Organisation for Economic Co-operation and Development
Global Science Forum

Report on
Science and Technology for a Safer Society

Final consensus report from the OECD Global Science Forum Workshop
held in Tokyo, Japan, on December 5-6, 2005

1. Introduction: Science and Technology for a Safer Society

Modern societies are exposed to numerous natural and man-made hazards, and governments are keenly motivated to reduce the resulting harm to the lowest practical levels. Science and technology are among the most effective tools that governments have at their disposal, and thus there is a clear incentive to design science policies in ways that both maximise the creation of knowledge, and the exploitation of that knowledge to protect individual citizens and society as a whole.

In every hazard category (for example, floods, earthquakes, epidemics, chemical spills, releases of nuclear radiation, industrial and transportation accidents, unsafe lifestyle choices) there is a long history of applying science and technology to reduce the likelihood of harm, and to mitigate the consequences of incidents that do occur. To date, however, S&T applications for enhanced safety have been pursued primarily within single isolated S&T domains, and have not had to take into account the societal (sociological or psychological, i.e., human) dimensions of the technology and its applications. Only recently have the social and behavioural sciences begun to play a greater role. Thus (to pick just one out of many possible examples) in the area of aircraft safety, superalloy single crystal turbine blades have significantly enhanced the safety and performance of jet engines, but this success was achieved almost entirely within the domains of materials science and aeronautical engineering. By contrast, designing a modern aircraft cockpit with its (many displays and controls) cannot succeed without an in-depth understanding the way pilots behave (including inter-personal behaviour of the entire crew) and the many complexities of human-machine interactions. These advanced kinds of S&T challenges – where the human element is an integral part of the system whose overall safety must be enhanced – are becoming increasingly important and were the subject of the OECD Global Science Forum workshop.

Among the reasons why some S&T-based development projects for enhancing societal safety do not always succeed are the following:

1) The societal issues are very complex, with many stake-holders and multiple, intricate social interactions. It can be difficult to even identify the most essential elements of the safety problem. Typically, a solution realised within a single S&T domain can only resolve a small portion of the entire complex problem.

2) The safety issues are composed of not only technical aspects but social aspects as well. In fact, in most cases the latter are dominant, and any purely technological solution cannot be fully effective if it does not adequately account for the human dimension.

3) Many safety challenges are inherently multi-disciplinary, but, unfortunately, the body of accumulated useful knowledge (principles, theories, techniques, devices, best practices, etc.) is largely fragmented: that is, its elements typically remain confined to the narrow circle of experts in each domain, and are not available to the wider hazard-reduction community, including persons who are concerned about (and/or may be among the potential victims of) existing or emerging threats.

For the above reasons, there is a need for an innovative approach to develop effective measures to resolve societal safety issues, utilizing the full strength of S&T.

2. Introducing the Bird's Eye View approach.

Many of the emerging serious problems that confront the modern world (for example, cyber attack or new viral diseases) are of the kind described above. Accordingly, new approaches are needed to realizing a safer society, and researchers in a number of countries are rising to the challenge with new creative solutions. In Japan, researchers have been exploring an innovative, strategic, holistic, multidisciplinary approach, known in Japan as *cho-kan*: "the Bird's Eye View" (BEV). Implementations that are developed under this approach share most or all of the following aspects:

1) Capturing a global picture of the problem:

   Society is complex, with numerous stakeholders and inter-dependant social sub-systems. Any safety issue has multiple aspects including technical, political, economic, cultural, and ethical. It is necessary to first capture and describe a global picture of the problem for its resolution. Otherwise, the essential point at issue cannot be identified. Local resolution for a limited portion of the whole problem may not lead to its complete resolution.

2) Utilizing available knowledge from multiple relevant fields of study:

   For the resolution of societal safety issues, an appropriate combination of S&T and social systems science is essential. It is an effective way to maximize the strength and advantages of S&T-based solutions. To implement the appropriate combination of S&T and social systems science, collaboration between natural and social scientists, and a general mobilization of experts from different fields, are necessary.

3) Taking advantage of experiences and good practices from different but similar fields:

   Too often, experts focus only on the limited knowledge and experience in within their own field. It is very important to focus, but that may preclude the utilization of experiences and good practices from other fields. Systematic mechanisms to utilize experiences and good practices in different fields are necessary.

3. Potential for benefits for the resolution of societal issues on safety.

In many ways, modern societies are not well prepared for emerging risks such as terrorism, new infectious disease (e.g., avian influenza) and other threats including large earthquakes, tsunamis, and hurricanes. Available resources are limited, and must be allocated efficiently. The BEV approach is expected to lead to innovative measures for dealing with such societal safety issues by taking maximum advantage of power of S&T, and of the significant investments that governments make in research. The innovativeness stems from utilization of advanced S&T, and the appropriate combination of S&T with social systems sciences.

4. Rationale for the Global Science Forum workshop

The Global Science Forum of the Organisation for Economic Co-operation and Development is a venue for consultations among senior science policy officials of the OECD member and observer countries on matters relating to fundamental scientific research. The Forum's activities produce findings and recommendations for actions by governments, international organisations, and the scientific community. The Global Science Forum's mandate was adopted by OECD science ministers in 1999, and an extension until 2009 was endorsed by ministers in February 2004. The Forum serves its member delegations by exploring opportunities for new or enhanced international co-operation in selected scientific areas; by defining international frameworks for national or regional science policy decisions; and by addressing the scientific dimensions of issues of social concern.

The Global Science Forum meets twice each year at OECD headquarters in Paris. At these meetings, selected subsidiary activities are reviewed and approved, based on proposals from national governments. The activities may take the form of studies, working groups, task forces, and workshops. The normal duration of an activity is one or two years, and a public policy-level report is always issued. The Forum's reports are available at www.oecd.org/sti/gsf.

In February 2005, the GSF approved a proposal by the Japanese delegation to convene a workshop on Science and Technology for a Safer Society. The proposal was based on the results of five years activities and experience at Research Institute of Science and Technology for Society (RISTEX) under Japan Science and Technology Agency (JST).

The workshop was hosted by the Delegation of Japan and was held on December 5-6, 2005, in Tokyo. The workshop is organized by the collaboration among MEXT (Ministry of Education, Culture, Sports, Science and Technology of Japan), JST-RISTEX (Research Institute for Science and Technology for Society, Japan Science and Technology Agency) and the OECD secretariat.

The workshop was attended by 30 experts and policy-makers from 14 countries and one international organization. There were 14 presentations including 3 keynote speeches. Necessity and validity of holistic approaches like Bird's-Eye View approach for the resolution of societal issues on safety and security were discussed in the panel discussion session.

5. Workshop findings regarding specific technical and policy issues

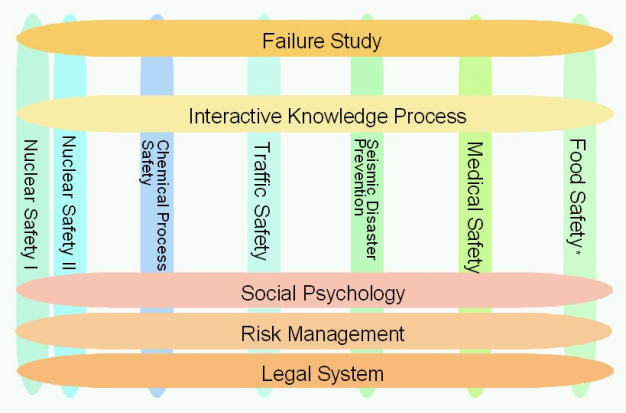
Finding A: Consensus about the value of the Bird's Eye View approach

There were a number of presentations and comments which support the concept of the BEV approach. For example, it was reported that great strides in technology and tools had increased the understanding of the nature of hazards and how we can lower their impact upon society, but this progress does not systematically take into account the social, economic, political and behavioural issues that are often the essence of disasters. The increasing multidisciplinary nature of research (including disaster-related research) is an important overall trend in science policy. For example, during the past four years, the fraction of interdisciplinary research at the United States National Science Foundation has increased significantly.

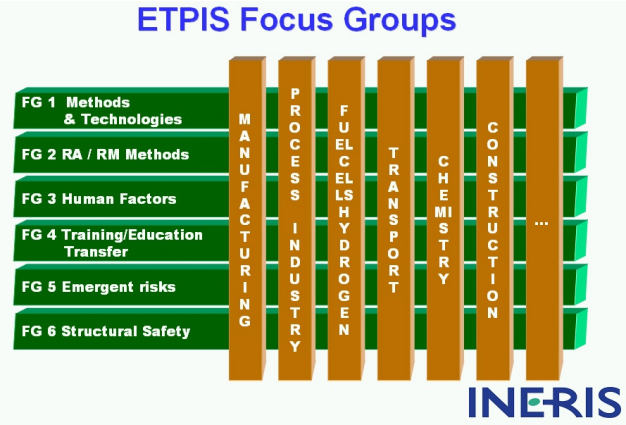
While the concept of Bird's Eye View approach was unanimously supported , various opinions were expressed about its exact definition (and even its name). It was pointed out that past and existing research projects in the societal safety area, generally termed "holistic" and/or "interdisciplinary", share the characteristics described under item 2 above.

Finding B: Existing projects adopting Bird's Eye View approach

A number of projects are successfully exploring and adopting the BEV approach, and some where described and discussed explicitly at the workshop:



A typical example is the research program of the Research Institute of Science and Technology for Society (RISTEX) under the Japan Science and Technology Agency (JST). Its objective is to develop measures to resolve societal issues on safety. The program is carried out by research groups covering various safety-related areas and those traversing research areas. Researchers, specialized in various fields such as engineering, medicine, law, economics, and social psychology, work in a collaborative environment, carrying out comparison of knowledge and collaboration of researchers from different areas. One of the characteristics of this program is in the matrix form of research groups. The Bird's Eye View approach adopted in this program is reflected in the matrix form of interdisciplinary research groups.



The European Technology Platform on Industrial Safety (ETPIS) aims at preparing a strategic vision of the priority research in industrial safety, and to implement a detailed action plan initiated by a high level group from industry, unions, governmental authorities, NGOs, banks, insurance and academic researchers. The technology platform aims to intensify networking and stimulate technological and organisational improvement in risk management by sharing methodologies and research results. The focus groups transverse various industries. ETPIS supports the sharing of lessons learned in industrial safety.

For more than ten years, the International Research Society on Methodology of Societal Complexity has been coordinating the work of over two hundred researchers from many disciplines in Europe, North America and Turkey on the topic of handling complex societal problems. This field combines multidisciplinary expert knowledge with the different views of stakeholders taking emotions into account. This approach, based on the COMPRAM method, supports the problem handling process of complex societal problems from awareness via changing to implementation and evaluation.

The Bird's Eye View approach is in harmony with various existing approaches called holistic approaches or integrated approaches. For example, operations research, which attempts to provide those who manage organized systems with an objective and quantitative basis for decisions, is characterized by the systems approach and the use of interdisciplinary teams. The systems approach to problems recognizes that the behaviour of any part of a system has some effect on the behaviour of the system as a whole. Operations research is normally carried out by teams of scientists and engineers drawn from a variety of disciplines.

Finding C: Benefits of the Bird's Eye View approach

At the workshop, a number of results achieved through the application of the BEV approach were presented. Here one of them is introduced to illustrate the benefits of the approach.

A comprehensive tsunami damage scenario simulator was developed by Professor Toshitaka Katada (Gunma University, Japan) based on the identified essential problem that people do not evacuate following a large earthquake, even though they know the threat of a tsunami. The scenario consists of a tsunami simulation, a warning transmission simulation, and an evacuation simulation. It demonstrates the influence of various response scenarios on the number of casualties, clearly illustrating the relationship between tsunami hazard preparation and disaster prevention. The simulator was used as a tool for risk communication. Meetings for local communities under tsunami threat were held. It is reported that the evacuation rate at a relatively large earthquake after the meetings was more than 70%, while it had been about 30% for a similar earthquake before the meetings.

In the BEV approach, the essential problem is identified and the best combination of S&T and social systems is selected. In this example, the simulator combines S&T and risk communication. The local community meeting for disaster prevention education is the selected social system. For this project, knowledge on earthquake, tsunami, information transmission, human behaviour, simulation, information technology, and risk communication are utilized. Not only natural scientists and social scientists, but also local government officers and local community leaders collaborated to develop and implement the simulator.

Finding D: Prerequisites for promoting the BEV approach

The implementation of the BEV approach requires action by interdisciplinary research groups. The following essential difficulties have been encountered in this endeavour:

Researchers are appreciated for their specialised knowledge. A specialty is associated with one particular discipline which has its own organised structures for maximising scientific achievement, evaluating research and researchers, training students, disseminating results, etc. Within these structures, the creation of knowledge tends to be more valued than its utilization. Research organizations are often established in accordance with existing traditional disciplines. Universities, for example, consist of faculties or schools which correspond to each discipline.

Interdisciplinary research fields do not benefit from such traditions and structures. Hence the results of problem-oriented interdisciplinary research aiming problem solution are rarely properly evaluated or appreciated. Researchers tend to remain within their base discipline and to devote

themselves primarily to knowledge creation. Researchers working in interdisciplinary fields face difficulties in getting permanent employment positions. Because of the lack of organizational and administrative structures for interdisciplinary fields in universities, it is difficult to educate students and produce researchers within the interdisciplinary fields. Those who are educated in the interdisciplinary fields are criticised for a lack of specialised knowledge.

Government organizations are generally formed so as to cope with specific tasks. A pinpointed research project aiming to cope with a specific problem can be naturally funded by the government organization responsible for the problem, and the results of the research will be implemented by that organization. To the contrary, the interdisciplinary research (risk management, for example) covering a wide range of related problems does not have a one-to-one relationship with a single government organization. Hence, the interdisciplinary research necessarily faces difficulties to identify who funds the project and who implements the results. Interdisciplinary research is often impeded by conflicts among government organizations.

For the Bird's Eye View approach to be promoted, strong initiatives at national levels are required to remove these inherent difficulties in the areas of research organization, research funding, education, evaluation, and implementation.

6. Recommendations

Recommendation 1:

The Bird's Eye View approach to problem-solving is a promising method for identifying the essential characteristics of a complex problem and for implementing solutions based on an optimal combination of knowledge about the material world (traditional science and technology) and knowledge about societies and individuals. When properly applied, it allows researchers to apply the full power of scientific and technological knowledge for effectively enhancing societal safety Research projects that are based on this innovative method are complementary to traditional discipline-specific projects, and can be applied with these methods in a synergistic way. The BEV approach promises to be particularly effective in addressing safety issues in a way that fulfils high-level social policy goals.

There exist, however, inherent obstacles to realising the full power of the Bird's Eye View approach. To overcome these, its value should be explicitly recognised, and strong initiatives put in place in coordination with all of the relevant institutions at the national level, transcending traditional institutional boundaries. Interested countries should consider establishing university-based multidisciplinary research institutes devoted to studying (and developing solutions for) complex societal hazards. These institutes should have be endowed with a sufficient amount of stable funding, such that there effectiveness can be assessed following an appropriate predetermined time interval.

Recommendation 2:

International cooperation within the established boundaries of recognised S&T disciplines has a long tradition, and is relatively easy to arrange. International research groups can be formed with a focused theme, bringing together researchers with similar backgrounds. On the other hand, to promote the BEV approach on a global scale, special care is required since it is based on interdisciplinary studies which do not have established procedures, traditions and sources of funding.

Since many threats to societal safety have an international (even global) dimension, and since expertise and other resources are widely distributed around the world, international cooperative projects based on the Bird's Eye View approach deserve the support of national authorities and appropriate international bodies. The existence of strong programs at the national level is a prerequisite for such international efforts.

Recommendation 3:

Countries that are most at risk due to various emerging complex hazards are often the ones that are least able to protect themselves by applying science and technology. Such applications are most readily developed in OECD countries, but their broader application must take into account the specific conditions and constraints that apply to the area where the solution is to be applied. Fortunately, this necessary flexibility is an inherent feature of the Bird's Eye View approach, within which knowledge of individuals, groups, cultures and entire societies is explicitly combined with scientific and technological knowledge.

The Bird's Eye View approach aims at developing general methodologies that are applicable to a wide rage of similar problems. It also seeks to identify the for the best combinations of S&T and social system methods. For solutions to be transferred from one country to another, the S&T components have to be adapted to any new conditions and requirements that characterise the social system in question. The Bird's Eye View approach may serve as a tool for technology transfer related to the resolution of safety-related societal issues. To realise this, appropriate consultations and actions should be undertaken by the international community.