Cetina 2000; Lente 2008; Nahuis, Powell & Hedgecoe 2010; Nowotny et al. 2005; Nowotny, Scott & Gibbons 2001; Webster 2007) and the discussion is not likely to reach a conclusion soon.

Some experiments and cases in context

Social, public and citizens' demands for participation in the elaboration of *public scientific and technological policy* and in associated decisions on resultant applications can be found throughout the history and theory of democracy. The demands were growing with the spectacular development of science and technology in the 20th century (J. D. Bernal in 1939 coined the term *scientific and technological revolution*). This development generated consequences that were transformative for societies and individuals, and some of these consequences were not only positive but also risky or detrimental, and costly (e.g. for environment and health). After the Second

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World War many countries in the world enjoyed growing democratization (in Europe especially after the de-nazification and the de-stalinization in the Soviet bloc), which was a convenient circumstance for the demands mentioned above.

It was the *ambivalence* of the effects and impacts of the massive application of science and technology results that caused both enthusiasm (technophilia) and also a feeling of potential risks and dangers in the advanced countries, and these reactions often led to critical discussions and even public protests and resistance (technophobia appeared as well). Moreover, the scientific and technological policy (as a rule heavily linked to military build-up during the Cold War period) was assessed as very costly and structurally controversial. This was not the case in the Soviet bloc with its centralized authorities and censorship: yet the concept of the scientific and technological revolution was ideologized and appreciated in the well-known book by Radovan Richta et al. (see Zacher 1995).

The first wave of the post-war *participatory innovations* appeared in the 1960s and referred mostly to questions of *public interest* (also referred to as social or all-national) (Joss 1999). In the beginning the dominant subjects were social services, environmental planning, and development of local communities. This range was expanded not only thematically, but also socio-culturally as well as methodologically and institutionally. The interest, sensitivity and engagement of scientific circles (universities, science centres, professional associations) and state institutions (government, parliaments, various commissions and councils) had evidently been raised. Many programs, initiatives and experiments were directed at including various societal actors into the processes of deliberation and decision-making in the area of science, technology and their applications and impacts.

The span of interests, evaluation, and participation was enlarging rapidly. This increase can be well illustrated by the increasingly rich literature on the subject and the most frequently used keywords. There were many texts on participation and participatory processes, on public perception, public debate, public consensus and acceptance, on participatory agendas of science and technology, on public financing of R&D, and on public policy (concerning also – even if indirectly – private entities,

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e.g. industrial). Other key terms and topics were: public accountability of science and technology, public competences (in particular personal knowledge and experience of lay people), democratization of expertise and of debates (by the inclusion of lay people, especially those harmed or potentially harmed by the detrimental side effects of technological applications). Some more general problems were discussed too, for example: the relations between science and politics and between technology and politics, information about science and technology, risk, justice, equality, social distribution of costs and benefits, gaps and divides (with reference to new technologies – ICTs, biotechnology, nanotechnology), new untraditional (trans-scientific and trans-educational) functions of universities (such as entrepreneurial universities).

More and more new participatory procedures were in use, e.g. voting conferences, consensus conferences, future search conferences, scenario workshops, citizens juries, co-operative discourses, social assessment of technology (or technology assessment, or evaluation), constructive technology assessment, impact assessment (and its versions such as environmental impact assessments or social and psychological impact assessments), scenario elaboration (based on Toffler's idea of anticipatory democracy). Some of these examples relate to technology and its consequences rather than to science *per se*. The above-mentioned concept (and practice) of constructive technology assessment was aimed at starting a dialog between those who create technology (universities, labs, and industries) and its potential or present users (including those impacted by its negative side effects, patients in particular). The aim was to include the 'contextual perspective' of users into the process of creation of new technologies that should result in better and more direct matching to societal needs and expectations (Joss 1999). This kind of public participation was oriented toward an opening of the R&D sector that has until now been closed to ordinary citizens. The decisions in this sector were predominantly made internally, and the public was only a source of information for them. Other types of procedures such as the aforementioned various 'conferences' were aimed at stimulating the broad socio-political debates, evaluating undertakings and participating in decision-making. In the evaluatory and decision type processes – besides scientists, technical experts, and

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decision-makers, there were many other participants, such as citizens, interest groups, and representatives of local communities, all of whom had the right (and obligation) to co-shape public policy and to influence decisions concerning the development of science and technology and their practical applications. Independently of the methods used and span of participatory undertakings and experiments, the relations between science, politics, and public debate were the reference point.

There were many successful examples of citizen participation in the area of science and technology (in various forms) in Europe, North America and Asia; Dutch and Danish consensus conferences and others considered the specificity of goals and of conflicts (e.g. British, German, American). This situation reflected the variety of organizational and institutional types, cultural differences, and political methods (top down or bottom up). Apart from this variety of approaches, procedures and experiments, this situation marked a progress in spreading democracy (and democratization as a process) in the sphere of science, technology, their applications and their multifaceted impacts that are so important in the technological civilization in which we live.

Unfortunately participatory attempts were not tried out, even theoretically, in the less developed countries that lacked democracy and democratic experience (as in post-Communist Eastern Europe). The progress of democracy, however, has led to positive changes in these countries. As has been seen in Poland, abandoning censorship and political control of everything encourages citizen involvement and local protests (for example, connected with localization of industrial projects, construction of highways, even against environmental cleaning facilities). There are some debates in the media, and there is more information on technological and ecological risks. Decision-makers are legally obliged to consult citizens, experts, and NGOs (e.g. representing interests of patients) with their plans. Some discussions in parliament and in the media became ideological and political. One case was embryonic stem-cell research (see Kulawik 2009) and the government attempt to build a highway across a unique area protected by the EU Natura 2000 Program (local people shouted 'kill the greens' against protestors who tried to protect this area, and paradoxically there were voices raised that the project was an EU violation of Polish

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sovereignty). A great deal thus remains to be done in the field of social consciousness, education, and media (which often favour the 'environmental sceptics'). More institutionalization is needed to support politically, organizationally systematic development of public participation in this area.

There is not much hope from political and scientific circles. So called 'greens' (mostly weak) are not an important margin. Furthermore the R&D sphere is underfinanced (0.5% of GDP in Poland) and is marginalized both socially and by the media. Moreover, the political, business and scientific elites show no interest in pursuing participatory democracy. Hope may lie in EU regulations, policies and impositions (e.g. environmental, food). Another frequent challenge for democratic practices is the accepted concept and strategy of *sustainable development*. Needless to add that this idea – known for decades, but still growing – is meeting with barriers and resistance, not only in Poland or Eastern Europe. It is evident, and necessary, that the transition to sustainable development must be complex and comprehensive, with the substantial role of innovations (i.e. products of science and technology), with the long term prospective orientation of choices and decisions. So it may be difficult to make strategic choices and policies as well as the implementation instruments the subject of a democratic process. There is no doubt about the necessity for this within the EU.

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When discussing democratization the hard facts should be considered and recognized in spite of many theoretical approaches and controversies in debates on science and technology status, relations, impacts, controllability etc. (see e.g. Bammé 2004; Bijker 1995; Brown et al. 2000; Feenberg 1999; Hughes 2004; Mitcham 1994; Negrotti 2008; Nye 2006; Vanderburg 2005). After all, technology is our expression of *rationality* (people also produce irrationality, stupidity, magic, ideologies, religions, etc.) (see Krogh 1998); what we are in is the co-production of technology and society (e.g. Harbers 2005). We are consuming / using technology but also *vice versa* – we are consumed (to recall Ritzer's con-

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notation of the term) by technology, and our future will be socio-technical (Johnson & Wetmore 2009). So why not make it more humane and democratic?

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