Science and Technology for Society System
Mission Program I

Report on Intra-Program Evaluations

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I. Overview of Mission Program I

1. Research background

Numerous issues, perceived by the public as closely related to sophisticated science and technology have come to the fore in recent years, such as safety cover-ups at nuclear power plants and the outbreak of BSE (bovine spongiform encephalopathy, or mad cow disease). Coming up with effective solutions to these problems and implementing them are not easy, due chiefly to the following two factors.

The first is that social issues are becoming increasingly complex and sophisticated. Since a variety of organizations, structures and systems are in each case intertwined, merely addressing the problems locally does not necessarily lead to the overall problem being addressed: the result is sometimes unintended consequences or counterproductive effects. On the other hand, sophisticated knowledge of science and technology is required to address these problems, and, for this reason, there is a chasm between specialists and non-specialists in terms of their perceptions and understanding. The increasing intricacy of issues also results in fields of research becoming segmented into areas of specialized expertise. The growing complexity and sophistication of social issues, especially those pertaining to science and technology, are making it even more difficult to see and gain a grip on the overall picture. “Seeing and gaining a grip on the overall picture of social issues” in this context refers to understanding the makeup of social issues—i.e., what elements they are composed of—and the causal relationships that exist between these groups. Until now, science has continued to develop through increased segmentation into specialized fields and through fuller knowledge of these narrowing sectors/areas. As a result, it has become more difficult to “see and gain a grip on the overall picture of social issues,” as mentioned above. An example of this is the Y2K problem, where nobody was able to fully understand or predict beforehand what type of problems would arise in which sector, or the repercussions they might cause in society as a whole.

Secondly, because a wide range of actors or stakeholders is affected by the introduction of solutions, and because these actors have diverse sets of values, it is difficult to determine the actual desirability of solutions that need to be introduced. That is to say, in a contemporary society with a wide spectrum of sets of values, changes that are favorable to one actor may not always be favorable to another. This is making it difficult to determine the best solutions for society as a whole.

In the context of these issues, the program aims to develop the technologies necessary for proposing and implementing effective solutions and countermeasures to social issues, especially those related to science and technology.

2. Research policies

This program focuses on the tasks most closely associated with science and technology, as well as society, as indicated in the previous section. In other words, emphasis is placed on (1) the increased complexity and sophistication of social issues and the difficulty of understanding the overall picture, and

(2) the difficulty of judging the relative desirability of the solutions to be introduced. This program defines technologies that help address social issues and that facilitate the smooth operation of society as "science and technology for society," and formulates a methodology for designing and developing them. Here, "technologies" refer not only to science and technology, but also include all systems and structures in society, including governing technologies such as legal systems, economic management technologies such as business/economic systems, public expectations, and regulations. Through the development and accumulation of science and technology for society, the process of addressing social issues related to science and technology can be expected to evolve in the following manner.

First, various types of science and technology for society will make it easier to gain a grip on the overall picture of social issues related to science and technology. Complex social issues which until now could be understood only by those with extensive expertise on a wide range of fields will be understood in its entirety relatively easily by people in any field. This means that people representing different areas of expertise can share their awareness of issues such as "What elements constitute the problem in question?," "What is the correlation between components?" and "What essential elements can help address the problem?"

Once an awareness of the issues can be shared, individuals who work to address those issues will make use of both their expertise and their new knowledge of the overall picture to draw up solutions. The methodology for designing the science and technology for society that will be constructed through this program will help draw up such solutions. For example, even if there is a problem which a certain sector has never experienced before, it may be something that other sectors have experienced and have already implemented solutions for. In that case, by elucidating and comparing the social issues at hand with similar cases that have already been addressed by other sectors, it should be possible to come up with the most appropriate solution.

Next, various types of science and technology for society will make it easier to determine the degree of desirability of the solutions that may be introduced. It will enable people to learn about decisions/judgments made by various actors that have different standpoints, sets of values, and interest areas, and explore the basis for making such decisions/judgments.

If actors from different standpoints and with contrasting sets of values can share information with each other on how decisions are made and what views they are based on, they will be better convinced of the desirability (or undesirability) of those decisions. Moreover, if science and technology for society can be incorporated into policy-decision processes, it should be possible to realize science and technology for society that can provide information to help select the best possible solutions (policies) from a range of options.

Therefore, the groups of science and technology for society that are to be developed to address the

two problems cited in 1. Research background, namely, (1) the increased complexity and sophistication of social issues and the resultant difficulty in gaining a grip on the overall picture, and (2) the difficulty in judging the degree of desirability of the solutions to be introduced, are expected to become technologies that will (a) support the conception of solutions that make maximum use of the existing knowledge in a cross-sectional manner, and (b) guarantee even higher-level conviction and support of society for these solutions.

3. Program goals

Based on the above-mentioned awareness of issues as the basis, the Program establishes the following three specific goals.

Goal 1: Develop science and technology for society that addresses social issues related to safety

Goal 2: Construct a knowledge base for the development of science and technology for society

Goal 3: Construct a general methodology for the development of science and technology for society

4. Research structure and points of concern

1) Research structure

The program comprises (a) research groups that cover areas pertaining to safety, such as nuclear safety, chemical process safety, traffic safety, seismic disaster prevention, and medical safety, (b) cross-sectional groups that cover topics such as failure studies, interactive knowledge processes, socio-psychology, legal systems and risk management groups, and (c) the General Research Group that oversees and coordinates the entire program. Besides these, the program includes researchers who study the issue of food safety, although they have yet to organize a specific group. The program comprises 20 full-time researchers and 58 part-time researchers. The period of research is five years, starting in FY2001. Details of the research structure and organization are shown in Section V.

2) Points of concern

The following points were taken into consideration in fulfilling the goals.

- The research structure will allow researchers and practitioners of engineering, medicine, law, economics, and socio-psychology to cooperate in addressing a variety of social issues.
- The program brings together sectors which, despite having faced similar social issues related to safety, have so far not been compared and studied.
- By discovering similarities as well as differences between areas, the researchers will build a universal methodology for the creation of a safe and secure society.

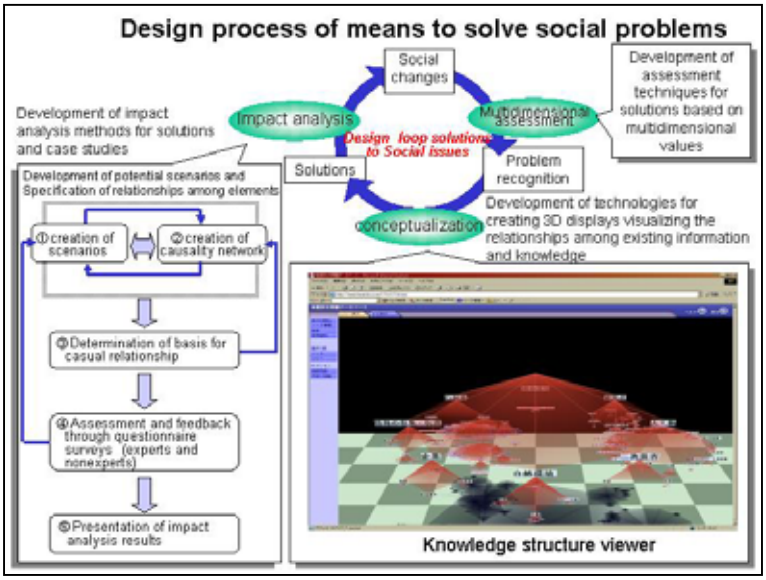
5. Introduction of representative research achievements

II.3 and 4 outlines program goals as well as current progress, with the details given in Section IV.

This section introduces representative research achievements.

1) Methodology for designing science and technology for society (General Research Group)

The General Research Group is in the process of constructing a general methodology for designing science and technology for society that draws together the knowledge and information generated from the results of individual studies conducted by the different research groups. In this section, methodology for designing science and technology for society w ill be described by taking, as an example, science and technology for society designed to resolve the problem of inappropriately constructed (disaster-prone) houses. This was a study carried out jointly by the Seismic Disaster Prevention Research Group, the Legal System Research Group, and the General Research Group.



○ Process of designing science and technology for society

Science and technology for society will be designed by identifying various social issues, drafting appropriate science and technology for society, predicting changes in society as a result of this new science and technology for society, and repeatedly evaluating the anticipated changes in society.

○Tools for supporting understanding of the overall picture

The Research Group drew up a list of approximately 1,000 items pertaining to seismic disaster prevention, including problems, countermeasures, facts, data, and legal regulations. These 1,000 items contain a huge volume of knowledge and information, making it by no means easy to understand the individual relationships between separate pieces of knowledge or to gain a grip on the overall picture. The Group therefore adopted 3D graphics techniques and developed an information visualization tool that can manipulate information via a Web browser, and used it to create a seismic disaster prevention knowledge database.

By using information structuring and visualization tools to browse the relevant knowledge, it is possible to gain an understanding of the overall picture of problems related to seismic disaster prevention. It has also become clear, from the perspective of protecting human lives, that eliminating inappropriately constructed (disaster-prone) houses is a high-priority issue. This tool can therefore be used to promote the awareness of social issues.

○ **Science and technology for society for eliminating inappropriately constructed (disaster-prone) houses**

To eliminate inappropriately constructed (disaster-prone) houses, it is imperative that the owners of such houses recognize the risks their houses carry. This is a key prerequisite for achieving the clear presentation of facts and resolving the problem of incomplete information. A microsimulator of quake disasters estimates the extent of damage an area would suffer, taking into account the degree of structural damageand road closures caused by collapsed buildings. It then simulates the disaster by taking into account the status of human casualties, the possibility of escaping from houses and buildings, as well as other human actions such as evacuating the area and confirming the safety of friends and family. The Figure on this page shows one page of the simulation on the computer screen. It provides a variety of information, including the level of damage sustained by various buildings and structures; the status and whereabouts of people who are trapped under the wreckage and missing, severely injured, or confirmed dead; the location of roads that are closed and how people are forced to make detours as a result; and how people are trapped in locations whose exits have been blocked.

It is true that, by looking at the results of these simulations, one should be able to visualize the sorts of things that would occur in his or her neighborhood if a major earthquake struck. But will this information actually encourage those individuals to take specific actions, such as rebuilding their homes or making them quake-resistant? Although this simulator is an effective tool for increasing people’s awareness of the risks involved, the problem can by no means be resolved with this tool alone.

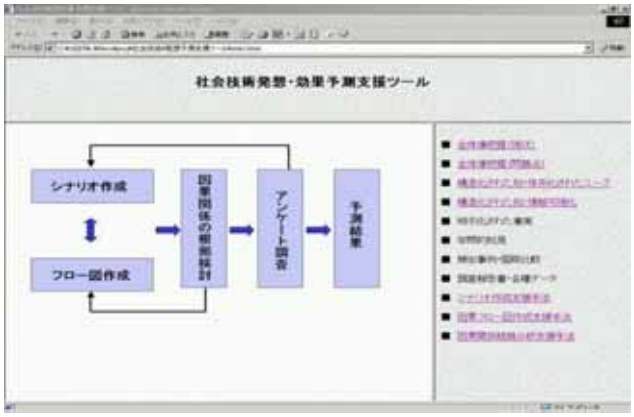
The Group analyzed the reasons why the implementation of anti-quake measures has not taken hold as hoped, and why the implementation of quake-resistant repairs has not increased as expected, each from the perspective of the current situation, recognition of the advantages, cost, and rules. After studying the responsiveness of the policies currently in place, the Group proposed the following six quake-resistance enhancement systems.

- A system of accountability when buying, selling, or renting second-hand houses (provisional name)
- A system for subsidizing quake-resistant repairs for inappropriately constructed (disaster-prone) roadside buildings (provisional name)
- A system for offering quake-resistant discounts to life/damage insurance programs (provisional name)
- A system for appraising the value of second-hand houses in terms of quake resistance (provisional name)
- A system for promoting quake-resistant, disaster-reduction repairs (provisional name)
- A system for restricting the use of buildings that are at risk of collapsing in the event of an earthquake (provisional name)

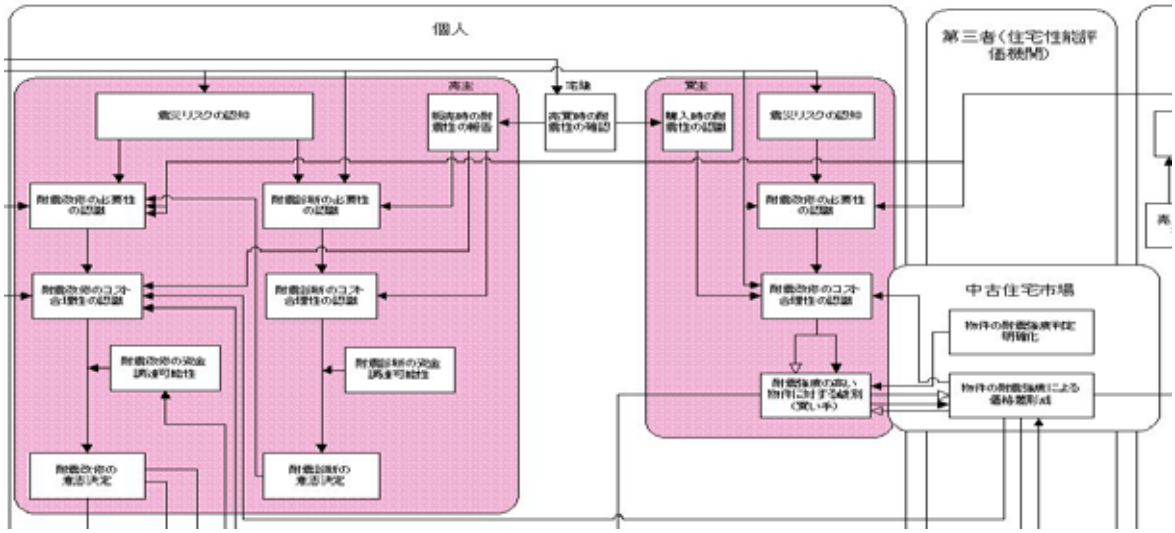
At present, quake resistance enhancements to houses have very little influence on their prices during buying/selling. Therefore, one idea is for the real estate appraisal sector as well as the real estate transaction industry to establish a method for calculating the price of a second-hand house's quake-resistance performance (to be provisionally called "a system for appraising the value of second-hand houses in terms of quake resistance"). Although the price of a second-hand house is determined by the market, this system provides information that helps the buyer and the seller review their suggested prices in the light of the building's resistance to earthquakes. The combination of a quake damage simulator and the system for appraising the value of second-hand houses in terms of quake resistance can be regarded as an example of science and technology for society. The next example shows how the influence of the introduction of science and technology for society is analyzed in the methodology for designing science and technology for society.

○ Method for analyzing the effects of the introduction of science and technology for society

The next process in addressing social issues through science and technology for society is the forecasting of changes that might occur as a result of the introduction of science and technology for society. The combination of a quake damage simulator and the system for appraising the value of



second-hand houses in terms of quake resistance is a typical example of science and technology for



society. A Web-based method of forecasting changes in society as a result of this science and technology for society has been established, and the window on the left shows the process for forecasting these changes. A set of tools to support the process is featured in the window on the right.

First, things that are expected to occur are written in the form of a story. This is called “scenario writing.” Here, the start of the scenario, or the introduction of science and technology for society, and the goal of the scenario, or the addressing of social issues, will be made clear. The scenario is modified and refined through repeating this process. If the part on the screen indicating “scenario writing” is clicked, a window showing the scenario appears.

Next, the scenario will be analyzed as a group of causal relationships and illustrated in the form of a diagram showing a causal network. Causes and their effects are represented as nodes (the title showing the contents is encircled by an oval or a square), while causal relationships are represented by the arrows that connect the nodes.

The grounds that provide the basis for each causal relationship will be investigated. In some cases, a causal relationship may be justified by similar past cases; it may also be based on the results of a questionnaire survey. For some cases, interview surveys of experts in relevant fields may be more appropriate. The scenario and the causal relationship network will be updated as necessary, and the final forecast results will be obtained after reiterating a series of these operations. The tools shown in the diagram support the forecasting operations; they are also a means for presenting the forecast results. If the arrow indicating a causal relationship is clicked, a window appears, and the results of analyzing the grounds for the causal relationship are displayed. Supplementary information used in making the forecast is shown in the “tool group” featured on the right. This information can be referenced.

Although the word “forecast” is used, the words “estimate” or “speculation” may be more appropriate. In some cases, a detailed forecast analysis may be conducted based on econometric methods. In view of the labor and cost that it would entail, however, this method is not likely to be very widely adopted. A more realistic method may be one which places emphasis on converting and visualizing the implicit knowledge possessed by experts into formal knowledge. Instead of quantitative forecasts, the targets should be narrowed down to a more qualitative forecast that convinces people that the findings are reasonable. The significance of this method is that a variety of problem-solving ideas can be analyzed at relatively low cost.

Lastly, the scenario, causal network, and the results of analyzing the rationale will be combined to generate “forecast results.” A questionnaire survey will be conducted to study whether the forecast results are deemed reasonable, and which causal relationships are problematic. Questionnaire survey respondents may either be experts in relevant fields or members of the public, depending on the problem. Although the appropriateness of the forecast is not always verified by this method, it is useful for identifying questionable or unpredictable causal relationships, or in confirming the degree of awareness of the general public.

The forecasting analysis presented here may not be too different from the type of analysis which has been traditionally conducted in past system designs. The important thing is that the type of investigations conducted can be seen at a glance. This enhances people’s trust in individuals who propose the use of science and technology for society, and leads to a deepening of people’s understanding of the experts’ efforts to conduct investigations. As a result, it may boost these people’s wish to cooperate in addressing various problems. Presenting the prospect of an ideal future leads to gaining people’s understanding of, and cooperation in, bringing about that prospect.

○ Evaluation of science and technology for society

The final process in the design of solutions to various problems is an evaluation of whether the anticipated social changes are desirable or not. A survey will be conducted that targets people holding diverse views who are affected in one way or another by the problems. The types of changes that are imposed by the introduction of science and technology for society are potentially very diverse. It is perfectly possible that an individual may regard one change as desirable but another as undesirable. For each anticipated change, survey respondents will be asked if such change is desirable or not, and the results analyzed. This process allows a value map to be drawn up. In other words, people with different sets of values can be positioned on a 2-dimensional plane. Although it is not possible to determine comprehensively whether the results brought about by the introduction of science and technology for society are desirable or not, a value map such as this provides materials for judgment during the process of attempting to gain public acceptance of that particular science and technology for society.

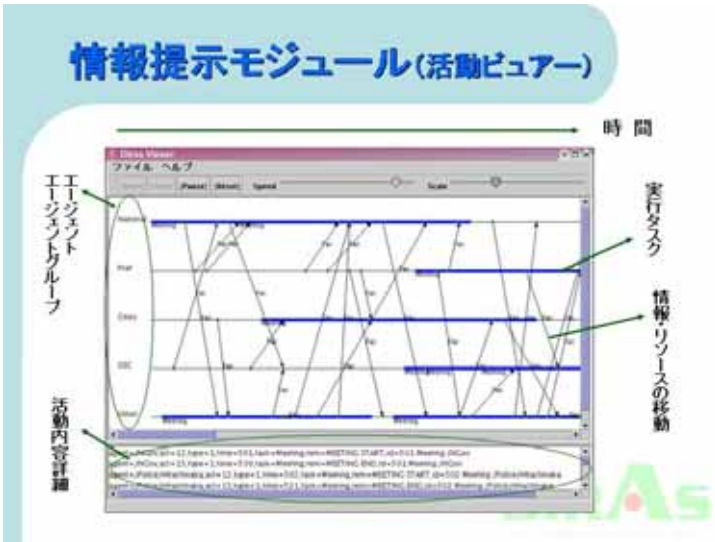
2) Evaluation techniques and supporting technology for crisis management systems (Nuclear Safety Research Group I)

The objectives of the Nuclear Safety Research Group I are to construct a structured and systematic ontology of nuclear safety from the many issues pertinent to this field and to establish a foundation for related knowledge to be shared throughout society. Furthermore, the Group aims to contribute to the resolution of the problematic aspects of science and technology for society related to nuclear safety by developing design evaluation techniques for organizational and social risk management systems not addressed by previous safety engineering methods, by building a store of knowledge for risk communication, and through the development of supporting technologies. In this section, a method for evaluating a risk management system and supporting technologies—which are part of the Group's achievements—will be described.

To establish an adequate risk management structure, the Group is developing a system for simulating behaviors and responses adopted in the event of an emergency. This system incorporates diverse actors—including enterprises, area residents, disaster prevention specialists, local governments, and the central government—as agents or models. The Group also aims at evaluating the performance of a risk management system that targets specific emergency scenarios, so as to gain knowledge of what a superior risk management system should ideally comprise. Once a simulation system is completed, the Group plans to publicize it to relevant parties, including local governments of areas where nuclear power plants are located.

○ Simulation system for organizational behaviors in emergency situations

The Group has developed a system simulating human and organizational emergency response to nuclear disaster. The system is comprised of a human and organizational simulator that models emergency behaviors based on interactions between various agents (models of each human and organizational unit installed on CORBA, a dispersion object specification method), as well as a viewer that presents the simulation results in an easy-to-understand manner. Each agent exchanges information and resources with other



agents, and decides on a course of action based on them. The nuclear disaster prevention training scenario in Ibaraki Prefecture in FY2001 was adopted as a model for emergency responses/behaviors, and a simulation was carried out using this system. As a result, it was confirmed that it would be possible to re-create emergency responses and behaviors through the application of this system and that the particulars of the emergency responses/behaviors could be clearly demonstrated by using the viewers.

○ **Qualitative models for the behavior of local residents in emergency situations**

To investigate the behavioral characteristics of local residents in the event of a nuclear disaster, the Group conducted case study analyses of the literature on 57 natural disasters and common accidents (in which the disaster spreads in stages, warnings and evacuation orders are issued, and evacuation measures are taken), identified the thinking and behavior of local residents in emergency situations, and, by so doing, identified and classified the factors that influence their behavior. These findings were used to construct a qualitative model for the behavior of local residents in the event of a nuclear power disaster. The model is comprised of 3 stages, namely information input, situation assessment, and decision-making.

This model is comprised of three attributes or conditions: information attributes (content of information, frequency of information, media, and dissemination source) that influence information input (whether or not information can be input, degree of understanding and reliability); recipient attributes (sex, age, family makeup, knowledge of disasters, past experiences) that influence circumstantial judgments (recognition of danger and anxieties); and environmental conditions (time zone, weather, season) that influence decision-making (presence of information behavior, presence of evacuation behavior).

3) Real-Time Treatment Navigation System (Medical Safety Research Group)

The Medical Safety Research Group is currently constructing information systems equipped with the functions outlined below. The goals are (a) to raise the level of general medical care by systematizing basic medical treatment information management to provide safe medical treatment services and to realize efficient and effective treatments, and (b) to address the economic problems associated with medical care.

(1) Digitization of medical treatment records (establishing a database of medical treatment information)
(2) Analysis of medical treatment data, mainly through data mining
(3) Real-time linkage and sharing of medical treatment information

An overview of each of these functions is given below.

○ **Electronic management of medical treatment records (establishing a database of medical treatment information)**

This system builds a database of different medical treatment information using the huge volumes of information obtained from daily diagnoses and treatments. A characteristic of this database is that it uses a data storage format that takes into account the elapse of time.

What specific advantages can be obtained by storing data in a chronological or sequential manner? The following are two such advantages.

- A patient's treatment information can be referenced chronologically.
- Both predictive and retrospective surveys can be readily conducted.

If a patient's medical treatment information can be shown in chronological format, such as on a chart, his or her treatment history can be evaluated visually. By adopting a data storage format that takes the passage of time into consideration, it becomes possible to chronologically examine and analyze the data accumulated from daily medical treatment information. Clinical research requires the collection of a large number of new patients, huge amounts of money, and long-term follow-up. By using this system, however, physicians could browse the results of such research, and access similar information, in real time.

○ **Analysis of medical treatment data mainly through data mining**

In this section, we discuss the extraction of medical information from the above-mentioned database. The Research Group is constructing an exhaustive data analysis method, known as data mining, as well as an analytical system that displays data by extracting and processing them in ways suited to various purposes.

Data mining is a technology that has come into wide usage in recent years. By setting simple evaluation criteria, it can be used to search efficiently, from among huge volumes of data, for a rule that meets set criteria. By means of exhaustive data analysis, data mining not only formally confirms empirically obtained medical information; it also can reveal previously unknown facts.

Meanwhile, the Group is also constructing an analytical system that is capable of extracting and processing data by simple condition-setting operations, and which is able to display the search results graphically. The characteristics of this analytical system are that it contains medical information obtained through data mining, extracts data pertaining to information that the searcher has some knowledge of from the start, and makes it possible to visually identify data trends. The diagram here shows a graphic representation using an analytical system. In this example, male patients are divided into two groups: those who are suffering diabetes and those are not. The graph shows the proportion of patients who developed re-stenosis after reconstruction of circulation in the coronary artery. Graphic representations make it easy to see trends in data as well as differences between different groups. We believe that the system will be a tremendous help in making clinical diagnoses.

As can be seen, medical information extraction methods by means of data mining and analytic systems can make a significant contribution to establishing new diagnostic methods and to devising treatment guidelines. Moreover, if medical knowledge can be shared by creating a database of diverse medical information that has been extracted (a database of diagnostic support information), this would greatly contribute to developing even safer medical treatments.

○ Real-time linkage and sharing of medical treatment information

A real-time medical treatment information linkage function is deemed necessary to boost the quantity and range of data included in the medical treatment database mentioned above, and to share the medical information and new diagnostic methods obtained through data analysis. During periods such as immediately after a new drug has come into wide usage, for example, it would be difficult to extract, in a short period of time, medical information on side effects, etc., associated with the new drug, unless medical treatment data were gathered and accumulated from across the nation. It is therefore necessary to centrally manage the data accumulated at various medical institutions and to enhance data-gathering capabilities. By rapidly disseminating acquired information throughout Japan, it should become possible to establish a set of standard diagnostic methods that can be used throughout Japan, thus also greatly enhancing the safety of medical care.

Today, thanks to the spread of the Internet and broadband services, it has become relatively easy to link various databases on a nationwide basis and facilitate the exchange of data. Because of the special nature of the medical care data, it is imperative that the security of the data be ensured. It is fully possible, nonetheless, to share medical treatment information on a nationwide basis. The creation of a network of medical institutions throughout Japan is expected to enable the nationwide sharing of medical information obtained through the accumulation and analysis of vast amounts of medical treatment data, as well as of new diagnostic methods.

By establishing a Real-Time Treatment Navigation System equipped with the above functions, the Medical Safety Research Group aims to formulate treatment guidelines and implement the “one

patient, one medical chart" system, and, as a result, hopes to promote the system such that it will contribute to developing medical safety as science and technology for society.

4) Formulation and verification of the interactive knowledge process (Interactive Knowledge Process Research Subgroup)

The implementation of science and technology for society encompasses high-level intellectual operations such as recognition of problems, fusion and systematization of knowledge, and formation of a consensus. However, in today's extremely diversified and mobile world of the Internet and other technologies, it is no longer possible to rely on simple, human intellectual operations to actualize science and technology for society. The goal of the Interactive Knowledge Process Research Subgroup is to establish a method for developing interactive knowledge processes to assist in the implementation of science and technology for society. To do this, innovative information media technologies will be used to expand the use of conversation, which is the most natural form of human communication.

The aim, in particular, will be to establish interactive knowledge processes as bases for science and technology for society that society can trust and depend on, and in which all people can take part with ease. The Subgroup carries out initiatives that focus on applying these processes to risk management, with the intention of creating a safe and secure society, a task which various mission groups have undertaken. This section introduces the interactive communication base technology which is a part of the Subgroup's research findings.

EgoChat, an agent system (a software agent that conducts communications on behalf of the user), was used to present the outcomes of the research carried out by various Mission Program teams. The Group also confirmed that, by using EgoChat, it was possible to effectively describe the contents of the JST failure knowledge database. EgoChat gives concrete form to the concept of "virtualized egos or agents," and techniques such as content creation via knowledge cards, circulatory models of knowledge cards, and knowledge channels for drawing up an information dissemination strategy for knowledge cards, were proven to be fully utilizable in practical applications as basic models for interactive communications base.

S-POC focuses on the concept of a Public Opinion Channel (POC), which is a new type of broadcasting medium that summarizes information disseminated by community members, and airs it as

a TV program. By integrating VMIS (a tool for collecting, editing, and browsing visual clips, still pictures and other materials with ease) and CRANES (a policy discussion system that enables groups of people with contrasting opinions to present, through a common medium, their views in a structured and visual manner), S-POC relates the characteristic features of each tool to support the sharing of realities or knowledge, and facilitate discussions for consensus formation. Therefore, S-POC is a community communications base. Since the format of data used in VMIS, EgoChat, and CRANES is unified, the data can be mutually exchanged. Moreover, by using CAST-RISA, an interactive agent presentation system, users can convey content-rich messages using nonverbal means of communication, such as gestures and facial expressions. The following are special characteristics of S-POC:

- Images, visuals, and agents are synchronized, then provided on the Web.
- Contents can be created by agents with ease on the server side, using text and other media.
- It uses Contents Management System (CMS), a portal site package, which enables users to create content with Web applications that they are familiar with.
- S-POC is not a media tool used by itself; it can be used in combination with other databases and applications.

As a result, costs for sophisticated content development and browsing can be dramatically reduced. At present, R&D of primary portions of the system's prototype has been completed, and preparations are under way to move on to the open test stage. It is hoped that S-POC's current prototype will be completed by the end of FY2003, and that, by so doing, it can be used by any member of the community to create contents that are persuasive (their ideas being expressed in terms of moving images) and easy to understand (the agents speaking in a normal conversational style), paving the way for circulation within the community.

II. Status of Program implementation

1. Program goals (featured earlier)

This Program established the following three specific goals.

Goal 1: Develop science and technology for society that addresses social issues related to safety

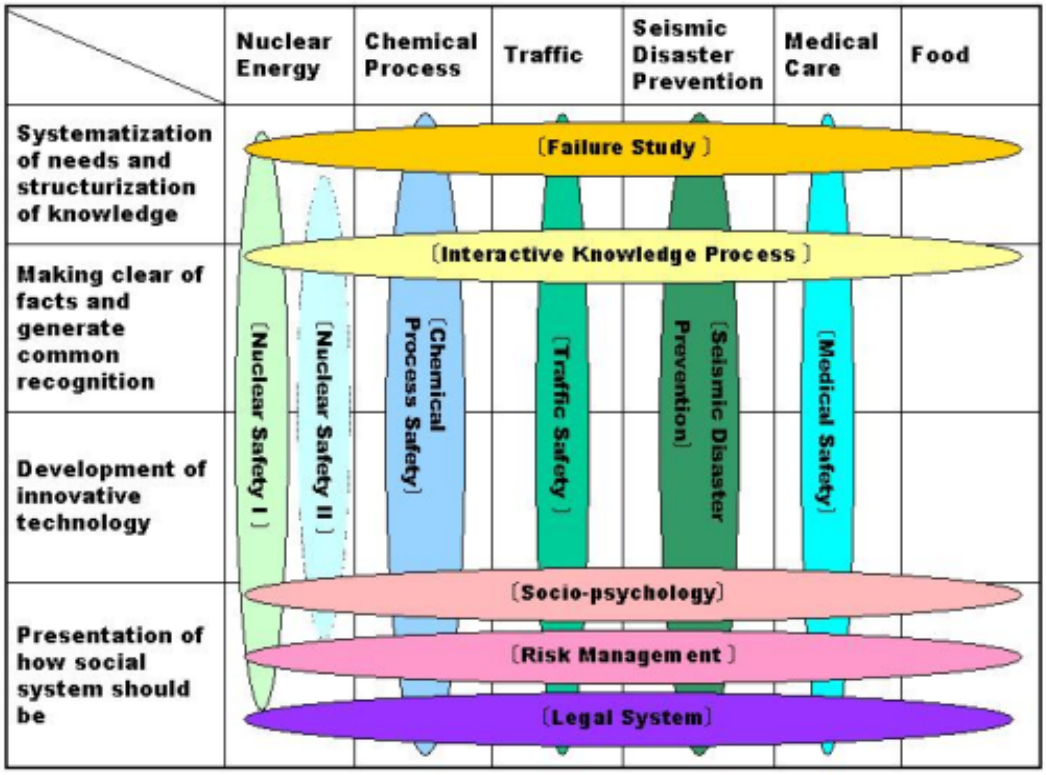
Goal 2: Construct a knowledge base for the development of science and technology for society

Goal 3: Construct a general methodology for the development of science and technology for society

2. Research structure and points of concern (featured earlier)

1) Research structure

The program comprises (a) research groups that cover areas pertaining to safety, such as nuclear safety, chemical process safety, traffic safety, seismic disaster prevention, and medical safety, (b) cross-sectional groups that cover topics such as failure studies, interactive knowledge processes, socio-psychology, legal systems and risk management groups, and (c) the General Research Group that oversees and coordinates the entire program. Besides these, the program includes researchers who study the issue of food safety, although they have yet to organize a specific group. The program comprises 20 full-time researchers and 58 part-time researchers. The period of research is five years, starting in FY2001. Details of the research structure and organization are shown in Section V.



2) Points of concern

The following points were taken into consideration in fulfilling the goals.

- The research structure will allow researchers and practitioners of engineering, medicine, law, economics, and socio-psychology to cooperate in addressing a variety of social issues.
- The program brings together sectors which, despite having faced similar social issues related to safety, have so far not been compared and studied.
- By discovering similarities as well as differences between related areas, the researchers will build a universal methodology for the creation of a safe and secure society.

3. A list of major research achievements at time of program completion

Below is a list of major achievements obtained at the time of program completion.

Classification of achievements		Name of achievement	Group in charge
Major item	Minor item		
Those that meet Goal 1 (Development of science and technology for society that addresses problems related to safety)	Specific examples of science and technology for society	Proposal of the system of promoting quake-resistant repair/reinforcement of inappropriately constructed (disaster-prone) houses and evaluation of its effects	Seismic Disaster Prevention G Legal System Research G General Research G
		Real-Time Treatment Navigation System	Medical Safety Research G
		A system for comprehensively evaluating traffic safety programs	Traffic Safety Research SubG
		Disaster prevention educational software	Seismic Disaster Prevention G
		Evaluation techniques and support technology for crisis management systems	Nuclear Safety Research G-I
		A system for certifying corporate decision-making mechanisms; a program for making corporate decision-making more sound	Socio-Psychology Research G
		Communications systems for local disaster prevention	Nuclear Safety Research G-II
		A system for forming a consensus on safety in the chemical industry	Chemical Process Safety Research G
Those that meet Goal 2 (Constructing a knowledge base that would the development of science and technology for society)	Components of science and technology for society	Method for visualizing structured knowledge and information	General Research G
		A system for supporting the understanding of the overall picture of the problems and issues	General Research G
		Interactive communications base	Interactive Knowledge Process Research SubG
		Failure knowledge management system	Failure Study Research G
	Basic knowledge of science and technology for society	Clarification of the concepts of safety and security	General Research G
		Construction of a cross-sectional knowledge base covering existing legal structures for safety	Legal System Research G
		Systemization of nuclear safety and information sharing	Nuclear Safety Research G-I
		The processes of social acceptance and the formation of a social consensus regarding nuclear power	Nuclear Safety Research G-I
Those that meet Goal 3 (Constructing a general	Design method for science and technology	Methods of influencing public views of science and technology for society	General Research G
		Method of evaluation based on multifactorial values	General Research G

Classification of achievements		Name of achievement	Group in charge
Major item	Minor item		
methodology for the development of science and technology for society)	for society	Demonstration of the social risk-sharing structure and the construction of the concept of public risk management	Risk Management Research G

4. Progress of investigations

1) Achievements that meet Goal 1 (Development of science and technology for society that addresses social issues related to safety)

○ Specific examples of science and technology for society

a) Proposal of the system of promoting quake-resistant repair/reinforcement of inappropriately constructed (disaster-prone) houses and evaluation of its effects (Seismic Disaster Prevention G + Legal System Research G + General Research G)

(Target achievements)

- Establish an environment for changing the public's awareness and design new systems with the goal of promoting quake-resistant repair/reinforcement of inappropriately constructed (disaster-prone) buildings and houses.
- Using earthquake simulators, present (1) a method for analyzing decision-making for promoting quake-resistant repair/reinforcement and for promoting earthquake insurance ownership, as well as (2) comprehensive risk management methods/techniques for disaster risks.

(State of progress)

The Group has developed a system for quantitatively explaining the benefits/effects of quake-resistant repair of inappropriately constructed (disaster-prone) houses both to the public administration and the public. They have been actively providing explanations to a wide range of targets, from Japan's central government to regional municipalities.

Since the characteristics and advantages of this system have been praised by the mass media and numerous experts, the Group has begun studying the establishment of specific systems and structures that incorporate this proposal system as their basis.

b) Real-Time Treatment Navigation System (Medical Safety Research Group)

(Target achievements)

- The Medical Research Group aims at building information systems (a) to raise the level of general medical care by systematizing basic medical treatment information management to provide safe medical treatment services and to realize efficient and effective treatments, and (b) to address the economic problems associated with medical care.
- Specifically, the Group will aim at constructing an information system equipped with the following three functions: (1) electronic management of medical treatment records (establishing a database of

medical treatment information), (2) analysis of medical treatment data, mainly through data mining, and (3) real-time linkage and sharing of medical treatment information.

(State of progress)

- At the present stage, a basic structure has been more or less established for a medical treatment database in the cardiovascular sector. The construction of the infrastructure for gathering data is making steady progress. It has also become possible to extract medical information on a test basis, using medical treatment data from the University of Tokyo Hospital's Department of Cardiovascular Internal Medicine.
- Other activities are making steady progress, including the development of methods to support diagnoses, and research into protocols for extracting medical information. The goal is to complete the system's basic foundations at this Department within one year.

c) A system for comprehensively evaluating traffic safety programs (Traffic Safety Research Subgroup)

(Target achievements)

- The Group will construct a system for comprehensively evaluating traffic safety programs that can appropriately evaluate the cost efficiency of various traffic safety program options.
- Using this system makes it possible to study traffic safety measures from a comprehensive perspective and to contribute to appropriate decision making by planners, policy makers, and NPOs, etc., related to traffic safety.

(State of progress)

- The Group has improved a model that can clearly show the circumstances and mechanisms of traffic accidents at intersections, and has used it to develop a system that can display the information on a Geographic Information System (GIS).
- The Group has also enabled this system to be viewed on the Web, allowing the general public and persons concerned to access information on traffic accidents.

d) Disaster prevention educational software (Seismic Disaster Prevention Research Group)

(Target achievements)

- Distribution of disaster prevention educational software based on the pseudo-experience system (earthquake simulator)

(State of progress)

- The Group is in the final stage of constructing a prototype for a "universal" pseudo-experience system (earthquake simulator) that can simulate ground tremors as well as evacuation activities, which will provide the basis for disaster prevention educational software.

e) Evaluation techniques and support technology for crisis management systems (Nuclear Safety Research Group I)

(Target achievements)

- With the aim of establishing appropriate crisis management systems to enable response to emergencies, this Group will develop an emergency behavior simulation system based on a model that simulates the actions of companies, local residents, government officials specializing in disaster prevention, local governments, central government and other diverse related actors.

(State of progress)

- A simulation system has been developed for human and organizational emergency response to nuclear disaster. It was confirmed that it would be possible to model emergency responses and behavior through this system and that it was possible to clearly demonstrate the particular characteristics of the emergency responses and behavior.
- The Group identified the thinking and behavior of local residents in emergency situations, and, by so doing, identified and classified the factors that would influence their behavior. These findings were used to construct a qualitative model for the behavior of local residents in the event of a nuclear power disaster.

f) A system for certifying corporate decision-making mechanisms; a program for making corporate decision-making more sound (Socio-psychology Research Group)

(Target achievements)

- The goal is to organize a System for Certifying Corporate Decision-Making Mechanisms that evaluates and certifies the soundness of the government's and companies' decision-making, as well as a Program for Correcting Corporate Decision-Making Mechanisms in the event that the decision-making mechanism is unsound, or if the mechanism is to be improved upon in the future.

(State of progress)

- At present, the components of the above certification system and correction programs are steadily being clarified.

g) Communications systems for local disaster prevention (Nuclear Safety Research Group II)

(Target achievements)

- Develop a communications system that supports the local community residents in obtaining adequate and appropriate information on accidents, as well as on further developments, and enables them to make informed decisions.

・ Analyze and identify the content of necessary information, visualize such information in an easy-to-understand format, and develop an efficient and effective means of conveying the information.

(State of progress)

・ Past documents and materials received from local residents involved in the JCO accident were critically analyzed, and the means and channels of communicating such information were assessed. In addition, computer servers capable of wide-area information dissemination were installed and consolidated at the JAERI Tokai Research Establishment.

・ The Research Group is at the initial stage of establishing fundamental concepts for disaster prevention communication systems, based on analysis to date. It will be developed into a full-scale research study in and after FY2003.

h) A system for forming a consensus on safety in the chemical industry (Chemical Process Safety Research Group)

(Target achievements)

・ Develop, through dialogue with society, a system for the formation of a social consensus on safety in the chemical industry with the aim of obtaining the trust of the general public in the safety of the chemical industry.

・ Aim to connect a “social acceptance system” and “chemical process safety evaluation system” as technologies that contribute to resolving any problems that the residents may have with chemical companies.

(State of progress)

・ The Group as established a System for the Formation of Social Consensus on Safety in the Chemical Industry (prototype). Here, a knowledge database for residents comprising a glossary of key terms was compiled, including a chemical substance MSDS and information on earthquakes. Furthermore, the Group conducted a case study and applied the data from an actual company located in Kawasaki City.

・ Regional versions focusing on certain areas have also been established as prototypes. In the future, the Group will conduct research to complete a nationwide edition of the System for Formation of Social Consensus on Safety in the Chemical Industry.

2) Achievements that meet Goal 2 (Constructing a knowledge base for the development of science and technology for society)

○ Components of science and technology for society

a) Method for visualizing structured knowledge and information (General Research G)

(Target achievements)

- Regarding the huge amount of knowledge gained through past research, technologies will be developed to support the understanding of the relationships between knowledge groups and the overall picture of knowledge and information.

(State of progress)

- A 3D graphics technology was adopted to develop an information visualization tool (a "knowledge structure viewer") by means of a Web browser, that can scan and explore information
- The Group also developed a system that automatically structures existing knowledge into strata and displays them on a 2D screen.

b) A system for supporting the understanding of the overall picture of the problems and issues (General Research G)

(Target achievements)

- Develop a technology that supports the understanding of the causal relationship between different constituents of a social problem, and the overall picture.

(State of progress)

- Themes were extracted from newspaper articles and other items. Keywords were added to these factors and grouped together under a major heading, using the KJ technique. By analyzing the mutual relationships between the factors that had been listed, the Group developed a method for identifying the structure and for expressing the overall picture using a directed graph.
- The Group applied the above technique to the actual incident—a cover-up at nuclear power plants—and confirmed its effectiveness.

c) Interactive communication base (Interactive Knowledge Process Subgroup)

(Target achievements)

- Establish a method for developing interactive knowledge processes to develop science and technology for society. To do this, innovative information media technologies will be used to extend the use of conversation, which is the most natural form of human communication.

(State of progress)

- EgoChat, an agent system (a software agent that conducts communications on behalf of the user), was employed to present the outcomes of the research carried out by various Mission Program teams. The Group also confirmed that, by using EgoChat, it was possible to effectively describe the contents of the JST failure knowledge database.
- The Group completed the R&D of the primary portions of the prototype for S-POC, a community communications base that facilitates and supports reality sharing, knowledge sharing, and discussions for consensus formation. Preparations are under way to move on to the open test stage.

・ The Group began designing and installing an “immersive interactive environment” in which scenes of an earthquake disaster are re-created as a three-dimensional virtual environment, and an agent that can converse with the users will appear at the scene. This way, users can share such experiences through conversations while experiencing the environment in a realistic manner.

d) Failure knowledge management system (Failure Study Research Group)

(Target achievements)

・ Construct a Failure Knowledge Management System (FKMS) that (a) provides the techniques and means for the effective use of failure knowledge by engineers and physicians, etc., who provide the public with science and technology, and (b) fosters a sense of safety and security on the part of the public with respect to science and technology

(State of progress)

・ The Group proposed measures for the construction of social systems and mechanisms for the circulation of failure knowledge.

・ “Seiko Taiken,” failure simulation software for experiencing an incident as it would occur inside a factory, was developed, and its efficacy was confirmed.

・ The Group took note of failures that occur in the course of implementing creative work, and studied predictive and diagnostic methods to enable team-based creative endeavors while avoiding failures.

・ Companies that have experienced failures were used as case examples to compare the profits they gained through fraudulent acts (failures and the cover-up of such failures, etc.) and the losses they incurred as a result of having such failures revealed. The Group was able to quantitatively demonstrate that it does not pay, economically, either to make mistakes or to cover them up.

○ Basic knowledge of science and technology for society

a) Clarification of the concepts of safety and security (General Research Group)

(Target achievements)

・ To clarify the context in which the concepts of safety and security are used in everyday situations.

(State of progress)

・ The Group studied how experts perceive each of these concepts by referring to the safety standards that are implemented in various sectors. Perceptions of safety and security were classified into two types: active and ignorant; and the Group showed how “active-type safety”—something that science and technology for society should aim at—may be achieved.

b) Construction of a cross-sectional knowledge base covering existing legal structures for safety (Legal System Research Group)

(Target achievements)

- To achieve clarification of the overall picture of the existing legal structure on safety (which has until now been difficult to gain an understanding of due to its historic complexity, etc.) through the following two perspectives: “an information-gathering and dissemination system relating to accidents, breakdowns/failures, and safety,” and “collaboration and allocation of responsibilities of countries, industries, academic societies, international organizations and foreign countries in establishing the standards,” etc.

(State of progress)

- A comprehensive investigation of the existing legal structures in the transport sector (aviation and vehicular transport), medical and pharmaceutical sectors, housing disaster-prevention sector, food safety sector, nuclear safety, etc., has been more or less completed. The Group is currently categorizing and analyzing the issues based on common perspectives.

c) Systemization of nuclear safety and information sharing (Nuclear Safety Research Group I)

(Target achievements)

- To construct a systematic ontology of nuclear safety by identifying all pertinent factors and subject fields relevant to nuclear safety and bringing together all relevant foundational concepts in the subject area.
- To develop a base technology to allow for the sharing of information related to nuclear safety within society, such as an information search engine, that makes use of this ontology.
- To establish and publicize a portal site on the Internet that enables both professional and non-specialist users to efficiently search and browse information related to nuclear safety on the Web.

(State of progress)

- Tools to support the construction of an ontology were developed, and their efficacy was confirmed through the construction of an ontology in the field of nuclear power.
- The Group investigated existing systems of conceptual classification for nuclear safety, and showed that most were constructed specifically for the specific nuclear facility in question, for specialist scientific domains, or a combination of both.
- To make possible an Internet-based document search service, the Group developed a system that conducts searches of documents related to the users’ interest areas by making use of this ontology, and completed installing the search engine component.

d) The processes of social acceptance and social consensus formation regarding nuclear power (Nuclear Safety Research Group I)

(Target achievements)

- Through social simulations and surveys, to obtain information on the dynamics of the social acceptance of nuclear power and the formation of organizational culture, as well as on the cognitive structures and other factors that influence these dynamics.
- To apply information-communications technology based on a model of social consensus formation to develop a technology to actively support the process of social consensus formation. To develop an environment that supports the social consensus formation.
- To publicize the Group's achievements in the form of handbooks on optimal risk communications, as well as tools to be used in intelligent electronics-based conferencing systems.

(State of progress)

- The Group analyzed the extent to which people's conclusions related to the public acceptance of nuclear power differ according to their area of residence and their level of knowledge of nuclear power. The results demonstrated that the factors influencing judgment differed according to the respondent's place of residence, but were not affected by their amount of knowledge.
- The Group identified the formation of public opinion on nuclear power as a multi-agent process involving the acknowledgment of the issue, exchange of views, and dissemination of information. The Group conducted a simulation analysis based on this process to discover the influence of factors such as the structure of social networks and individual cognitive mental effects on the macro-level distribution of public opinion on nuclear power.
- The Group also conducted protocol analysis, based on the concept of a "statement schema," on the transcripts of three actual government committee meetings, demonstrating that the use of consultation spaces reflected in hierarchical means-end analysis was effective in gaining an understanding of the process of social consensus formation.
- The Group developed an electronic conferencing system incorporating various support functions to facilitate the understanding of general conference proceedings and remarks made by participants in electronic conferences, to support the efficient formation of a social consensus.

3) Achievements that meet Goal 3 (Constructing a general methodology for the development of science and technology for society)

○ Methods for developing science and technology for society

a) Methods of assessing the influence of science and technology for society (General Research Group)

(Target achievements)

- To develop a method for predicting and analyzing the influence of the proposed introduction to the public of science and technology for society.

(State of progress)

- A prototype influence analysis method was developed in FY2001, and was applied from FY2002 to the development of science and technology for society.
- An assessment of the influence of science and technology was conducted in the following three sectors: (1) promotion of repairs/remodeling of inappropriately constructed (disaster-prone) houses (in collaboration with the Seismic Disaster Prevention Group), (2) Real-Time Treatment Navigation System (in collaboration with the Medical Safety Research Group), and (3) traceability of foodstuffs.

b) Methods for evaluating science and technology for society based on multifactorial values (General Research Group)

(Target achievements)

- In the event that a proposed science and technology for society is introduced to the public, an evaluation exercise should ideally be conducted amongst people of diverse standpoints who are affected by the problems, on whether the anticipated social changes are desirable or not. The results obtained in the evaluations are then analyzed, and trends in attributes are identified and positioned on a two-dimensional plane or "value map".
- Although the value map cannot comprehensively determine if the results brought about by the said science and technology for society are desirable or not, it can provide materials used for judgment purposes in the social acceptance of science and technology for society.

(State of progress)

- Investigations are under way, using materials such as minutes from meetings of the Committee for the Privatization of the Public Roads.

c) Demonstration of social risk-sharing structures and the construction of the concept of public risk management (Risk Management Group)

(Target achievements)

- To develop a general understanding of risk management with regard to safety issues from a societal perspective, or, in other words, to construct the concept of public risk management. To provide guidelines that would contribute to minimizing the costs of risk management activities for society as a whole—activities which until now have been conducted individually by various actors on an issue-by-issue basis.

(State of progress)

- The Group is conducting comprehensive and panoramic studies envisioning how risk management between various sectors studied in the science and technology for society mission programs should be carried out.

- Research is also being conducted that focuses on municipalities that have the greatest responsibilities for risk management of natural disasters, as well as on the behaviors of influential private companies. Particular emphasis is being placed on the relationship between municipalities and citizens and on the public role of private enterprises, to identify the current status of social behaviors and activities.
- Moreover, since Japan suffered numerous natural disasters this fiscal year, the Group is conducting awareness surveys targeting residents of sites where disasters occurred.

5. Overall initiatives of the program

As shown below, a variety of activities is being carried out with the goals of promoting intra-group discussions and exchange, fostering common awareness of the issues at hand, developing human resources, and disseminating messages and information to the public.

1) Mini-symposiums

Five mini-symposiums and four leader conferences have so far been held.

2) Group leader training programs

Until now, two overnight training camps have been held: at Izu Kôgen and in Karuizawa.

3) Development of human resources

○ Undergraduate, master's and doctorate theses on science and technology for society

As of October 28, 2003, fourteen undergraduate theses, sixteen master's theses and four doctorate theses have been planned or completed.

○ College seminars and classes on science and technology for society

As of October 28, 2003, a total of 39 college seminars and classes have been held on science and technology for society. The number of people attending such events totaled approximately 5,400.

○ Seminars and lectures on science and technology for society

As of October 28, 2003, a total of 126 seminars and lectures have been held. The number of people attending such events totaled approximately 11,000.

○ YRA/Science and Technology for Society.com

A new initiative set forth in Mission Program I is the YRA system, in which undergraduate students become involved with science and technology for society through part-time jobs. The program allows participants to become involved in wide-ranging research to gain an awareness of various issues and

problems, which may assist in determining their area of professional study. Parts of their research results were featured in the Science and Technology for Society Papers.

The content of their research is due to be published in a Web-based journal, “Science and Technology for Society.com.”

4) Websites

Information is released through the following websites:

○ **Science and Technology for Society Research System website:**

http://www.ristex.jp/mission/mission.html

○ **Website for Mission Program I:**

http://www.ohriki.t.u-tokyo.ac.jp/S-Tech/

5) Papers

To date, approximately 200 papers have been drawn up, 42 of which were included in the Collection of Science and Technology for Society Papers.

6) Books

A book entitled “Science and Technology for Society to Address Problems (provisional title)” will be published in FY2003 by the Chuko Shinsho Publishing Company.

7) Mass media coverage, etc.

Articles describing the activities of Mission Program I were featured in Nihon Keizai Shimbun’s “Lessons on the Economy,” in a bulletin of the Ministry of Education, Culture, Sports and Science and Technology, and in various other publications.

8) Presentation of research results

So far, four forums on science and technology for society have been held. For the forum held in spring, members participated in presenting its achievements to the public, while in the forum held in autumn, they took part in theme-specific panel discussions.

9) International seminars, etc.

An international workshop will be held on December 18-19, 2003, with members of Mission Program I planning to attend the event.

10) International educational/publicity activities

○ **Invitational lectures, etc.**

- A workshop on science and technology for society at the Swiss Federal Institute of Technology (ETH), June 2002
- Researchers of MIT and ETH invited to a mini-symposium.
- Exchange of information with OECD Director Michael Oborne, February 18, 2003

○ **Visits and exchange of opinions**

Two surveys each were conducted in the US and Europe for international publicity and information exchange purposes. Members of the survey team visited universities, government agencies and research institutions.

III. Assessment of the overall program

1. Comprehensive assessment

1) Is the concept of science and technology for society clearly presented?

The concept of science and technology for society as “a technology in the broad sense that addresses social issues” has been clearly presented. Specific examples of how science and technology for society has been deployed can be seen in sectors such as nuclear safety, chemical process safety, seismic disaster prevention, traffic safety, and medical safety. Science and technology for society deployed in seismic disaster prevention to eliminate inappropriately constructed (disaster-prone) houses is especially well-designed, and clearly illustrates the concept of science and technology for society which Mission Program I has in mind. The development of other examples of science and technology for society is also steadily under way and currently on schedule to reach completion within the stipulated period. Once these technologies can be lined up one next to the other, the overall image of the concept of science and technology for society can be illustrated in a more concrete manner.

2) Is developing science and technology for society presented as an effective way of addressing to various problems?

The various forms of science and technology for society presented in the Program all take a comprehensive perspective of the problem at hand. They also utilize, in an organic way, the knowledge that has been generated in different research areas. It is thus superior to other conventional ways of addressing social issues. The effectiveness of science and technology for society can be demonstrated only after it is introduced to society and acts to address social issues. However, the types of science and technology for society that have been presented in the program clearly demonstrate the ability to address a range of problems.

3) Is universally relevant knowledge being created through the research achievements of the program?

A distinct feature of Mission Program I is that it considers diverse issues side by side in its analysis, including nuclear safety, chemical process safety, seismic disaster prevention, traffic safety, medical safety, and food safety. One of the key tasks of the program is to extract universally relevant knowledge out of individual cases. As the first step, a methodology for developing science and technology for society is being developed. The concept of science and technology for society has been clearly identified, and the techniques and methods to be used, as well as the development process, (such as identifying problems, devising science and technology for society, analyzing the influences of science and technology for society, and evaluating the changes in society brought about by science and technology for society) have been presented. As for the analysis of the influence of science and

technology for society, methods and technologies have been constructed and applied to eliminate inappropriately constructed (disaster-prone) houses, to develop medical treatment navigation systems, and to improve the traceability of food safety. The usefulness of such technology has been confirmed in this way. As for identifying and understanding the problems, a system for furthering the understanding of the overall picture of problems and issues, as well as a system for visualizing structured knowledge, have been completed and are being used to develop science and technology for society. The next task is to develop a method for evaluating social changes brought about by science and technology for society. This is on schedule for completion within the designated period.

The methodology formulated for the development of science and technology must be novel and creative. The development of science and technology for society represents an alternative to processes of policy formulation that have traditionally been used in policy and legal studies. However, policy and legal studies still do not incorporate this alternative methodology. Alternative policies are for the most part implemented based on bureaucrats' experience and implicit knowledge, and there have been few, if any, opportunities for such policy processes to be turned into formal knowledge. The methodology for developing science and technology for society that is being developed can cope with changes in the awareness and behaviors of people, the most important players in social issues. Since the methodology is specific and applicable, it is highly useful. It can be applied not only to social issues related to safety, but also to a wide variety of problems, including the issue of security, social issues related to the environment, problems which developing nations face, etc. It can also be applied to problems facing both companies and individuals. It is therefore thought to have major implications for society.

Another type of universally relevant knowledge generated from individual issues is a general methodology for risk management. The task is to consider which kinds of science and technology for society are suited to which kinds of risks, and to elucidate corresponding relationships. Now that there is a clearer picture of what kinds of science and technology for society will be developed in various sectors, a Risk Management Research Group was newly launched in FY2003. One of the goals of this group is to construct a general methodology for risk management related to science and technology for society. On the basis of what the Program has achieved in clarifying the concept of safety and security—a task that the Mission Group has tackled since its formation—it is deemed fully possible to achieve this goal in three years' time.

4) Has the principle of "Addressing social issues by deploying multi-disciplinary knowledge" been realized?

Mission Program I aims to address social issues by deploying the knowledge of a variety of sectors. The research format for the development of science and technology for society is through the collaboration of researchers representing different areas of expertise, which has been put into practice.

For example, the development of a system for eliminating inappropriately constructed (disaster-prone) houses is a result of a joint collaboration among the General Research Group, Seismic Disaster Prevention Group, and Legal System Research Group. Similarly, the development of a treatment navigation system in the field of medical safety is being studied jointly by the Medical Safety Research Group, General Research Group, and Legal System Research Group.

Members of Mission Program I have also actualized a comprehensive, problem-solving type research format that corresponds to *Mode 2*, a new knowledge production format presented in Michael Gibbons' theory of knowledge production modes. A program that utilizes this research format on a large-scale basis is unprecedented in the world, making it a truly innovative program.

5) Have the human resources for comprehensive, problem-solving type research programs been developed?

Mission Program I is a research program, and does not directly aim at training and developing human resources. However, for comprehensive, problem-solving-type research to flourish, it is important that individuals who are able to further such research activities be trained and fostered. There are a number of problems that must be resolved to do this.

First is the problem of assessment. Individuals are appointed to university posts based primarily on the number of papers they have published. Comprehensive, problem-solving type research papers are not likely to be targets of assessment activities. To address this problem, members of Mission Program I have cooperated in launching a Collection of Papers on Science and Technology for Society as well as a symposium on science and technology for society. The Collection of Papers on Science and Technology for Society provides a forum for publishing the results of research that has contributed to addressing social issues. It adopts a unique system of having the authors declare, in having their papers reviewed, the type of assessment criteria by which their papers should be assessed. Volume 1 was released in October 2003, and 42 papers were published as the outcomes of the research undertaken in Mission Program I. About two-thirds of all papers submitted were taken up. The contents of the papers included in this book will be presented at the First Symposium on Science and Technology for Society, to be held in March 2004.

The second problem pertains to the period required to nurture comprehensive capabilities. There would be very few problems if a researcher who had already established his or her area of specialty became engaged in comprehensive, cross-sectional research. However, opinions differ as to the desirability of having individuals engage in comprehensive research before they develop their area of specialization. A new initiative set forth in Mission Program I is the YRA system, in which undergraduate students become involved with science and technology for society through part-time jobs. The program allows participants to become involved in comprehensive research in order to gain an awareness of various issues and problems, which may assist in determining their area of professional study. Parts of their

research results were featured in the Science and Technology for Society Papers. The content of their research is due to be published in a Web-based journal, “Science and Technology for Society.com.”

Researchers involved with Mission Program I on a full-time basis carry out research that makes use of a cross-sectional research environment while maintaining their unique professional expertise. A number of researchers are beginning to land full-time jobs at universities, which indicate that efforts related to human resource development are beginning to bear fruit.

2. International recognition

We are planning to ask overseas researchers to participate in an evaluation questionnaire survey, using an English edition of the Outline of the Evaluation Report and the English-language website. Findings will be compiled by mid-January 2004.

3. Future tasks and challenges

1) Introducing science and technology for society

The future tasks are for various research groups to complete the science and technology for society that they are currently developing, and to upgrade/refine it further on the one hand, and to introduce the science and technology for society thus developed to society on the other. There are diverse ways to introduce such technologies to society, and this will be considered flexibly by taking into account the problems targeted and the nature of the science and technology for society in question. Although various considerations have been made in developing science and technology for society, it is extremely important that such technology be introduced by maintaining responsible attitudes toward society, as well as ethical standards, so as to prevent unintended results and adverse influences. It is desired that, in line with the concept of social experiments, the members start on a small scale and proceed carefully by conducting repeated monitoring and modifications.

As was the case with the methodology for developing science and technology for society, a methodology for introducing such technology must be formulated prior to introducing it to the public. In this case, methods employed in political sciences should play an important role. Depending on the circumstances, development and introduction may be implemented simultaneously. Therefore, a mechanism for coordinating the two must be investigated.

The Medical Safety Research Group plans to begin running the Treatment Navigation System on a test basis at the University of Tokyo Hospital, then introduce the system to Bunkyo Ward where the hospital is located, and subsequently extend it to the rest of the country. Similarly, the Socio-Psychology Research Group plans to team up with interested corporations to conduct joint research on systems for certifying corporate decision-making mechanisms, and on how to make corporate decision-making sounder.

2) Stepping up intra-sector collaborations/partnerships

Overnight training camps, mini-symposiums and other events were held frequently to finalize research plans and form stronger links between different sectors. After the research directions of various research groups were finalized, the research groups proceeded with research in their relevant fields. Since various research groups are beginning to produce results, the focus of the activities will be placed, from here on, on comparing and systemizing those results.

We will compare types of science and technology for society developed in sectors related to safety, identify their similarities and differences, determine the relationship between social issues and forms of science and technology for society suitable in addressing the problem, and develop them into a technique/method for supporting the development of science and technology for society.

Efforts will be made to increase the quantity of research that can be carried out by multiple research groups, for example, in science and technology for society for eliminating inappropriately constructed (disaster-prone) houses (developed by the joint collaboration of the General Research Group, Seismic Disaster Prevention Group, and Legal System Research Group), as well as the treatment navigation system (being studied jointly by the Medical Safety Research Group, General Research Group, and Legal System Research Group).

3) Evaluation of science and technology for society

It is necessary to confirm that the science and technology for society developed as the outcome of comprehensive, cross-sectional research is superior to the currently proposed solutions to social issues. For example, the program must confirm if sector experts can provide comments such as “It is an entirely new concept, because the research has been carried out from a comprehensive, panoramic perspective.” The aim is to demonstrate that a breakthrough can be achieved through universally relevant knowledge drawn from cross-sectional analyses and individual cases.

4) Making research more academically appealing

Mission Program I is a problem-solving type research project. Although it does not aim at creating academic knowledge, it is important to create academic knowledge through research into problem-solving to increase the number of researchers engaged in such problem-solving type research and to extend problem-solving type research further. This is positioned as “knowledge creation for the purpose of knowledge utilization.”

The methodology for developing science and technology for society, which Mission Program I is aiming to establish through the cultivation of science and technology for society in individual subject areas, is universally relevant knowledge. How to effectively describe this methodology is an important future challenge. If knowledge is to be made even more universally relevant, elements of implicit knowledge and knowledge based on experience must be turned into formalized knowledge to the

greatest extent possible. Research results become academic knowledge only when the knowledge they embody is formalized. In the course of generating academic knowledge, however, we should not forget that addressing social issues is our primary goal. We should always remain aware that we are creating academic knowledge that contributes, first and foremost, to addressing issues that affect the public.

5) Making the concept of "science and technology for society" more widely known

The concept of science and technology for society is a new one, and time and effort is needed for it to take root in society. As part of the human resource development project, Deputy Research Supervisor to Mission Program I Hideyuki Horii will give three lectures in 2003 on the theme of "Science and Technology for Society and Safety and Security" at the "Open School" entitled "Safety, Security and Science and Technology for Society," sponsored by the Ministry of Education, Culture, Sports, and Science and Technology. Vigorous efforts will be made to increase opportunities such as these and to publish new books to broaden the public's understanding of science and technology for society.

6) Systemization of knowledge

Systemizing the knowledge gained through Mission Program I is important to gain an understanding the overall picture of the accomplishments made. After the program ends, we will plan and prepare to publish an academic book provisionally entitled "Theory of Science and Technology for Society". We believe that this work will be beneficial in strengthening partnerships and collaboration among the different research groups.