

A Critical Assessment of Public Participation in Science and Technology in Korea¹

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Public participation in science and technology can be broadly defined as a various set of situations and activities that involves experts, policy analysts, and decision-makers as well as a wider range of social actors in shaping science and technology or the process of science and technology policymaking (Bucchi and Neresini, 2008; Rowe and Frewer, 2000, 2005). For the last twenty years, public participation in science and technology has developed into more diverse programs and experiments² in many countries. It has been institutionalized in some countries like Denmark (Joss and Durant, 1995; Jensen, 2005) as an element in the formal science and technology policymaking process, to the extent that there is a “rhetorical shift towards...public dialogue, transparency and democratic engagement” in S&T policy discourse from the late 1990s (Irwin, 2006, 300).

The evolution of these participatory policy programs, exercises, and policy discourses has been accompanied by the development of a body of academic and theoretical work with approaches that support, analyze, or critically review the changes and developments in participatory policy programs and activities. First, there has been a theoretical work that evaluates and classifies public participation methods or models (e.g., Rowe and Frewer, 2000, 2004, 2005; Beierle and Cayford, 2002) as well as an attempt to make a manual for “participatory methods tool kit” (Steyaert and Lisoir, 2005). In addition, some researchers have tried to theorize and understand the role of public participation and

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This paper is based on the research on the same topic, which was carried out at the Science and Technology Policy Institute (STEPI) (<http://www.stepi.re.kr>) in 2008. All the analysis and explanation of the empirical cases in this paper is entirely built on Chang and Han (2008), unless otherwise mentioned. Thanks are due to the STEPI for financial support. The authors are also grateful to Dr. Wichin Song and Dr. Jieun Seong, our colleagues at the STEPI, for their very helpful and encouraging comments on the earlier versions of this paper. All the remaining errors and omissions in the paper are entirely the authors’.

² These include, for example, focus group, consensus conference, citizens jury, science shop, and scenario workshop (e.g., Rowe and Frewer, 2000; Steyaert and Lisoir, 2005).

social movements in the development of science and technology and the social process of innovation from a broader social and historical perspective (e.g., Jamison, 2003, 2006; Hess, 2007). There have also been critical voices that require that the theories behind technology should devote more attention to the reality of and demand for public participation in science and technology (Foltz, 1999; Hamlett, 2003; Sclove, 1995). A growing body of literature has tried to analyze, evaluate or compare participatory programs and activities in a specific national and social context (e.g., Blok, 2007; Fischer et al., 2004; Guston, 1999; Hansen, 2006; Jensen, 2005; Joss, 1995; Kleinman et al, 2007; Powell and Kleinman, 2008; Sclove, 1997).

Since the early 1990s the necessity and desirability of public participation in science and technology has been increasingly discussed and advocated by STS scholars and social movements in Korea. Responding to these pressures from the civil society and academic circles, the Korean government has gradually introduced new elements of public participation into the S&T policymaking process. Social movements and civil NGOs began to demand that public voices should be consulted in the S&T policy formation that had been previously regarded as the exclusive realm of a small group of policy makers (bureaucrats) and S&T experts. In some cases they were successful in influencing the shaping of S&T policy and research agenda.

This paper analyzes and assesses the current state and problems of public participation in science and technology in Korea. It also proposes some policy suggestions to improve and enhance participatory and democratic programs that can help define science and technology in Korea. For this purpose, using and slightly modifying the framework developed by Bucchi and Neresini (2008), this paper analyzes a couple of cases of public participation in science and technology in Korea.

This paper is organized as follows. As a background to our empirical case studies, the first section provides a brief historical introduction to the development of public participation in science and technology in Korea and an outline of how various social actors and groups have contributed to this. The second section is the main empirical part of the paper and provides a descriptive account of the cases of participatory exercises and activities in Korea with a focus on several key dimensions of participation. In the third section, we provide a preliminary interpretation of the cases examined in the previous section. The conclusion is based on the Korean experience and some policy suggestions are proposed for a more effective public participation in science and technology.

To conduct the research (Chang and Han, 2008) that this paper is based on, we have carried out literature survey and a limited number of interviews with policy makers, researchers, and activists involved in public participation in Korea. A couple of seminars were also organized with researchers well versed in these issues.

1. A BRIEF HISTORICAL INTRODUCTION TO PUBLIC PARTICIPATION IN SCIENCE AND TECHNOLOGY IN KOREA

In Korea science and technology policy has traditionally been an arena where a small group of civil servants and techno-scientists have largely dominated the central aspects of decision-making that include a strategic direction and overall funding priorities as well as selected research programs and themes. It is worth mentioning that in Korea the role and power of civil servants and a bureaucratic 'policy culture' (Elzinga and Jamison, 1995) has consistently been salient in science and technology policymaking. This is partly explained by the fact that socioeconomic development under the successive authoritarian regimes of the 1960s strengthened the influence and power of bureaucrats in a

diversity of policy areas that included science and technology policy. There has also been a prevailing 'deficit model' where science and technology issues become too complex and difficult for the public to understand and participate in policy decision-making and debates about them. The deficit model argues that it is best to leave science and technology decision-making to experts who have a professional knowledge of science and technology and not to allow the public to participate in or engage with science and technology policy/decision making (Bucchi and Neresini, 2008; Wilsdon and Willis, 2004). The dominant bureaucratic policy culture and the predominating deficit model are two key factors that have made it difficult to introduce more participatory programs and activities in science and technology in Korea.

Social and political upheavals in Korean society in the late 1980s contributed to exposing policy/decision making in science and technology to a wider critique from civil society. A growing wave of criticism on the expert-centered bureaucratic policy/decision making in science and technology began to emerge in the late 1980s, largely in parallel with the rise of social movements for democracy and the resulting general democratization of Korean society.

Critical discourse on science and technology began to appear in Korea in the 1970s. Some student groups and activists (largely composed of science and engineering students), devoted to transforming Korean society to a democratic and egalitarian path and operating under a highly authoritarian government, began to criticize the 'value neutrality' of science and technology. They emphasized the social responsibility of scientists and argued for 'science for the people' that put a primary focus on the application of science for the welfare and well-being of the public.

By the mid-1980s, a critical 'science and technology movement' had not confined itself to small circles of student groups and began to transform into a social movement. The social nature of scientists as 'workers' has been reemphasized and the huge upsurge and struggle of the trade union movement in the latter half of 1987 had a tremendous impact on Korean society. This helped to unionize scientists and other employees who worked for government-supported research institutes and resulted in the successive unionization of many major public research institutes since 1987. At that time, the central demands and goals of these unions included the improvement of wages and other working conditions, the democratic management of research institutes. In addition, there was also the goal of institutionalizing independent research relieved of undue intervention and influence by the government. However, social, political, and environmental issues related to science and technology largely remained outside of their immediate concerns.

In the 1990s, Korea was able to see the emergence of a group of what could be broadly termed as a 'citizen science movement' that strived for democracy in science and technology. This was encouraged by the great struggle for democracy in mid 1987 and the subsequent and gradual disintegration of authoritarian elements from a variety of social domains in Korea. The citizen science movement was involved in diverse activities to achieve their goals. Some focused their attention on monitoring and critically supervising or evaluating the national science and technology policy, while others concentrated their efforts on IT-related issues, such as open software and 'human rights and the internet'.

The late 1990s saw the appearance of a citizen science movement directly focused on the democratization of science and technology. In November 1997, a group of STS scholars, students, scientists, and citizens formed the 'Center for Democracy in Science and Technology' (CDST)³ within the People's Solidarity for Participatory Democracy (PSPD), a foremost civil organization established in

³The CDST became independent from the PSPD in 2005.

1994 to promote justice and human rights in Korean society through participatory democracy. The main goals of the CDST were to stimulate public participation in science and technology, to introduce and institutionalize technology assessment (TA), and to keep a critical and watchful eye on the national science and technology policy. The CDST first introduced ‘consensus conference’ to Korea and directly organized or helped to organize several consensus conferences on various themes since 1998.

The late 1990s saw the emergence of science shops in Korea with the goals quite similar to those of the CDST. In 1997, the first science shop in Korea appeared at Seoul National University as a new alternative for a critical science and technology movement at the university; however, it failed largely due to the inability to develop appropriate practical programs suited to university conditions. In July 2004, another science shop, called the ‘Center for People’s Participatory Research’ (CPPR), was launched in Daejeon. The CPPR was not university-based but community-based and has been able to maintain a cooperative relationship with local trade unions and NGOs.

The 1990s witnessed the rise of various social movements that strive for cooperation with others to promote public participation in science and technology in Korea.

2. CASE STUDIES ON PUBLIC PARTICIPATION IN SCIENCE AND TECHNOLOGY IN KOREA

1) Analytical Framework

We have adapted and slightly modified the framework developed by Bucchi and Neresini (2008) to put the empirical cases of public participation in a broader perspective.

Bucchi and Neresini (2008) proposed an interpretative framework that could account for ‘spontaneous’ participatory forms “not deliberately elicited by a sponsor” such as “public mobilization and protests, patient associations shaping the research and care agenda, and community-based research” (ibid. 461). This framework is based on two key dimensions of public participation. One dimension is the intensity of participation in knowledge production processes and the extent to which different social actors cooperate in the knowledge construction processes. The other dimension is the degree of spontaneity in public participation and the extent to which public participation is deliberately brought forth by a sponsor (ibid. 461-462).

We adapted and slightly revised the above framework to better understand cases of public participation in Korea. That is, we substituted the degree of impact on policy decision-making for the intensity of participation in knowledge production processes, partly because the latter is, relatively speaking, and at least for us, more difficult to identify in the empirical cases. The ‘spontaneity’ dimension is retained in our framework.

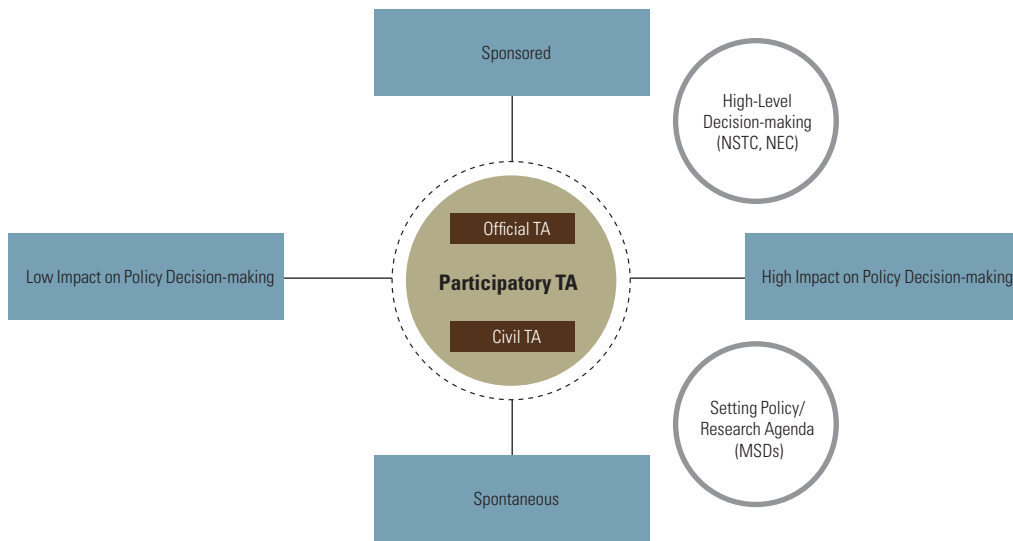
This section deals with the five cases of public participation in science and technology in Korea and they are as follows.

- Public participation in high-level policymaking bodies: the National Science and Technology Council (NSTC) and the National Energy Committee (NEC)
- Public participation in technology assessment (TA): official (‘sponsored’) TAs and civil (‘spontaneous’) TAs organized by civil organizations
- Public participation in shaping policy and research agenda: work-related musculoskeletal disorders (MSDs)

The reason behind the choice of the empirical cases here is our perception that too much analytical and practical attention has so far been on ‘sponsored’ public participation in Korea. We thus want to contribute to redressing this imbalance by actively highlighting ‘spontaneous’ forms of public participation. We prefer a broader concept of ‘public participation’ that includes both ‘sponsored’ and ‘spontaneous’ forms.

Combining our interpretative framework and empirical cases of public participation, we can get a map of public participation in science and technology in Korea as shown in the figure below.

FIGURE 1 A Map of Public Participation in Science and Technology in Korea



In investigating these cases, our main analytical focus has been on the following dimensions of public participation.⁴

- Who participates?
- Who sets the agenda for the process? At what stage in the policymaking process does public participation take place?
- To what extent can we say that the output of public participation has had an impact or influence on policymaking?

⁴To derive these analytical dimensions, we have relied on Hansen (2006) and Rowe and Frewer (2000).

2) Case Studies

A) Public participation in high-level policymaking bodies

A-1 the National Science and Technology Council (NSTC)

The National Science and Technology Council (NSTC) is a highest decision-making body of science and technology policy in Korea and is chaired by the President of Korea. The NSTC was established in 1999 by *A Special Law on Science and Technology in Korea* (SLST) and has a similar leadership role to the Science and Technology Policy Council of Finland (Pelkonen, 2006; Pelkonen et al., 2008). The scope of its mission is both strategic and comprehensive. At the national level, it covers the key S&T agenda and issues such as the strategic direction and planning of national S&T policy and research programs, S&T related industrial and human resources policy, regional innovation policy, and the effective management of a national S&T budget. The focus of the NSTC is the planning and coordination of a national S&T policy.

According to the law, the members of the NSTC should have expert knowledge and substantial experience in science and technology. Regarding its membership, the NSTC shows no consideration or hint of public participation. The members of NSTC are almost entirely composed of government ministers, industrialists, and S&T community leaders. For example, from August 2005 to August 2007, there has been only one representative from the civil society (the PSPD) and currently the NSTC does not have any civil society representative in its membership, as if it were a genuine embodiment of the 'deficit model' mentioned above. There is little in the NSTC that shows the policy impact of public participation, even if the NSTC is located at the highest and strategic level of policymaking for science and technology in Korea.

A-2 the National Energy Committee (NEC)

The National Energy Commission (NEC) was established in 2006 by a special *Law on National Energy* (LNE), whose main goal was to stipulate basic directives on energy policies and energy-related plans for the purpose of a stable, effective, and environment-friendly structure for the supply and demand of energy in Korea. The law also stipulated the formation of a National Energy Commission to consult on major national energy policies and energy-related planning.

According to the law, the members of the NEC should have expert knowledge and substantial experience in energy technology and policies. Regarding its membership, the NEC (unlike the NSTC) does allow some degree of public participation. According to the law, more than five members of the NEC should be recommended by civil organizations or NGOs. Currently among its 24 members, the NEC has five members recommended by civil organizations or NGOs. Furthermore, to enhance the quality and depth of public participation in the NEC, a network called 'Citizen Forum for Energy' (CFE) was formed in March 2007 that include five civil society members of the NEC, representatives and activists from energy NGOs and other experts. This network is to exchange ideas, coordinate opinions and views on the agenda of the NEC as well as formulate common strategic responses to the government and the NEC. To facilitate this process, the network shares a mailing list for everyday communication. In terms of the composition of members and public participation, the NSTC and the NEC reveal a substantial difference.

The process of making the 'National Energy Planning 2008-2030' (NEP 2008-2030) shows how public participation works in reality for the NEC. The NEP 2008-2030 was a requirement stipulated in the LNE and intended to implement the national energy policies in a more effective and systemic way. The focus here is on examining how public participation took place in the making of the NEP

2008-2030 and how the involved civil organizations have evaluated this participatory exercise.

The NEP 2008-2030 was largely a policy reaction by the government to rising oil prices, global climate changes, and the impending greenhouse gas (GHG) reduction requirement. It has received significant attention as a symbol of strong political will of the new government to pursue a 'low carbon growth strategy'.⁵ As a first step for the creation of the NEP 2008-2030, the government commissioned the Korea Energy Economics Institute (KEEI) in early 2006, to conduct research on the creation of a national energy plan and submitted the research results to the first meeting of the NEC in November 2006. The energy policy subcommittee (EPS) and the conflict management subcommittee (CMS), two subcommittees of the NEC, were directly involved in the making of the NEP 2008-2030. The EPS was responsible for examining the results of the KEEI research, while the CMS was responsible for searching for an appropriate share of nuclear power in the total energy mix of the country, a key energy issue with crucial social and political repercussions.

The EPS and the CMS had a couple of joint meetings in order to decide on procedures for the creation of the NEP 2008-2030. Of note is the second joint meeting in which major decisions on the scope, depth, and forms of public participation in the creation of the NEP 2008-2030 were made. According to the decisions, the whole process leading up to the final construction of the NEP 2008-2030 should be based on expert-centered discussions and how and whether other public or social voices are to be dealt with would be left to the NEC and its two subcommittees. These decisions precluded the possibility of building a broader social consensus on energy issues in Korea. Opportunities have been lost to initiate a wider process of social consultation and take into account the opinions of lay people in the policymaking process. The public is rarely given a chance to express their views on energy issues and their interests are not always sufficiently represented by civil organizations.

The first draft of the NEP 2008-2030 was presented in December 2007 at a public hearing. There was a spate of criticisms on the draft, arguing that it ignored the reality of skyrocketing oil prices. For several months after the public hearing, the government revised and modified the first draft for a second public hearing in June 2008. In July and August 2008, four workshops were organized to intensively discuss the key contentious issues such as the validity of energy demand forecasting and the appropriateness of the share of nuclear power in the total energy mix of the country. Among the participants of the workshops were representatives of the research community, industry and civil organizations. After these 'communication' activities, the government finalized and made public the NEP 2008-2030 in late August 2008.

How were other social stakeholders involved in the process of making the NEP 2008-2030? In addition to five civil organization representatives in the members of NEC, other civil society representatives were also active in the NEC subcommittees and their occasional taskforces. As previously mentioned, to share information and facilitate the coordination of opinions and the exchange of views between these representatives and environmental NGOs and activists, a network called 'Citizen Forum for Energy' (CFE) was created that includes five civil society members of the NEC, other civil society representatives in the NEC subcommittees and taskforces, representatives of energy and

⁵The new government took office in February 2008 and proclaimed, in August 2008, 'low carbon growth strategy' as the overarching national development strategy for the coming decades. Since then, huge social controversy and ongoing debates have erupted over the 'greenness' of the strategy. This situation has been aggravated by the unilateralism and the lack of consultation and communication of the government with relevant social stakeholders. The new government is widely regarded as the most neo-liberal since the late 1980s.

environment NGOs, and other experts. This network was to be enlarged to form a broader alliance among the relevant NGOs and mobilize public opinion for wider social support. However, this was never realized.

The focus of the CFE was centered on two set of activities. First, it pointed out the planned schedule of the government for the NEP 2008-2030 was too tight to allow a sufficient discussion of controversial issues, the construction of social consensus, and broader participation by various stakeholders in the process. The CFE argued that a two month period intended for four workshops was too short and criticized the government for intending to reach hasty conclusions and to abruptly finalize the NEP 2008-2030 without a wider social support and consensus. However, the government organized the workshops as planned and the CFE contested that the workshops were merely a token gesture of the government and not a genuine attempt to seriously reflect or take into consideration diverse opinions and perspectives in the policymaking process.

Second, the CFE tried to coordinate all the voices and opinions of civil society representatives, both within and outside of the NEC, and to express a more combined and integrated opinion at the workshops and public hearings organized by the government. The CFE had a series of internal meetings and workshops and made public in early 2008 the 'Counter Report on the draft NEP 2008-2030'; in addition, it also made a number of public statements and comments. This provided a significant foothold for civil organization representatives within the NEC and its subcommittees to play their proper social role there.

With all these efforts of the CFE, however, civil organizations and NGOs were not successful in achieving their intended policy impact on the NEP 2008-2030. They could not possibly reach an acceptable agreement with the government on the final contents of the NEP 2008-2030. In protest they boycotted in mid-August 2008 the final public hearing on the NEP 2008-2030 and argued that it had clearly showed the conspicuous lack of recognition by the government of the energy crisis. At the NEC meeting in late August 2008, five civil society representatives were all opposed to the final draft of the NEP 2008-2030 and asserted through a separate public statement that the NEP 2008-2030 should be annulled because it would result in higher energy consumption and increase the already high dependence on nuclear energy.

Compared with NSTC, public participation in the NEC is significant in terms of its membership; however, we cannot see any sign of participation by lay people in the NEC that is distinct from civil organization representatives. Public participation (though limited in scope) allows some public or social voices to be heard at the early stage of the NEC policymaking process; however, it seems that the agenda of the NEC is predominantly set by the government. In terms of the impact on policymaking, public participation in NEC was unable to have a tangible influence on the final output of the policymaking, as shown in a detailed examination of the process of making the NEP 2008-2030 at the NEC.

B) Public participation in technology assessment (TA)

Technology assessment (TA) as a form of social appraisal of technology is a response to public concerns about modern science and technology that implicitly or inherently reflects public views, concerns, and misgivings about science and technology. TA has developed from an expert-centered exercise to a more participatory one (Joss and Durant, 1995) and has been shaped and institutionalized in a diversity of forms in different nations (Joss and Bellucci, 2002; Vig and Paschen, 2000).

In Korea, since the mid 1990s some STS academics have introduced the concept of TA and carried out TA-related research and several civil organizations argued for the need for TA and its institutionalization and examined and tried a couple of models for participatory TA. Under these social pressures, the government stipulated, for the first time in Korea, the institutionalization of TA in a revised SLST enacted in 2001 and conducted its first TA in 2003. Since the late 1990s there have been a dozen of TA cases or programs in Korea as shown in Table 1.

TABLE 1 Technology Assessment in Korea since the late 1990s

Year	Cases	Initiated/Organized by	Notes
Before 2000	consensus conference on GMOs (1998)	KNCU*	spontaneous TA
	consensus conference on cloning technology (1999)	KNCU	Spontaneous TA
2003	Nano-Bio-Information Technology (NBIT) TA	MOST** & KISTEP***	Sponsored TA
2004	Consensus conference on the future of electric power policy	CDST****	Spontaneous TA
2005	TA on nanotechnology	MOST & KISTEP	Sponsored TA
	TA on RFID	MOST & KISTEP	Sponsored TA
2006	TA on ubiquitous computing (UCT)	MOST & KISTEP	Sponsored TA combined with 'citizen open forum'
	TA on stem cell technology	MOST & KISTEP	Sponsored TA
	TA on nano-materials	MOST & KISTEP	sponsored TA
2007	TA on climate change technology	MOST & KISTEP	Sponsored TA combined with 'citizen open forum'
	Consensus conference on xenotransplantation	KNCU & Bioethics Policy Research Center, Ewha Univ.	Spontaneous TA
2008	TA on national management system for national emergency and epidemic	MEST***** & KISTEP	Sponsored TA combined with 'citizen jury' organized by CDST as requested by MEST and KISTEP

* KNCU: Korean National Commission for UNESCO

** MOST: Ministry of Science and Technology

*** KISTEP: Korea Institute of Science & Technology Evaluation and Planning

**** CDST: Center for Democracy in Science and Technology

***** MEST: Ministry of Education, Science and Technology

B-1 Official (Sponsored) TAs

The legal basis for the official TA by the government is a revised SLST, enacted in 2001, which stipulates that the government should conduct TA on economic, social, ethical, and environmental impacts of new emerging technologies and duly consider the results of TA in the policymaking process. According to the enforcement regulations of the revised SLST, the government should allow a broader participation of civil experts and civil organizations in TA and take into account the opinions of lay people in the TA process. The relevant ministers are obliged to reflect TA results in the R&D planning of the respective ministries or produce measures to minimize the expected negative impacts of science and technology.

The first official TA in Korea was conducted in 2003 by the KISTEP, as stipulated by the revised SLST. The KISTEP was a R&D planning and evaluation agency under the Ministry of Science and

Technology (MOST).⁶ The first TA was carried out on Nano-Bio-Information Technology (NBIT) and was an expert-centered activity (although there was a small group of civil organization representatives participating in the TA subcommittees), which was quite different from more participatory exercises like consensus conferences or a citizen jury. There was also another social controversy over the first TA that focused on whether the KISTEP was independent enough to conduct a proper TA. The controversy was due to the location of KISTEP within MOST and the ambiguity on how TA results would be used in the policymaking process.

Reflecting this criticism, the government tried to complement and improve various aspects of the TA process by increasing elements of public participation. Two TA exercises in 2005 on nanotechnology and RFID were also largely expert-centered, but the KISTEP intended, for the purported purpose of redressing or attenuating the ‘expert-centeredness’ of TA process, to organize a ‘citizen open forum’, quite similar to consensus conference. However, the intended citizen open forum never materialized. The 2006 TA on UCT was for the first time accompanied by a ‘citizen open forum’, while the other two 2006 TAs on stem cell technology and nano-materials were not. The 2007 TA on climate change technology were also combined with an open citizen forum and the 2008 TA on a national management system for national emergencies and epidemics was accompanied by a ‘citizen jury’ that was organized by the CDST as requested by the MEST and KISTEP.

B-2 Civil (Spontaneous) TAs

In 1998 and 1999, the Korean National Commission for UNESCO (KNCU) organized (in cooperation with the CDST) two consensus conferences on GMOs and cloning technology. These were entirely spontaneous exercises without any legal support or encouragement from the government that later became an influential reference when elements of participatory TA received a legal foundation in a revised SLST in 2001. In 2004, the CDST organized, with the financial support of a government agency (the Korea Science Foundation, renamed in 2008 the Korea Foundation for the Advancement of Science and Creativity), a consensus conference on the future of electric power policies in Korea. This was explicitly intended to show and criticize the lack or absence of public participation in the official TA conducted by the government. In 2007, the KNCU and the Bioethics Policy Research Center, Ewha University, organized (with the support of the Ministry of Health and Welfare) a consensus conference on xenotransplantation. In 2008, commissioned by the MEST and the KISTEP, the CDST organized a ‘citizen jury’ on a national management system for national emergencies and epidemics as part of the official TA. This was the first time that a citizen jury model was applied in the official TA. It had a special meaning in the sense that part of the official TA was conducted by a civil organization.

C) Public participation in shaping a policy and research agenda

C-1 Work-related musculoskeletal disorders (MSDs)

Work-related musculoskeletal disorders (MSDs) are “impairments of bodily structures such as muscles, joints, tendons, ligaments, nerves, bones, and the localized blood circulation systems, that are

⁶ In 2008 the MOST merged with the Ministry of Education to become the Ministry of Education, Science and Technology (MEST), with the change of the government in the same year. The KISTEP is currently under the MEST.

caused or aggravated primarily by work and by the effects of the immediate environment in which work is carried out.” (EU-OSHA, 2007). Most work-related MSDs are cumulative disorders that result from repeated exposures to high or low intensity loads over a long period of time and mainly affect the back, neck, shoulders, and upper limbs, but can also affect the lower limbs (ibid).

It was in the late 1980s that unions and workers in Korea began to recognize and sporadically express their serious concerns for the need to treat and prevent work-related MSDs. It was the Korea Telecom (KT) union that first contributed to making work-related MSDs a social agenda of grave concern. In 1995, the KT union organized a couple of big union rallies in front of the KT headquarters in downtown Seoul, in which about a thousand women telephone operators participated. They demanded that the KT should do a special investigation on work-related MSDs, increase staff, provide adequate break times, and improve the working environment. They also called on the government to take necessary measures for the treatment and prevention of MSDs. The background for the action of the KT union was that the working environment at KT drastically changed due to office automation beginning in the early 1990s. Work intensity increased due to the rise of the number of telephone subscribers and the reduction of telephone operators. Under these circumstances, some union activists laid eyes on the frequency of sick days or absenteeism among telephone operators (overwhelmingly women) and were able to conclude, with the help of a hospital specialized in workplace illness and diseases, that the underlying cause of frequent sick days and absenteeism was work-related MSDs.

Largely confined to visual display terminal (VDT) syndrome until the mid 1990s, work-related MSDs began to emerge as a crucial health issue in a wider range of industry since the late 1990s. Especially since the IMF crisis in 1997, work intensity has increased thanks to restructuring and layoffs. Work-related MSDs became a critical issue of occupational health, among others, in the manufacturing industry. The unions took the initiative (in cooperation with civil organizations and experts specialized in occupational safety and health) in carrying out an extensive MSD survey that revealed the reality of work-related MSDs suffered by workers. In July 1999 the Korean Confederation of Trade Unions (KCTU) (one of two trade union national centers in Korea) and the ‘Alliance for Occupational Safety and Health’ (a non-profit civil organization devoted to creating healthier workplaces and society) jointly conducted a fact-finding survey on those who suffered from spinal injuries among those who worked for big manufacturing firms such as Hyundai Mipo Dockyard and Hanjung and revealed the critical state of MSDs based on the survey results.

The KCTU and the Korean Metal Workers’ Union (KMWU) (one of the industrial federations belonging to the KCTU) became further involved in MSD issues and the fact-finding MSD surveys became more systematized and conducted on a national scale. This resulted in the collection and availability of more comprehensive data and information on work-related MSDs. In 2000, the KMWU conducted, in cooperation with several civil research centers and organizations specialized in occupational safety and health, a fact-finding survey on MSDs that covered 53 workplaces it had organized and more than 26,000 workers there. In 2003, the KCTU conducted a similar fact-finding survey on MSDs that covered 80 workplaces it had organized and more than 10,000 workers there. The 80 workplaces covered by this survey were respectively organized by four member industrial federations of the KCTU: the KMWU, the Korea Health and Medical Workers’ Union (KHMWU), the Korean Chemical and Textile Workers’ Federation (KCTF), and the Korean Federation of Construction Industry Trade Unions (KFCITU).

Faced with rising pressures from the unions based on extensive in-house surveys on MSDs, and union rallies and other protest activities, the government and the employers had to do something

to mitigate the soaring social tensions over work-related MSDs. For example, the KT agreed after a lengthy negotiation and debate with its union to accept the union demands for a special medical examination of workers and improved working conditions. In May 1997, the Ministry of Labor drew up a set of 'work guidelines for VDT workers' and created a draft of 'work guidelines for those doing simple repetitive jobs' in December 1998.

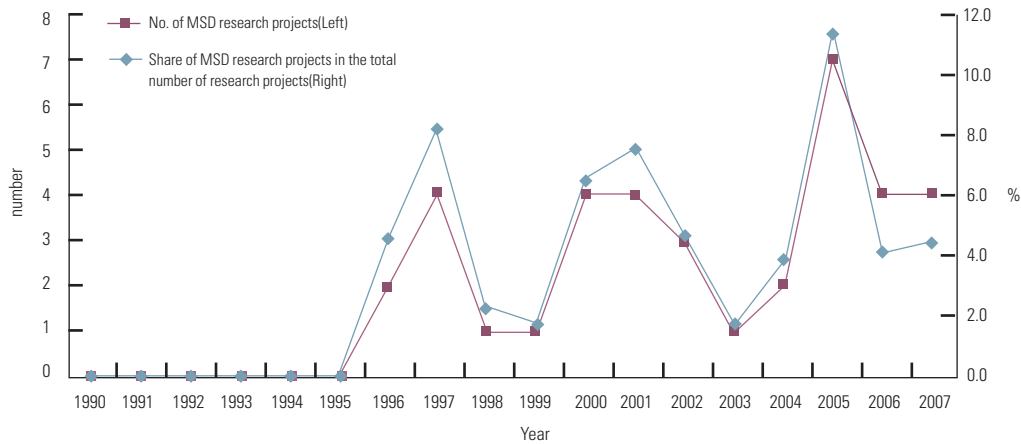
As an additional sign of improving its policies on work-related MSDs, in March 2003, the government said it was going to submit a motion to revise the *Law on Occupational Safety and Health (LOSH)* that would require workplaces to take necessary measures to prevent MSDs when workers are exposed to the risk of work-related MSDs. In December 2002 the National Assembly passed a revised LOSH that stipulated that employers are obliged in principle to take necessary measures to prevent work-related MSDs.

However, social conflict and a tug of war erupted between unions and the government and industry during the drafting of the enforcement regulations for the revised LOSH. The issue was what work-related MSDs are and how to define them. This produced an inability to find a consensus between different social interests on the understanding and interpretation of work-related MSDs.

The main issue was how to define in reality the scope of MSD-inducing jobs. The government and employers argued that the scope of such jobs must be defined in such an exact and detailed way that it would enable employers to provide specific remedies against the risk of work-related MSDs. As a result, they made a detailed and strict classification of MSD-inducing jobs in 16 categories. From the perspective of unions, this classification unjustifiably defined the MSD-inducing jobs in a simplistic mechanical way. According to this classification, for example, one of the MSD-inducing jobs was defined as 'a job that makes you either bend your neck over 30 degrees back or forth or angle your head over 45 degrees forth or over 20 degrees back for more than two hours a day.' According to unions, such bizarre definition of the MSD-inducing jobs would only reduce the scope of the responsibility of employers for work-related MSDs and give employers an abundant source of excuses for evading their responsibilities. A group of ergonomics experts also contended such detailed quantitative and mathematical definition showed an obvious lack of understanding by the government and employers of the complex and manifold causes of work-related MSDs. Unions criticized that confining the scope of MSD-inducing jobs to such narrowly defined categories of jobs would encourage employers to easily disregard social and structural causes of work-related MSDs such as understaffing and the resulting intensified workloads, insufficient time-off (break), and long hours of work. Unions maintained it was imperative to assess the full range of MSD risks and to comprehensively address them as recommended by the EU-OSHA (2007). However, despite such strong opposition by unions, the government finally took sides with employers in this significant social controversy over the legal definition of MSD-inducing jobs.

The efforts of unions to achieve a social and legal recognition of work-related MSDs and their extensive fact-finding surveys contributed to making work-related MSDs an important research agenda for the relevant research community as well. Since the outbreak of the issue of work-related MSDs at KT in 1995, there has been a definite increase in the number of research for MSDs caused by the VDT jobs that focused on CAD workers and telecom workers. Since 1995, as shown in Figure 2, we were able to notice a gradual increase in the number of research projects on work-related MSDs at the Occupational Safety and Health Research Institute (OSHRI), a public research institute belonging to the Korea Occupational Safety and Health Agency (KOSHA), a government agency under the Ministry of Labor.

FIGURE 2 Trend of the Share of Research Projects on Work-related MSDs in the Total Number of Research Projects at the OSHRI



A union activist directly involved in the fact-finding surveys on work-related MSDs, stated in an interview that the reason why unions were able to get support and cooperation from civil organizations and experts specialized in work-related MSDs was due to a preexisting network among union activists involved in occupational safety and health issues and civil organizations as well as experts. This informal network had continued to have internal discussions on the issue of work-related MSDs until the mid 1990s.

In the wake of social controversies over work-related MSDs beginning in the late 1990s, a new civil organization, called the 'Allied Research Group on Work-related MSDs (ARGWM), was formed in March 2002. The ARGWM (in cooperation with unions nationwide) conducted a series of fact-finding surveys on work-related MSDs and (based on survey results) helped and supported the collective application of workers suffering from work-related MSDs for a paid leave of absence for the medical treatment of the disease. In 2003, the ARGWM transformed itself into a new civil research organization, called the Korea Institute of Labor Safety and Health (KILSH), to conduct systematic research on broader occupational safety and health issues that included work-related MSDs as well as to support unions and workers.

3. A PRELIMINARY INTERPRETATION OF CASE STUDIES

We have provided a descriptive account of empirical cases of public participation in science and technology in Korea at the different levels of policymaking and at the diverging degrees of spontaneity. The table below gives a comparative summary of the empirical cases dealt with in the last section.

TABLE 2 Comparative Summaries of the Cases of Public Participation in Science and Technology in Korea

Analytical dimensions	Cases of public participation in science and technology in Korea				
	Sponsored public participation		Spontaneous public participation		
	High-level policymaking bodies		Public participation in TA		Public participation in shaping policy and research agenda
	National Science and Technology Council (NSTC)	National Energy Committee (NEC)	Official TA	Civil TA	Work-related musculoskeletal disorders (MSDs)
Who participates?	Low No participation of civil organization representatives and lay people	Middle Participation of civil organization representatives, but no lay people	Middle Participation of civil organization representatives and lay people	High Civil society's initiative the participation of lay people	High Initiated by unions and civil organizations Participation by rank and file workers in the surveys
Participation at what stage of policymaking?	Low	High Beginning at the early stage	Low/Middle Recently getting closer to the early stage, for example, the selection of technology for TA	High Starting at the early stage, for example, the selection of technology for TA	High Starting at the stage of setting policy and research agenda
How much policy impact of participation?	Low	Low/Middle No tangible effects on main policy issues	Low Difficult to identify Ambiguity on how to use TA results in policymaking	Low/Middle No institutional links with policymaking, but sizeable media coverage and publicity	Low/Middle The government taking sides with employers despite strong opposition from the unions

This section provides a preliminary interpretation of the empirical cases explained in the previous section.⁷

Let us first look at the cases of public participation in high-level policymaking bodies. As shown above, the NSTC and the NEC are all legal entities chaired by the President of Korea, grounded in the respective special laws, and located at the highest and strategic level of policymaking. However, despite the similarities, they showed a sizeable difference in terms of public participation and the way they worked.

First, there is a need to examine the specific social contexts in which the two high-level policymaking bodies were respectively constructed. As for the NSTC, its historical roots begin with the National Committee on Science and Technology (NCST) that was established in 1971 during the zenith of the authoritarian Park Chung-hee regime. For us, it seems that the highly bureaucratic pol-

⁷ It is 'preliminary' in two ways. First, due to the time and resources constraints we were unable to delve into a deeper and more comprehensive examination of individual cases and to do a more exhaustive examination of (for example) the minutes and proceedings of various meetings, media coverage, questionnaires, and documents used in the cases. Secondly, this study is an interpretation from an 'outsiders' perspective. We had only a limited number of interviews with those who directly organized or participated in the participatory exercises discussed in the previous section. To obtain a fuller understanding of the cases, we need a more input from the 'insiders' who actually arranged or took part in the participatory exercises and programs. The experience, knowledge, and critical reflection of these insiders on the reality of public participation are a fertile ground to search for the way to improve and revitalize public participation and are interesting issues for further investigation (Felt and Fochler, 2008; Kleinman et al, 2007).

icy culture that originated from that period has been largely maintained in the NSTC until now and subsequently reinforced by the authoritarian governments of Chun Doo-hwan and Roh Tae-woo. The NSTC seems to be more narrowly concerned with the issue of policy coordination within the government rather than public participation or communication with civil society. On the other hand, the NEC was established in 2006 in a social context in which we could notice the rise of discourse on governance and public participation in general, and the NEC had thus less difficulty in embracing elements of public participation in its organizational structure and operation.

Second, the NEC was created in the wake of enormous social conflict and controversy in 2003 over the siting of nuclear waste facilities in Korea. This conflict was a result of the unilateral decision of the central and local government to site the facilities in the 'Buan' county located in the southwest of Korea. The decision divided Korean society and dominated the news headlines all through the year. This costly experience helped convince the government to become more open to the idea of public participation in designing the NEC. In contrast, in 2000, the PSPD, the KCTU, and the environmental and other civil organizations demanded that the scope of public participation should be more extensive in the planned NSTC to allow a broader representation of diverse stakeholders in it; however, it was minimally reflected in the final organizational design of the NSTC the following year.

The NEC was not that impressive in terms of policy impact of public participation even if it had more elements of public participation when compared to the NSTC. The cause of this is the underlying reluctance and lingering hesitation of the government to open the policymaking process to broader public participation and take seriously into account the results of public participation in policymaking.

Public participation in the NEC showed that public participation by civil organizations had internal problems to cope with. First, there were the issues of whether civil organization representatives that participated in the NEC really represent the opinions of lay people or how different they were from the putative representative sample of the larger population. These issues illustrate the difficulty to secure a fair and justifiable representation of public interests and views in the policymaking bodies. Second, the government was free to choose and ask civil organizations that had a considerable influence on specific issue/policy areas and recommend civil organization representatives for NEC membership. There was understandably the potential risk of the arbitrary choice of the government here. That is, the government would, in all probability, choose and give NEC membership to those civil society organizations that it thinks are more accommodating or compliant. Related to this, there was a latent rivalry, among environmental civil organizations, over the right to recommend the NEC members. These organizations were unable to form a 'united front' against the government and frequently had a substantial difficulty in generating a coordinated common stance on key policy issues. Third, there was a lack of consensus on how civil organization representatives would behave and represent public interests at the NEC. Opinions were divided between those who argued civil representatives should faithfully represent the views and opinions of those who they are supposed to represent and those who supported a more unconstrained and independent role of the representatives at the NEC. Accordingly, there was a sizeable divergence in the behavior of civil representatives at the NEC.

Let us now examine the cases of official and civil technology assessments. As for official (sponsored) TAs, the government accepted the criticism that there was a lack of public participation in the official TAs and gradually introduced elements of public participation in the recent official TAs. In 2006, the government introduced for the first time a 'citizen open forum' that was similar to a consensus conference into the official TA. This was a positive development as the official TA in Korea created an opportunity for a participatory exercise of a consensus conference type. The government commis-

sioned the CDST to conduct an independent observation and evaluation of the citizen open forum. The evaluation report (Lee and Kim, 2007) published in 2007 pointed out both the advantages and problems of the 2006 citizen open forum.

As the positive effects of the 2006 citizen open forum, the report mentioned that it had significance as the first participatory TA organized by the government and that its citizen panel had a great learning experience and was able to increase their knowledge level in relevant science and technology issues. However, the report was overwhelmingly critical of other aspects of the 2006 citizen open forum. First of all, thanks to the budget and time constraint, the open forum was unable to obtain adequate support and enough publicity. Second, the selection of technology for the forum was inappropriate. UCT as a theme for TA was too broad and abstract to be a focused subject for the citizen panel. Third, due to insufficient publicity for the forum, there were limited applicants and it was impossible to construct a more balanced citizen panel. Fourth, the time constraint prevented the citizen panel from adequately understanding and discussing the theme of the forum in its preparatory meetings and plenary sessions. In addition, the inadequacy of the documents provided for the forum and the high-handedness of some expert panelists were an additional obstacle for the citizen panel to overcome. Fifth, it was not at all clear what the role or position of the citizen open forum was in the 2006 official TA. It was also mentioned that the results of the official TA were barely reflected or utilized in the government's policymaking. Finally, the report suggested several policy recommendations to address these shortcomings.

Spontaneous participatory TAs (consensus conferences) organized by civil organizations have stimulated and urged official TAs to move in a more participatory direction. Civil organizations also played a leading role in introducing and actually organizing consensus conferences in Korea. However, we should not allow these positive contributions to prevent us from realizing problematic aspects of civil participatory TAs. First, we can mention the lack of policy impact of civil participatory TAs. This reflects the fact that the consensus conferences organized by civil organizations did not have any formal or institutional links with the policymaking process and that the results of the consensus conferences remained outside of the actual policymaking cycle; however, they did receive sizeable media coverage. Second, there is the issue of the 'neutrality' of those civil organizations arranging consensus conferences. If a consensus conference were organized by a civil organization that has a specific stance or perspective on the theme of the consensus conference it organizes, the organization would be exposed to the controversy over its neutrality.

Finally, the trade union movement in Korea was successful in making work-related MSDs an emerging policy and research agenda as well as revealing an 'undone science' (Hess, 2007). It was able to mobilize its informal network with civil organizations and experts specialized in work-related MSDs. However, we could not find any suggestions that the union movement had an explicit long-term strategy to acquire its own research capability in this area as was the case with the French Association of Neuromuscular Disease Patients (Callon and Rabeharisoa, 2008). Such a consistent long-term strategy might be unthinkable for the union movement in Korea that is currently in a very hostile social and political climate.

4. CONCLUSIONS

Our overall impression, from the two previous sections, of the current state of public participation in

science and technology in Korea can be epitomized as follows.

The Korean government has been reluctant to accept public participation as part of the normal policymaking process. With the abrupt social change since the late 1980s and the resulting gradual democratization of Korean society in the 1990s, the government slowly began in the first decade of the 2000s to introduce elements of public participation in the S&T policymaking process. However, public participation in science and technology in Korea is undesirable in terms of the actual policy impact. This situation justifies the criticism that the government's commitment to public participation is dubious and tokenistic.

On the other hand, social movements and NGOs in Korea do not seem to be well prepared for public participation in the S&T policymaking, particularly in terms of expertise and resources required for such participation and the relationships between them and their representatives involved in the policymaking process.

By way of conclusions (based on the Korean experience discussed in this paper) we would like to offer the following policy recommendations for social actors and stakeholders involved in public participation in science and technology.

First, the government must have a strong vision to support and foster public participation in the S&T policymaking process. Public participation should be a long-term and continuous endeavor. The government should be able to show whether and how the results of public participation have been reflected or utilized in the policymaking process. This information should also be easily accessible and available. This will certainly help the government to demonstrate its strong will for public participation to major stakeholders and lay people (Ferretti, 2007; Joly and Kaufmann, 2008).

Second, as for public participation in high-level S&T policymaking bodies, the diversity of participating stakeholders of civil society should be wider than now. If the voices and opinions of lay people could be heard or reflected through citizen participation models (such as consensus conferences) in the high-level policymaking process, it would contribute to enriching and enhancing the quality of policy deliberations and decisions there.

Third, when organized stakeholders of civil society participate in high-level S&T policymaking bodies, they should make every effort to ensure that their representatives properly represent public interests and to maintain a close and reliable relationship with their representatives. On the other hand, the prevalent strong technocratic policy culture requires that S&T experts need to be more exposed to and educated on technology assessment (TA) and discourses of public participation. This exposure and education would be definitely conducive to creating or improving mutual communication and trust between S&T experts and the public.

Fourth, the government agency responsible for official technology assessment should be independent of the government and have autonomy in their regular TA activities while maintaining close links with the government. A search for such an organizational/institutional design should be initiated.

Fifth, there need to be more public funding and support for weaker social groups and minorities to learn and get knowledge and expertise on public participation and technology assessment and to produce or acquire counter-expertise and capabilities. It would contribute to more equitable distribution of the opportunities for social groups to participate in the S&T policymaking process. In addition, the government should promote and nurture a culture of public debates and discussions on S&T issues of social significance. This would help to encourage a more discerning critical public awareness of S&T issues and enhance the capacities of both civil society organizations and lay people to deliberate on science and technology policy. A fixed amount (for instance, 2-3%) of the national

budget for S&T programs needs to be devoted to enhancing social sciences research on various aspects of public participation and technology assessment that includes ethical, legal, and social implications (ELSI) studies on science and technology.

Finally, we need to push up public participation ‘upstream’ in the S&T policy-making process. In this way, we can make the fundamental questions of science and technology more amenable to public scrutiny, such as tacit or explicit goals, visions, and assumptions that frame and shape the strategic direction and research priorities of national expenditure on S&T, the selection of research programs and themes as well as the trajectories of national scientific and technological development (Joly and Kaufmann, 2008; Stirling, 2008; Wilsdon and Willis, 2004). If successful, this would certainly make science and technology more transparent and enhance the social effectiveness of public participation in science and technology. We think it is a crucial duty of social study of science worth its salt to contribute to making this possible.

REFERENCES

- Beierle, T. C. and J. Cayford, “Democracy in Practice: Public Participation in Environmental Decisions.”, Washington, DC: Resources for the Future, 2002.
- Blok, A., “Experts on Public Trial: On Democratizing Expertise through a Danish Consensus Conference.”, *Public Understanding of Science*(2007), No. 16, pp.163-182.
- Bucchi, M. and F. Neresini (2008), “Science and Public Participation.”, in Hackett, E. J., O. Amsterdamska, M. Lynch, and J. Wajcman (eds.) (2008), *The Handbook of Science and Technology Studies*, Third Edition, The MIT Press, pp.449-472.
- Callon, M. and V. Rabeharisoa, “The Growing Engagement of Emergent Concerned Groups in Political and Economic Life.”, *Science, Technology, & Human Values*(2008), Vol.33, No.2, pp.230-261.
- Chang, Y. B. and J. K. Han, “Towards Participatory Science and Technology Policy-Making in Korea.”, The Science and Technology Policy Institute (STEPI), 2008.
- Elzinga, A. and A. Jamison (1995), “Changing Policy Agendas in Science and Technology.”, in Jasanoff, S., G. E. Markle, J. C. Petersen, and T. Pinch (eds.) (1995), *Handbook of Science and Technology Studies*, Revised Edition, Sage Publications, pp.572-597.
- European Agency for Safety and Health at Work (EU-OSHA) (2007), “Fact Sheets Issue 71: Introduction to Work-related Musculoskeletal Disorders.”, <http://osha.europa.eu/en/publications/factsheets/71>, last accessed 3 August 2009.
- Felt, U. and M. Fochler, “The Bottom-Up Meanings of the Concept of Public Participation in Science and Technology.” *Science and Public Policy*(2008), Vol.35, No.7, pp.489-499.
- Ferretti, M. P., “Why Public Participation in Risk Regulation?: The Case of Authorizing GMO Products in the European Union.” *Science as Culture*(2007), Vol.16, No.4, pp.377-395.
- Fischer, C., L. Leydesdorff and M. Schophaus, “Science Shops in Europe: The Public as Stakeholder.”, *Science and Public Policy*(2004), Vol.31, No.3, pp.199-211.
- Foltz, F., “Five Arguments for Increasing Public Participation in Making Science Policy.”, *Bulletin of Science, Technology & Society*(1999), Vol.19, No.2, pp.117-127.

- Guston, D. H., "Evaluating the First U. S. Consensus Conference: The Impact of the Citizens' Panel on Telecommunications and the Future of Democracy", *Science, Technology & Human Values*(1999), Vol.24, No.4, pp.451-482.
- Hamlett, P. W., "Technology Theory and Deliberative Democracy.", *Science, Technology & Human Values*(2003), Vol.28, No.1, pp.112-140.
- Hansen, J., "Operationalising the Public in Participatory Technology Assessment: A Framework for Comparison Applied to Three Actors.", *Science and Public Policy*(2006), Vol.33, No.8, pp.571-584.
- Hess, D. J., "Alternative Pathways in Science and Industry: Activism, Innovation, and the Environment in an Era of Globalization.", The MIT Press, 2007.
- Irwin, A., "The Politics of Talk: Coming to Terms with the 'New' Scientific Governance", *Social Studies of Science*(2006), Vol.36, No.2, pp.299-320.
- Jamison, A., "The Making of Green Knowledge: The Contribution from Activism.", *Futures*(2003), 35, pp.703-716.
- Jamison, A., "Social Movements and Science: Cultural Appropriations of Cognitive Praxis.", *Science as Culture*(2006), Vol.15, No.1, pp.45-59.
- Jensen, C. B., "Citizen Projects and Consensus-Building at the Danish Board of Technology: On Experiments in Democracy.", *Acta Sociologica*(2005), Vol.48, No.3, pp.221-235.
- Joly, P.-B. and A. Kaufmann, "Lost in Translation?: The Need for 'Upstream Engagement' with Nanotechnology on Trial.", *Science as Culture*(2008), Vol.17, No.3, pp.225-247.
- Joss, S., "Evaluating Consensus Conference: Necessity or Luxury?", in Joss and Durant (eds.), pp.89-108, 1995.
- Joss, S. and S. Bellucci (eds.), "Participatory Technology Assessment: European Perspectives.", Centre for the Study of Democracy, University of Westminster, 2002
- Joss, S. and J. Durant (eds.), "Public Participation in Science: The Role of Consensus Conferences in Europe.", London: Science Museum, 1995.
- Kleinman, D. L., J. Grice and J. Adrian, "A Toolkit for Democratizing Science and Technology Policy: The Practical Mechanics of Organizing a Consensus Conference.", *Bulletin of Science, Technology and Society*(2007), Vol.27, No.2, pp.154-169.
- Lee, Y.-H. and M.-J. Kim, "An Evaluation Report on the Citizen Open Forum as Part of the 2006 Official TA on UCT.", the MOST and the KISTEP, 2007
- Pelkonen, A., "The Problem of Integrated Innovation Policy: Analyzing the Governing Role of the Science and Technology Policy Council of Finland.", *Science and Public Policy*(2006), Vol.33, No.9, pp.669-680.
- Pelkonen, A., T. Teräväinen and S.-T. Waltari, "Assessing Policy Coordination Capacity: Higher Education, Science, and Technology Policies in Finland.", *Science and Public Policy*(2008), Vol.35, No.4, pp.241-252.
- Powell, M. and D. L. Kleinman, "Building Citizen Capacities for Participation in Nanotechnology Decision-making: the Democratic Virtues of the Consensus Conference Model.", *Public Understanding of Science*(2008), Vol.17, No.3, pp.329-348.
- Rowe, G. and L. J. Frewer, "Public Participation Methods: A Framework for Evaluation.", *Science, Technology, & Human Values*(2000), Vol. 25, No. 1, pp.3-29.
- Rowe, G. and L. J. Frewer, "Evaluating Public Participation Exercises: A Research Agenda.", *Science, Technology, & Human Values*(2004), Vol. 29, No. 4, pp.512-556.
- Rowe, G. and L. J. Frewer, "A Typology of Public Engagement Mechanisms.", *Science, Technology, & Human Values*(2005), Vol. 30, No. 2, pp.251-290.
- Sclove, D., "Democracy and Technology.", New York: The Guilford Press, 1995.
- Sclove, D., "Research by the People, for the People." *Futures*(1997), Vol.29, No.6, pp.542-549.

- Steyaert, S. and H. Lisoir (eds.), "Participatory Methods Toolkit: A Practitioner's Manual.", Brussels: King Baudouin Foundation and Flemish Institute for Science and Technology Assessment, 2005.
- Stirling, A., "'Opening Up' and 'Closing Down': Power, Participation, and Pluralism in the Social Appraisal of Technology.", *Science, Technology, & Human Values*(2008), Vol.33, No.2, pp.262-294.
- Vig, N. J. and H. Paschen (eds.), "Parliaments and Technology: The Development of Technology Assessment in Europe.", State University of New York Press, 2000.
- Wilsdon, J. and R. Willis, "See-through Science: Why Public Engagement Needs to Move Upstream.", London: Demos, 2004.