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Risk Management Practices in Japan — Standards Setting Problems for Environmental Risks

by

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RISK MANAGEMENT PRACTICES IN JAPAN

- Standards Setting Problems for Environmental Risks

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ABSTRACT

In September, 1983 the Japan Society for Promotion of Science (JSPS) announced support for U.S.-Japan Workshop on "Risk Management" to conduct a comparative analysis of how technological risks have been managed in both countries. In the United States, the National Science Foundation supported a 20-month exploratory research project on this topic conducted by Vanderbilt University, U.S. with co-operation from University of Tsukuba, Japan. This paper intends to provide an overview of Japanese approaches to regulatory practices concerning environmental risks. Particular emphasis is paid to the analysis of standards setting problem in environmental risk management.

1. INTRODUCTION

— Background and methodology for the comparative study -

Since the start of the industrial revolution, a massive volume of industrial and municipal wastes have been dumped into the air, water and land. Those wastes include noxious substances of metals, chemicals and new synthetic materials which have been gradually acknowledged as being hazardous or risky to human health and amenity as well as to natural environment. Throughout the world industrialized nations have bocome aware of the problem despite great benefits of modern technology, but, until very recently, the nature and speed of their responses have varied widely.

In Japan, a new type of industrial innovation has emerged, made easier by the devastation of the Second World War which wiped out the residues of old-fashioned technologies, and societal institutions and legacies. Intensive investiment schemes in both private and public sectors have transformed Japan into one of the economic super powers. Steel, chemical and heavy manufucturing industries have mushroomed; fossil fuel consumption has grown exponentially in the quater century, 1950-1972. The scale of operation, complexity of the processes involved, and pace of the change are nowhere more evident in Japan throughout the world. First, occupational morbidity, mortality and disamenity attributable to industrial pollution have likewise increased, and then followed the involuntary public involvement in the evils of pollution risks.

Dr. Bunichi Ohishi, the director general of the Environment Agency, set up in 1971, put the position to the UN Conference on the Human Environment at Stockholm (June 1972) [1]:

> The Japanese people had assiduously worked for twenty years and seemed to come close to their target, when they realized that they were faced with the serious destruction of the environment whch inevitably accompanies intensive economic growth. The air is unclean and the water is polluted. Urban areas are overpopulated and precious nature is beginning to be ruined. Pollution has come to cause many illness and death . . . These experiences should have started serious re-thinking. "GNP for whom, for what?" is a question posed by the people, demanding the recovery of the wholesome, bright and worthy living environment, is rising like a surging tide. Under these circumstances, Japan's policies have been re-oriented from priority on economic growth to respect for human life.

The battle for a clean and safe environment in Japan has been necessarily fought in a radical and hasty manner in order to cope with the painful burden imposed by the high pace of change and the

intensive scale of economic activities in a high-density society. As a consequence, as the the OECD report [2] on Japanese environmental policy states, "The Japanese approach to environmental pollution abatement appears to be largely non-economic." Stringent direct administrative measures were taken without waiting for conclusive scientific evidence and full knowledge of economic costs and their consequences.

So far the control of sulphur oxides has been quite successful, reducing the pollution level drastically, but there has not been as much success with controlling other pollutants, such as nitrogen oxides and airborne particulates. Inconsistencies in regulating each air pollutant in terms of costs and actual improvement of air quality were found after the initial ambitious period of administration (1968-1978), which laid particular emphasis on the protection of human health. The high costs incurred in the improvement of air quality linked with low economic growth since the late seventies have posed new challenging questions concerning what real benefits are derived from environmental regulations and also what price the public and private sectors are willing to pay for this cleaner and safer environment.

Meanwhile Japanese firms have increasingly adopted the concept of Technology Assessment, begining a new era of technological innovation in the late 1970s. Among various aspects of technology assessment, the issue of environmental risks from modern industrial technology has been one of the major questions. Much work has been done by private firms or their associations in the industrial sector. Some of these activities in which one of the leading firms of electronics industry in Japan, Hitachi Corporation, took part during the past decade are [3]:

1. Evaluation of CATV services from the standpoint of public users and planning of systems development strategy from the standpoint of related product manufacturers.

2. Safety analysis and evaluation of new urban mass transportation systems, and feedback of the results to hardware and systems design organizations.

3. Evaluation of environmental impacts by nuclear power plants on plant employees and the local populace, and improvement of radioactive waste disposal systems based on these evaluations.

4. Cost-benefit analysis and evaluation of various solid waste recycling systems.

5. Assistance in applying TA methodologies to corporate and divisional strategic planning.

6. Assistance in planning and giving lectures for in-company TA methodological training courses.

7. Participation in an Institute for Future Technology Research program, "Research and Development Project for Soft Sciences."

8. Participation in the Council for Industrial Structures of the Ministry of International Trade and Industry to discuss the newly expanding systems engineering business.

9. Participation in the Systems Research Committee of Japan Electronic Industry Development Association to improve and propagate systems engineering methodologies.

In spite of a remarkable methodological development of technology assessment for new industrial innovations in the industrial circle which includes both private and public sectors, there has been little progress observed in the administration by various regulatory authorities which are scattered in the governmental body. The Environment Agency in Japan is still struggling to establish a legally bounded procedure of "Environmental Impacts Assessment" and a large number of the regulatory activities dealing with hazardous wastes, chemicals, pesticides, herbicides, detergents, food additives, etc. has been tentative and piecemeal in practice, often taking the path of least resistance.

For example, the intensive use of chemical pesticides for rice production started in the early days of the 1950's shortly after the Second World War in order to overcome food shortages. The introduction of both BHC and Paratrion controlled "rice stem borer" which had been one of the most harmful insects in Japan, but also they promoted another harmful pathogen of rice, "rice blast" which required the new introduction of pesticides such as "organo-mercury" fungicides. The amount of the pesticides consumed in our country grew from 200 million dollars in 1960 up to, 1,300 million dollars in the late 1970s.

The structural change of agricultural production from a labor-intesive type to a capital-intensive (less labor force and intensive use of energy and agricultural chemicals) type has strongly promoted the successive introduction of new pesticides. The recent trend indicates increased usage of herbicides by both the farmers and public that were once alarmed by the environmental movements in the late 1960's such as "Silent Spring" by R. Carson and "Combined Pollution" by S. Ariyoshi (a Japanese novelist). Major concerns among farmers and public are:

(a) accidental death and chronic health damage by either maloperation or normal operation

(b) increase of capital cost for pesticides (1/4 of total product cost)

(c) complicated management in pesticides use-combination, effects, timing, etc.

(d) pesticides residues in foods and soils

(e) excessive and misuse of pesticides in home gardens or public facilities

In this workshop, we compare US and Japanese approach and practices in technological risk management, taking account of the differing historical, socio-economic and cultural background. The major objectives of this comparative study are:

1) Conduct a systematic comparison of risk management, choosing up typical cases in terms of "structural charactaristics" of risk management in both countries.

2) Suggest possible cross-cultural lessons in view of methodologies, data collection and analysis and decision processes.

This paper is primarily concerned with environmental risks arising from utilizing modern technology. Our attention focusses on the interface between policy decisions and regulatory measures. Standards or criteria for setting ambient or quality levels, testing or registration procedures, and guidelines or emission standards, are based on scientific and technological knowledge, economic cost, and subjective judgement of what constitutes an acceptable level of risk or health hazard. The interface involves not only science and technology but also politics and social values, and perceptions which are deeply roted in both countries.

2. FRAMEWORK FOR THE STUDY

The English term "risk" can be defined in various ways depending on which concerns are perceived as important. Webster's Dictionary defines it as "possibility of loss or injury, or the degree of probability of loss". A formal definition would be "potential realization of unwanted consequences of an event" [4]. The Japanese term "kiken or kiki" that is likely to correspond to "risk", has a somewhat negative feeling of being in danger, which has to be avoided as much as possible in formal decision making. Thus most people in business or public administration don't like to use the word "risk" or "risk management", instead they often use the word "safety" or "safety management".

In the context of environmental science, risk is generated by man's introduction into the environment of substances or energy which is liable to cause potential hazards to human health, harm to living resoruce and ecological systems, damage to structures or amenities, or interference with legitimate uses of the environment. Clearly, man cannot live without having some effect on the environment. Burning of fuels and producing technological goods is certainly to have some harmful effects, but they have also been a vital means for human beings to survive. The substances which can become risks or hazards at high concentrations, may exist at low concentrations over wide areas in the natural environment. In practical terms, therefore, it can be said that risk occurs if a potential pathway for exposure exists and such substances arise in the wrong time and wrong place [5]. During industrialization the pace and scale of man's release of these noxious substances into the environment was accelerated to such a extent that harmful effects could be assessed not only locally, but also regionally or globally. Nevertheless, a divergence of perception exists, even within the different sectors of the scientific community, on various aspects involved in the definition above. For example:

- how much risk or what range of effects is acceptable to the health of individuals, populations or society as a whole?
- what range of damage is tolerable to living resources and ecological systems in terms of the carrying capacity of the natural environment?
- what is a content of "amenity" to be protected or pursued as a measure of the quality of life associated with legitimate uses of the environment?

From an economic and resource management point of view, the total cost of environmental risks to society must take into account the desire of industry or the public to minimize the use of resources which they have to pay for. The central concept is that of 'external cost' that exists when

> a production or consumption activity induces a direct loss of utility (adverse effects), or an increase in production cost, which does not enter the decision calculus of the controller of the activity.[6]

This external cost can be considered to consist of two components: first, the 'private costs' of dischanging activities by the use of resources; and secondly the 'social costs' of these activities to the society as a whole. The divergence between the producer's evaluation of the cost and that of society as a whole is typified by the notion of 'public goods', such as air, water or amenities. Thus

the air may be polluted at zero private cost, but generate large social costs, for example, extra cleaning, medical expenses, and the disamenity of dark-smogs.

Whichever definition of environmental risk is taken, however, there is a primary need for identifying and quantifying the impacts of either:

i) hazards, harm or damage to human health or ecological components in terms of biological or ethical value; or

ii) loss of utility or increase of social costs in terms of monetary value.

How this is to be done is the basic challenge facing the public, developers, researchers, administrators, decision makers and society as a whole. The evaluation of impacts of noxious substances depends on the values or beliefs of individuals, groups and society. These values or beliefs are the products of intricate interactions between individuals and other actors, and between society and ecosystems. There is thus a sociological viewpoint on environmental risks [7].

> "How one views environmental risk and what level of it one should tolerate, of conflict between groups and interpretations, then rightness becomes a practical matter of power and political persuasion."

Most European citizens at the time of the industrial revolution had not perceived that smoke was a pollutant which shortened their lives rather than being merely a nuisance which was socially accepted in the interest of their economic prosperity. A series of smog episodes in London in the nineteenth century did not change the people's continued desire to have an open coal-burning fire (which was the main source of smog in cities) even when data disclosed that the excess death rates from the smog episodes were comparable to those from cholera [8]. Perceptions in the industrialized world are now, however, very different. As an illustration in recent years the Japanese have coined the term 'Kogai' when referring to envionmental pollution or nuisances in general [9].

> "The term is a combination of two characters - the first meaning 'public' and the second meaning 'hazard' . . . 'Kogai' is a sociological term. It does not denote a particular phenomenon. Moreover its meaning has changed over the years as new kinds of hazards emerged and control of the living environment became an urgent matter of public concern."

The determination of acceptable levels of environmental risks is thus ultimately a political decision-making process, from which all control and legislative measures stem. This process of judging acceptability is a prescriptive one in which social habits, percep-

tions of pollution, and economic, political or ethical considerations are dominant. This does not necessarily mean a less important role for science and technology. On the contrary, policy makers are asked to justify their decisions on the basis of scientific and technological data to make the decisions as practically effective as possible.

This discussion leads us to suggest that there are four major components of risk management: Science, Technology, Society and Politics. Figure 1 illustrates our framework for the analysis of Japanese approaches to the environmental risks. Science provides the data and findings on items such as:

- types of risks and their sources;
- pathways, and the effect of climate and topography on theme;
- exposures and responses of living organisms;
- health effects;
- criteria and sources of uncertainty.

Technology provides information on items such as:

- technical options for abating risks;
- institutional or administrative options for regulating risks;
- monitoring or surveillance schemes for identifying risks,

together with socio-economic constraints as well as ecological capacity on these options.

Society transmits its:

- experiences on hazardous events and catastrophe;
- values and attitudes on risk issues.

Finally, politics reflects and interprets society's views providing subjective evaluations of 'political feasibility' in terms of factors promoting social acceptance.

- Urgency of the problems;
- Efficiency of resource utilization;
- Equity of distribution either in benefits or damages;
- Accommodation to a existing legislative and administrative fram

A decision will then be taken either to institute new administrative and legal actions or to remain of the status quo for future decision. Another aspect which we have to address in this particular study is the assessment of the dynamic nature of the risk management process when formulating and implementing risk regulation policies.

Given the analytical framework of four components, shown in Figure 1, we will attempt to describe the roles and beliefs of influential actors, groups or individuals involved in the following three development stages of:

1. risk acknowledgement (policy influence)
2. risk engagement (policy formulation)
3. risk resolution (policy implementation)

The example of decision making process in setting environmental quality standards will show the complicated chain of processes between the disclosure of an environmental risk or hazard and the resulting political actions from which we could draw both common and different features for our comparative study.

3. DECISION PROCESS OF AIR QUALITY STANDARDS AND REGULATION MEASURES IN JAPAN

The concept and content of environmental quality standards (EQS) has so far been a specific feature of the Japanese approach to environmental risk management. The English word 'standards' which is used as a translation from a Japanese word 'Kijun' causes some confusion in understanding the content of the air quality management carried out in Japan. The Basic Law of 1967 (amended in 1971) describes the character of the EQS as follows in article 9:

Article 9

1. With regard to environmental conditions relating to air, water and soil pollution and noise, the Government shall establish environmental quality standards, the maintenance of which is desirable for the protection of human health and the conservation of the living environment.

2. In the event that one of the standards referred to in the preceding paragraph establishes more than one category and stipulates that land areas or areas of water to which those categories are to be applied should be designated, the Government may delegate to the prefectural governors concerned the authority to designate those land areas or areas of water.

3. With regard to the standards provided for in paragraph 1, due sientific consideration shall always be given and such standards shall be revised whenever necessary.

4. The Government shall make efforts to ensure the maintenance of the above-mentioned standards, by implementing environmental pollution control measures in a comprehensive, effective and appropriate manner.

This description does not define the legal character of the EQS well: rather it states an administrative character which the Government shall pursue (as indicated in the underlined parts by the author), reflecting the past lessons from the Yokkaichi case concerning the integrated effect of pollutant discharges.

Dr. T. Suzuki, who has been working at the centre of the standards setting process in Japan and was also involved in the Kurokawa Commission established in 1964 for the study of the Yokkaichi case, classifies the concept of so-called 'Environmental Standards' in the context of the Japanese understanding [10];

i) 'Standards' as legal binds to be enforced

ii) 'Guides or Guidelines' as administrative measures for regional environmental management

iii) 'Goals' and desirable states to be attained for regional environmental management

iv) 'Criteria' as the judgement of environmental quality

The relationship between 'criteria' and the other three categories of 'standards', 'guidelines' and 'goals' seems to be logically clear in the sense that 'criteria' are used primarily as the scientific knowledge for setting those values besides other socio-economic, technical and political considerations. A distinction may be often drawn between 'standards' as legally enforceable and 'goals' or 'guidelines'. Both may specify desirable target exposure levels or pollutant concentrations, but goals or guidelines

are not normally backed by law and may not be considered to be attainable, at least at a socially acceptable cost in the economic sense. The distinction between 'guides and guidelines' and 'goals' also seems to be ambigous. In the Japanese context of the decision process in setting the EQS, the guidelines are considered as the quantitative values which are recommended by the expert committee to the regulatory agencies for their political decision making.

According to the official documents, when the Basic Law was enacted, the interpretation of the EQS was as administrative goals of policy implementation for promoting pollution control measures [15]. They are, in fact, policy objectives and do not impose any legal constraints by themselves on polluters or regulators unless the emission of each specified pollutant is offensive to other pollution control under the framework of the Basic Law. The role of setting EQS is also explained as being guidance for controlling the future development of unpolluted areas and as setting targets for pollution abatement in polluted areas. The other type of 'standards', emission standards (EMS), are determined as direct control measures for each specified pollutant to be legally enforceable, taking into account the EQS class by class and area by area, depending on the current levels of pollution in specific local circumstances.

The role of the Japanese EQS as administrative goals to be achieved some time in the future - in the sense of 'protecting human health and conserving the living environment' - and, at the same time, providing a kind of legal responsibility to the government for making efforts to ensure the maintenance of the EQS, has not only formed the specific character of the EQS, but has also brought confusion in the actual standard setting process and its implementation. The residents who have been suffering pollution in highly polluted areas take the view that the levels of the EQS should be guaranteed as early as possible. The local governments that have direct responsibility for public health standards are apt to take the attainment of the EQS as seriously as if they were 'standards' where noncomplience would be seen as maladministration by the public.

The EMS are the enforcement standards which are direct regulatory tools for managing a particular pollution problem. They put enforceable limits on emission or total amount of pollutants. The EMS of sulphur oxides are defined in terms of quantity of pollutants, but they are also a function of the volume of exhaust gases which are subject to the dispersion capacity of chimneys as determined by effective stack height (He). The actual EQS are set in terms of the K-value in the follwing scheme.

$$q = K \times 10^{-3} \times He^2$$

The maximum allowable amount of sulphur oxides in terms of hourly volume q (Nm^3/h) is determined by the value of K and He, which is the sum of actual chimney height and smoke ascent height. The range of K (0.3-17.5 at September 1976, see Table 1) determines the degree of regulation (stiffness of standards) depending on the state of local conditions of sulphur oxides concentration. In addition, the regulation of fuel use in the major cities (Tokyo, Osaka and seven other cities) was added in terms of prohibition of fuel oils containing more than the specified level of sulphur.

Table 1
Regulation on sulfur oxides emission (K value)

(a) General standards

	Area	K value
1	6 areas: Central Tokyo, Yokohama·Kawasaki, Nagoya, Yokkaichi, Osaka·Sakai, Kobe·Amagasaki	3.0
2	21 areas: Chiba, Fuji, Kyoto, Himeji, Mizushima, Kitakyushu and others	3.5
3	1 area: Sapporo	4.0
4	4 areas: Hitachi, Kashima and others	4.5
5	3 areas: Toyama, Kure, Tohyo	5.0
6	9 areas: Annaka, Niigata, Okayama, Shimonoseki and others	6.0
7	3 areas: Tomakomai, Hachioji, Kasaoka	6.42
8	6 areas: Sendai, Fukui, Hiroshima and others	7.0
9	8 areas: Asahikawa, Utsunomiya, Mihara, Tokushima and others	8.0
10	8 areas: Akita, Kanazawa, Ohtsu, Fukuoka, Nagasaki and others	8.76
11	6 areas: Takasaki, Urawa, Narita, Naha and others	9.0
12	4 areas: Shizuoka, Sasebo and others	10.0
13	15 areas: Hakodate, Gifu, Takamatsu, Minamata and others	11.5
14	6 areas: Aomori, Morioka, Yamagata, Nagano, Kagoshima and others	14.5
16	Others	17.5

(b) Special standards

6 areas:	Central Tokyo, Osaka·Sakai, Yokohama·Kawasaki, Kobe·Amagasaki, Yokkaichi, Nagoya	1.17
8 areas:	Chiba, Fuji, Himeji, Mizushima, Kitakyushu and others	1.75
14 areas:	Kashima, Toyama, Kyoto, Fukuyama, Ohmuta, Ohita and others	2.34

Note: Special standards are applied to newly constructed facilities only.

Actors or Organisations Involved in the Standard Setting Process

In analyzing the standards setting decision process, one of the fundamental questions is:

> Who sets the standards and who is involved in the process?

It is a difficult, almost impossible, task to clearly classify of actors involved directly or indirectly in the process, since the process is considered to be ultimately a political decision. Neverthless, to structure the complex problem into a simplified one is of value in understandeng the nature of the process. One of the methodologies from the view point of systems analysis is the actors-classifications on the basis of different values and perceptions on the air pollution issue, and the degree of involvement in the process. This approach applied to the case of noise standards for Shinkansen Trains in Japan [13]. A set of actors categorised into the following five classes illustrates a broad array of the interested groups as shown in Figure 2.

i) Regulatory actors (governmental departments, quasi-governmental bodies)

ii) Development actors (industry, public corporations, governmental departments)

iii) Experts (reserch bodies, professional organisations, quasi-governmental bodies)

iv) Impactees (general public, residents groups, industry)

v) Exogenous actors (interested groups who are not directly involved, mass media).

Here, only three main actors will be discussed: the regulatory actors as the Ministry of Health and Welfare (MHW) or the Envionment Agency (EA; the central governmental regulatory agency which took over the former responsibility since 1972); the experts as the Central Council for Environmental Pollution Control (advisory body to the MHW, later to the Environment Agency), and the developers as industry whose opinions may be represented by the Council of Industrial Structure (advisory body to MITI). Since there has been no direct participation of the impactees in the standards setting process, the court suit of the Yokkaichi case will be referred to as their indirect impact on the decision process only.

Determination and Implementation of EQS for Sulphur Oxides

Two major disputes were fought over setting EQS for sulphur oxides. The first was in the late sixties when the first EQS of sulphur oxides were determined, and the second was in the early seventies when the court decision on the 'Yokkainchi case' ruled out the responsibility of industry and administrators concerned with air pollution cotrol in favour of protecting the public health.

The bulk of the information processing, evaluation and recommendations were performed by the Central Advisory Council for Environmental Pollution. Although the Council is subdivided into three layers (the general meeting, the subcommittee of air pollution and the expert committee of the EQS) a substantial proportion of the work has been done by the expert committee. The decision process of setting EQS can be illustrated in terms of 'criteria', 'guides', 'recommendations' and 'standards' as shown Figure 3.

The expert committee, whose members were academics in public health, governmental research bodies and experts from industry gathered information on epidemiological, clinical experimental and other evidence with regard to the criteria necessary for the evaluation of dose-response relationships and their effect on human health. Particular attention was paid to damage to human health, but no consideration of the effects to ecosystems or amenities was undertaken. The factors which the expert committee believed to be important in order to evaluated the criteria on damages to human health are shown in Figure 4.

After surveying information on the criteria at the world-wide level, the expert committee arrived at the conclusion that the guidelines for sulphur oxides should be based on that threshold value of sulphur oxides concentration over which there is no conclusive evidence of damage to human health. The concept of the threshold value seems to have stemmed from the traditional concept in the field of public health and working hygiene which corresponds with the third level of health effect in the WHO definition (see Figure 5). Their recommended guidelines on the basis of the above arguments were:

One hour average	0.1 ppm
24 hours average	0.05 ppm

Having received the criteria and guides in February, 1968, the subcommittee for air pollution whose members consisted of 'experts', 'regulators' and 'developers' disputed the technological and economical feasibility of the submitted guidelines. In the light of the character of the EQS, the final 'recommended guidelines' were a product of a compromise between the threshold value and the concept of 'percentile' which was taken as the US Air Quality Criteria for

Sulphur Oxides as shown in Table 2. The 'percentile' lessens the impact of the proposed threshold levels by allowing a period of emissions exceeding the threshold to a prescribed extent.

Table 2-(a) U.S. HEW's Recommendations for Acceptable Level of Air Quality in 1967

Time period	Maximun (ppm)	One percentile*
24 hour average	0.05-0.08	0.04-0.06
1 hour average	0.12-0.20	0.05-0.11
5 minute average	0.10-0.50	0.05-0.14

Source: HEW, PHS, Air Quality Criteria for Sulfur Oxides (Washington, D.C., 1967),p.1vi.
*) Percentile: the percentage of time a specified value is allowed to be equaled or exceeded during the time period. Thus, 1 percentile values could be reached or exceeded 1 percent of 24 hours, 1 hour, or 5 minutes

Table 2-(b) The recommended guidelines for the EQS of sulphur oxides

Time period	Concentration (ppm)	Time to be within the value specified
24 hour average	less 0.5	70 - 80 %
1 hour average	less 0.1	88 - 93 %
1 hour measurement	less 0.2	over 93 % (1 percentile)
Emergency measure	over 0.1 for consecutive three hours over 0.3 for consecutive two hours	less 3 % less three, consecutive days

The final decision by the Cabinet was made in February, 1969, one year after the expert committee's report appeared. Although the guidelines for setting EQS of sulphur oxides were complicated by the addition of political considerations, no substantial modifications were made to the recommendations. And, although there was no legal bounded penalty for the pollutors to comply with the newly established EQS, the general public and regulatory agencies in local

and central government took the EQS very seriously. Hence, administrative measures and a target time for its attainment (within 10 years) were attached to the EQS. Figure 6 illustrates the policy measures which the Cabinet announced with the intermediate target values for highly polluted areas such as Tokyo, Osaka, Yokkaichi and Kawasaki. Within this specific area, when the concentration for one hour average over 0.3 ppm, it was agreed that there should be some specified target values taking account of local specific conditions. Among the available measures, desulphurisation technology for both crude oil and flue-gas was considered as the one measure crucial to them attaining their ambitious goals. In order to stimulate technological innovations whose signs had already appeared (but not at the practicable application level), the Environment Agency and MITI also set targets to reduce the sulphur content of fuels (as specified in Table 3) in 1972. Despite both the gradual strengthening of emission standards (tightening K-value) after promulgation of the EQS, and the progress of the low-sulphurization policy, actual progress in decreasing the number of pollution sufferers has been obstructed by the despersion of pollutants over an increasingly large range of territory (regional scale) in connection with the new problems of 'photochemical smog' and 'lead pollution' from the automobile.

Table 3 Targets for sulphur content reduction

	Fuel Consumption in 1967 (10 kl)	S (%)	Fuel Consumption in 1973 (10 kl)	S (%)	Fuel Consumption in 1978 (10 kl)	S (%)
Excessively populated areas (1)	22.97	2.41	43.60	0.90	55.0	0.55
Polluted areas (2)	13.07	2.51	28.30	1.30	46.0	0.80
Threatened areas (3)	-	-	27.50	1.45	54.0	1.00
All areas requiring countermeasures	36.04	2.45	99.40	1.20	155.0	0.80
Fuel supply to all sectors of the economy	63.90	2.5	155.20	1.50	220.0	1.15

(1) Excessive population and extremely polluted air due to the disorderly establishment of industries.

(2) Pollution levels, exceeding environmental quality standards.

(3) Threat to exceed air quality standards if sulphur content in fuels is not reduced.

The second dispute followed after the revision of the Basic Law in 1971 when the new epidemiological survey in Yokkaichi, Osaka and the other highly polluted areas identified further outbreaks of respiratory illness. Further, in the court process of the Yokkaichi air pollution case, the EQS and the EMS of sulphur oxides were at the center of the dipute over the alleged responsibility of the six defendant companies who were charged with being guilty of negligence by heedlessly continuing their operations. They carried on despite their obligations to take care that they did not cause harm to the life and health of the residents through smoke and soot emission. Although the defendants claimed that their emissions were of small quantities, within the EMS, and could not alone have been responsible for the resulting consequences and that there was no clear scientific evidence on the causality, the court supported the epidemiological studies as the basis of judgement on the causal relationship between respiratory diseases and sulphur oxides emissions.

In the light of the societal attitudes towards pollution in the early 1970s, the expert committee for the EQS of sulphur oxides (reorganized in 1972) reviewed the new data and information gathered since the first EQS were set in 1968, and concluded that much more strict conditions would be necessary to judge that threshold level of sulphur oxides under which there was no significant damage to health. The reasons for the revision were based on the epidemiological data on the chronic asthma-like diseases which showed increased numbers of patients under the former EQS of sulphur oxides where various provisions had been made to excuse the temporary emission of high concentrated smokes using the concept of the percentile. The expert committee also thought the level of 3% having been likely asthma-like disease among the local population should be taken as a whole, rather than the level of 5% as in the former case. Their recommended guidelines were:

24 hours average	:	less than 0.04 ppm
1 hours average	:	less than 0.1 ppm

(yearly average will be 0.012 - 0.015 ppm)

The report of the expert committee, which was submitted to the subcommittee on air pollution, was approved by the Council and later by the Environment Agency in 1973. The technical and economic considerations, in particular, the uncertainty of energy supply both in quantity and quality of low sulphur content, resulted again in some degree of compromise with respect to the target time in which it was to be attained and 2% execution of higher measurement values over 0.2 ppm (1 hour average) from the evaluation of the long term attainment of the EQS. Even taking into account these technical considerations, it seems that the Japanese EQS of sulpher oxides became the most severe, ambitious, and least economic ones in the world at that time. Table 4 shows the current EQS of air pollutants including sulphur oxides (for 1980).

Table 4 National Environmental Quality Standards

Sulfur Dioxide, Carbon Monoxide, Suspended Particulate Matter, Nitrogen Dioxide, Photochemical Oxidants.

Substance	Sulfur dioxide	Carbon monoxide	Suspended[1] particulate matter	Nitrogen[2] dioxide	Photochemical[3] oxidants
Environmental conditions	Daily average of hourly values shall not exceed 0.04 ppm, and hourly values shall not exceed 0.1 ppm.	Daily average of hourly values shall not exceed 10 ppm, and average of hourly values in eight consecutive hours shall not exceed 20 ppm.	Daily average of hourly values shall not exceed 0.10 mg/m³, and hourly values shall not exceed 0.20 mg/m³.	Daily average of hourly values shall be within the range between 0.04 ppm and 0.06 ppm or below.	Hourly values shall not exceed 0.06 ppm.
Measuring methods	Conductometric method	Nondispersive infrared analizer method	Weight concentration measuring methods based on filtration collection, or light scattering method, or piezoelectric microbalance method or β-ray attenuation method yielding values having a linear relation with the values of the above method	Colorimetry employing Saltzman reagent (with Saltzman's coefficient being 0.84)	Absorptiometry using neutral potassium iodide solution, or coulometry

Notes: 1. Suspended particulates matter shall mean airborn particles of 10 microns or less in diameter.
2. a) In an area where the daily average of hourly values exceeds 0.06 ppm, efforts should be made to achieve the level of 0.06 ppm by 1985.
b) In an area where the daily average of hourly values is within the range between 0.04 ppm and 0.06 ppm, efforts should be made so that the ambient concentration be maintained around the present level within the range or not significantly exceed the present level.
3. Photochemical oxidants are oxidizing substances such as ozone and paroxiacetyl nitrate produced by photochemical reactions (only those capable of isolating iodine from neutral potassium iodide, excluding nitrogen dioxide).

4. PERCEPTIONS AND ATTITUDES TOWARD ENVIRONMENTAL RISK

The evolution of public perceptions and attitudes on environmental pollution or risks in Japan seems to have stemmed from factors which characterize a pragmatic but non-economic approach up to the mid-seventies. In fact, one of the leading Japanese officials in the environmental administration recently noted that the 1950s and early 1960s were "a polluter's heaven" and the late sixties marked the beginning of the stormy days for the anti-pollution movement and administration. The swing from "the polluter's heaven" to "a polluter's hell" was ironically described by his report [14]. "Kogai", the term for environmental pollution in Japanese became one of the fundamental political issues during the "stormy days" (1964-1973). A number of citizens' movements against "Kogai" (consisting of pressure groups which involved citizens who were directly or indirectly impacted or were likely to be damaged by the development projects) mobilized by the mass media and environmentalist pressure groups had urged the environmental administration to take prompt remedial measures to mitigate the growing conflicts between economic interests and damage to the

environment from pollution. The decisive role was played by four major court decisions between 1971 and 1973 ruling "strict liability" and "joint delict" on the part of factories which were connected to each other through material or energy supply. They were charged massive financial penalties to compensate the pollution victims. For example, six petrochemical companies in the Yokkaichi industrial region were ordered to pay $285,000 (in the value at that time) to nine plaintiffs who were suffering from so-called "Yokkaichi-asthma". However over 1,000 other victims, 76 of whom died, were kept waiting for compensation. As far as the air pollution problem was concerned, it was the Yokkaichi judgement that stated, reflecting a nation-wide consensus, including industrial circles in Japan, that without proper anit-pollution measures there would be no further industrial development.

After the initial success in the fight for clean air, which resulted in a drastic decrease of sulphur dioxides, the mid-seventies seems to have been characterized by inconsistency among the objectives of environmental protection and the economic burden which society as a whole was prepared to pay. This left a series of conflicts between economic growth and disamenities at the international, national, regional and local levels. In particular, industry which had been forced to invest a huge amount during the environmental decade (1965-1975), began to find it harder to spend more money on abatement of pollutants where this was limited by present technology. Typically the cases included nitrogen oxides, hydrocarbons and chemical particulates of aerosols. This attitude of the industry appeared as the sharp declining trends of both pollution abatement investment and in its contribution to the overall investment by the private sector to the national economy, since they reached the highest level in 1975 (about 900 billion yen), of which air pollution over fifty per cent of total investment (see figure 7).

In particular, industrial firms of small- and medium-scale have a number of difficulties in responding to tighter control measures due to lack of economic incentives for pollution abatement, unless appropriate public financial aid is given. Figure 3 shows a list of these economic and technical difficulties surveyed by the Environment Agency and MITI in 1980.

Occasional public opinion polls on environmental pollution undertaken by the Environmental Agency reveal some characteristically Japanese features of public perception and attitude. Figure 9-(a) and 9-(b) show the reactions in response to the following questions:

(a) industrial development versus pollution control

(b) environmental protection versus pollution control

Despite the slight economic recession from 1973 to 1975, the margin in favor of environmental protection has not changed, as shown by the sharp growth of the environmentally concerned from 27.4 per cent in 1966 to 48.3 per cent in 1971. However, as far as the economic burden which tax-payers have to share is concerned, a slight shift can be seen from the affirmed attitude of accepting some sort of economic burden for a better environment of 43 per cent in 1973 towards the neutral position of "don't know" in 1975. Nevertheless, it is possible to say that public attitudes seem to show the firm determination of the people that no more people should be victimized by environmental risks or hazards [15].

The Japanese trend of newspaper coverage in air pollution is shown in Figure 10-(a). The subjects were counted from the "Asahi Shinbun", one of the leading national newspapers during the period between 1960 and 1979, including the volume of 1955. The major events before and after the peak year were:

(a) 1966-70 : "white smogs" and health-damages around industrial bases such as Yokkaichi, Kawasaki and Osaka

(b) 1970-72 : sulphur oxides control (standards and regulation), and compensation of health-damage

(c) 1973-75 : nitrogen oxides control (standards and regulation), and automobile exhaust gas (emission standards)

Figure 10-(a) shows the numbers of articles associated with air pollution problems which appeared in The Times (London) between 1951 and 1979. The subjects were extracted from "The Times Indices" which included "The Sunday Times". There were the following four groups of trends:

(a) 1953-57 : London smog of 1953, and legislation of the Clean Ai Act of 1954, and its implementation process

(b) 1962 : London smog of 1962

(c) 1970-71 : UN Stockholm conference and new stage of the environmental administration, and enlargement of smoke control zones

(d) 1978 : exhaust gases from automobiles, lead in petrol, and global air pollution of CO_2 and particulates

In contrast with "The Times" Japan has an extraordinary peak in 1970 when Tokyoites had a number of warnings to stay home in hot summer because of photochemical smogs, and alarms of possible lead poisoning from automobile exhaust gases at traffic intersections. Both examples indicate the year of 1970 was important in the history of air pollution control. It is, however, interesting to see a

contrast between enthusiastic reaction by the Japanese mass media to the air pollution problems at the time during 1968-72, and rather quick decay during the late 1970s. Meanwhile, the British mass media's response, if we are allowed to neglect some different characters between the two papers in terms of circulation and class of subscribers, seems to have shared same tendency as that of the environmental administration had in such a relatively consistent but less dramatic way.

5. CONCLUDING REMARKS

Though the primary purpose of this paper is to be an overview of Japanese practices on risk management, only the issues of environmental risks are presented with special reference to the decision process concerning environmental quality standards. In Japan, the determination of acceptable levels of environmental risks such as pollution hazards posed by air, water and soil pollutants has been so far a primary and urgent task for environmental policy making. The dermination process includes

i) risk identification
ii) risk quantification
iii) risk evaluation and
iv) subjective evaluation of public acceptance of health risks.

Since the setting of such quality standards is a cornerstone of the Japanese approach to environmental risk management, the disputes have focused on both how to set target values for quality standards in terms of protecting human health and the living environment, and on what the socio-economic implications of attaining those target values are. The validity of the "non-economic" approach which resulted in great success in mitigating SO_2 or acute environmental hazards has become gradually questioned from a viewpoint that a more integrated approach should be taken into consideration. In order to establish workable and enforceable standards, all knowledge of science, technology and societal perceptions or attitudes has to be mobilized to improve the decision making process in environmental risk management. In this context, we need further development of formal assessment tools for comprehensive management of technological risks, such as decision analysis or cost-benefit analysis used widely in the field of technology assessment. However, it is also true that their value is restricted where consensus rather than confrontation is used to settle socio-political conflicts and where the interplay between the decision-makers and the interest groups is highly intricate and unquantified. One may conceive of various ways to improve environmental risk management in future cases which should include institutional, procedural and methodological innovations. Perhaps, procedural and methodological innovations are the most urgently reguested for more utilization of risk management in actual decision making in Japan.

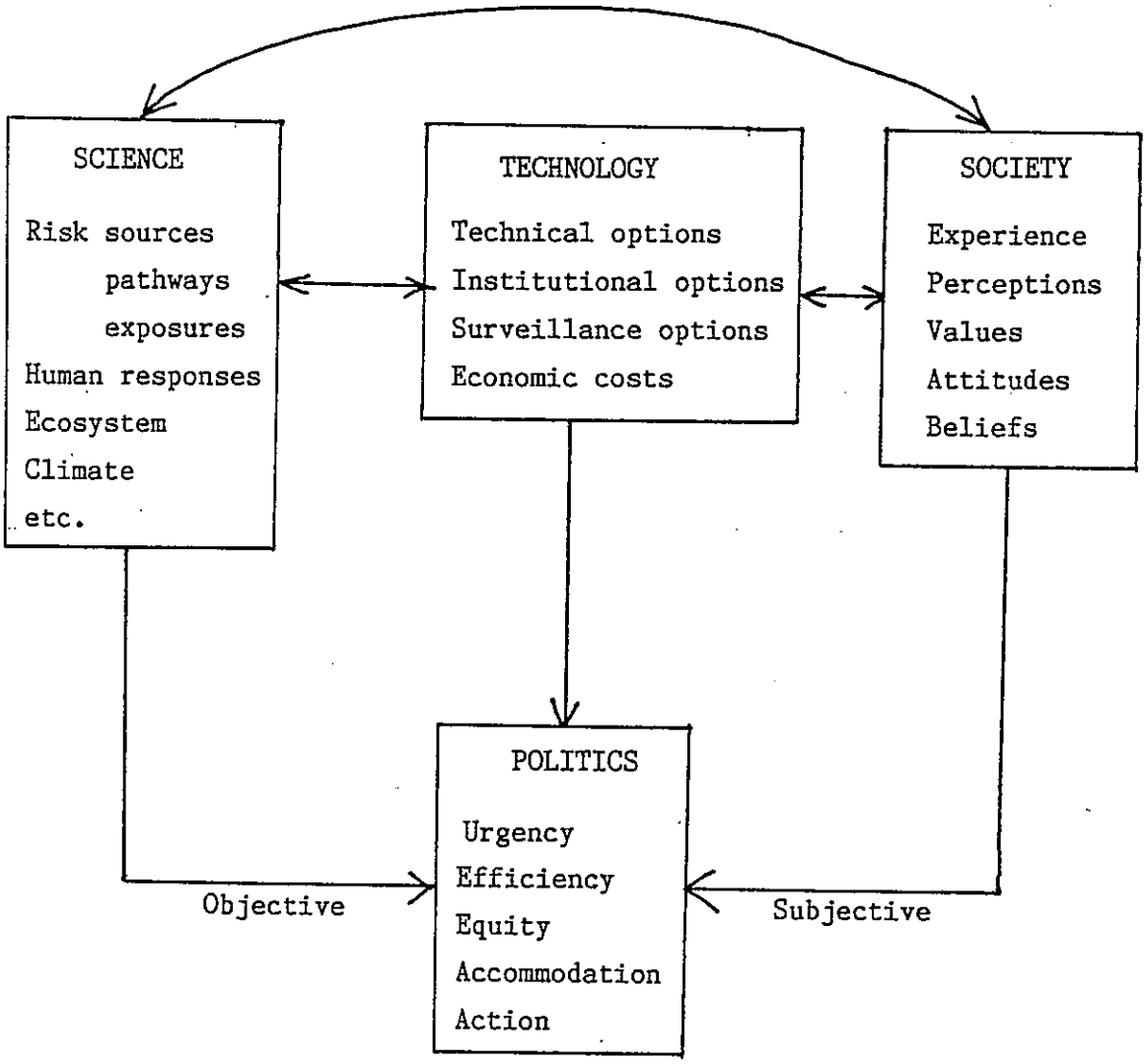
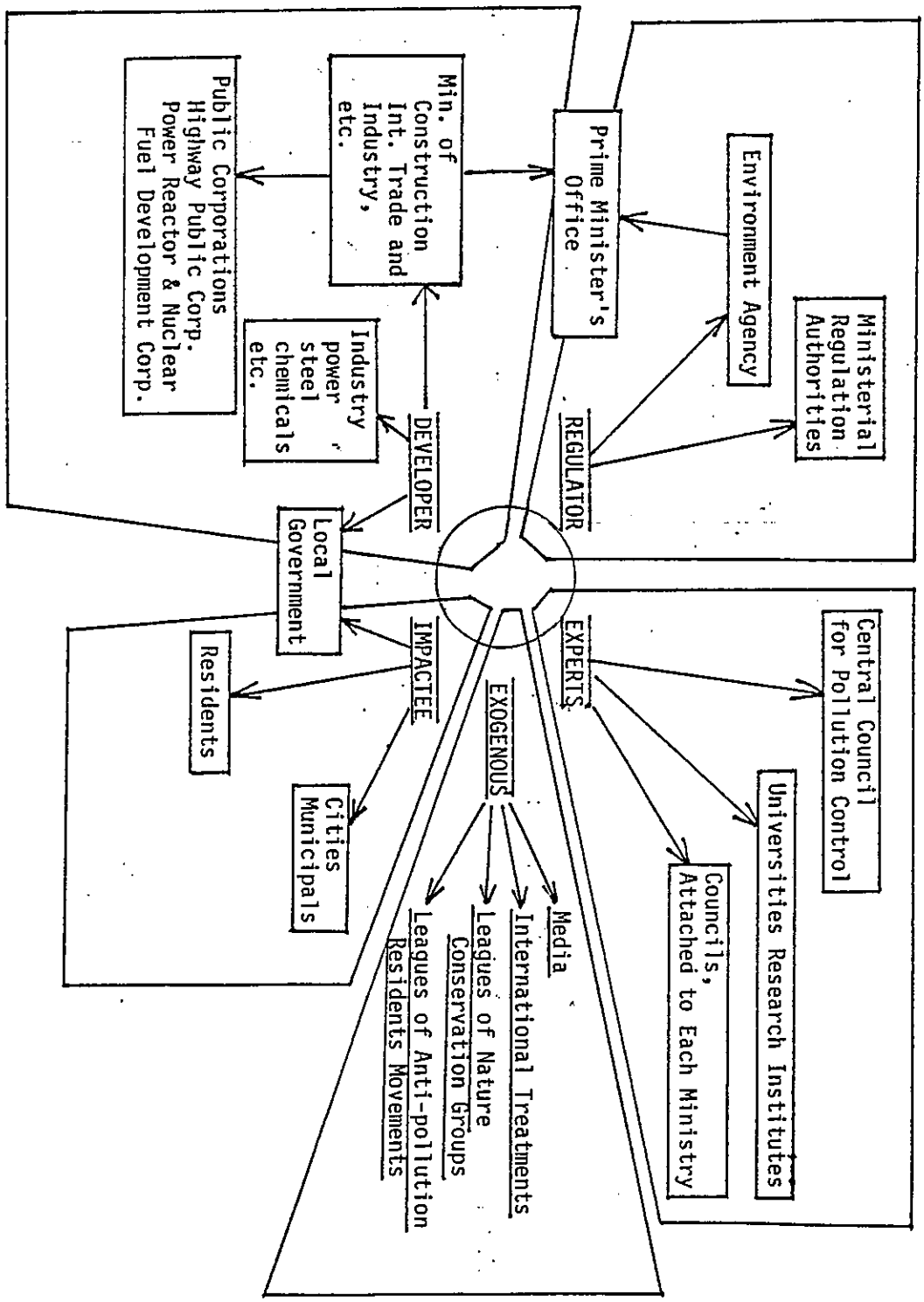


Fig. 1 Study Framework for Environmental Risk Management

Figure 2 Actors involved in standards setting for air quality in Japan



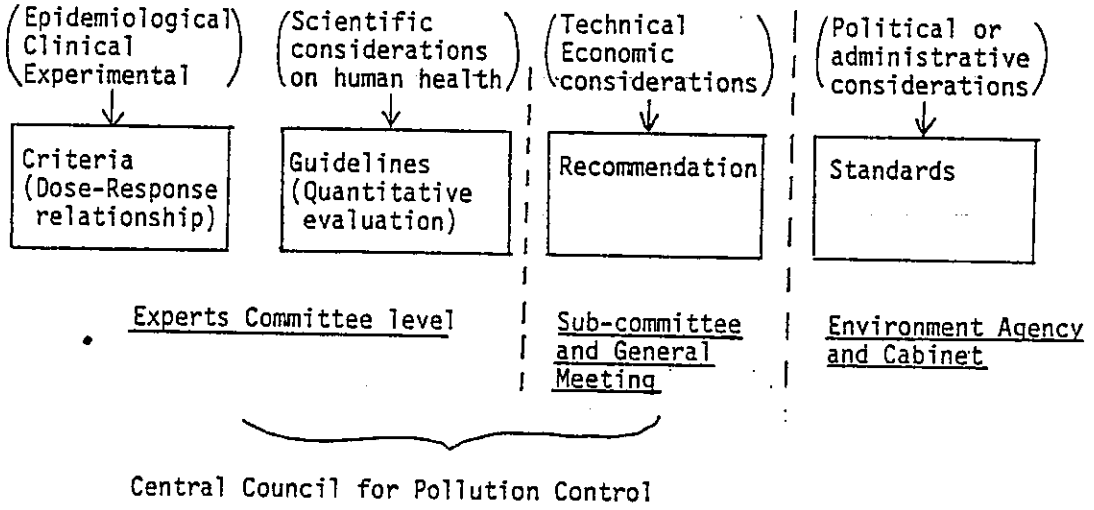


Fig. 3 Standards setting process for ambient air quality in Japan

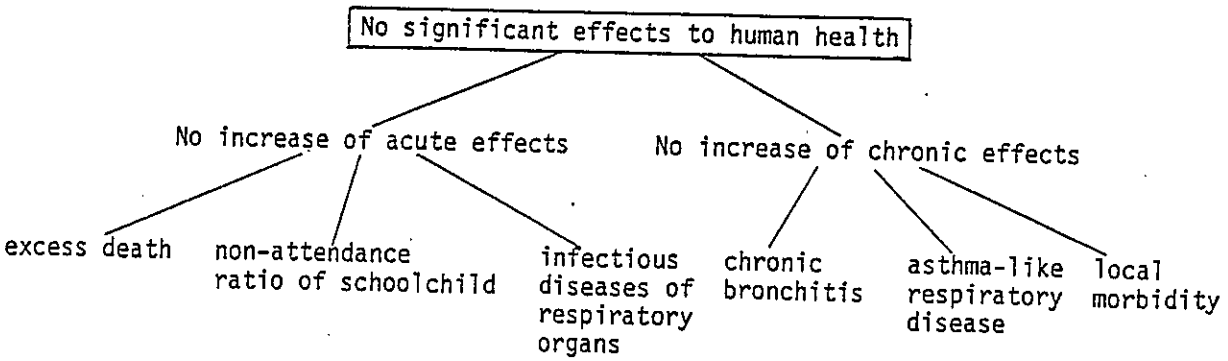


Fig. 4 Major factors of air quality criteria taken by the expert committee

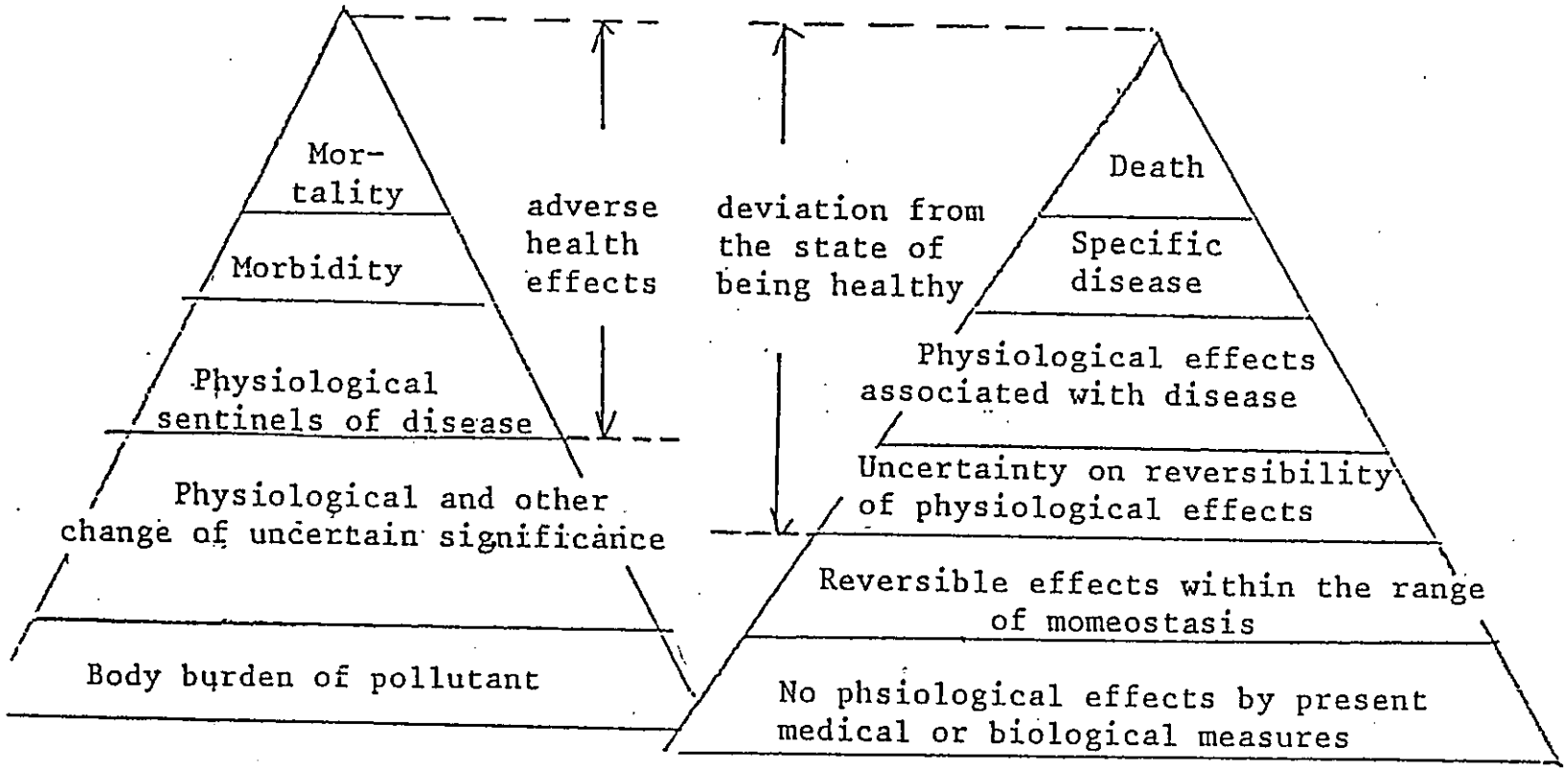


Figure 5 : Comparison of concepts of health effects by air pollution

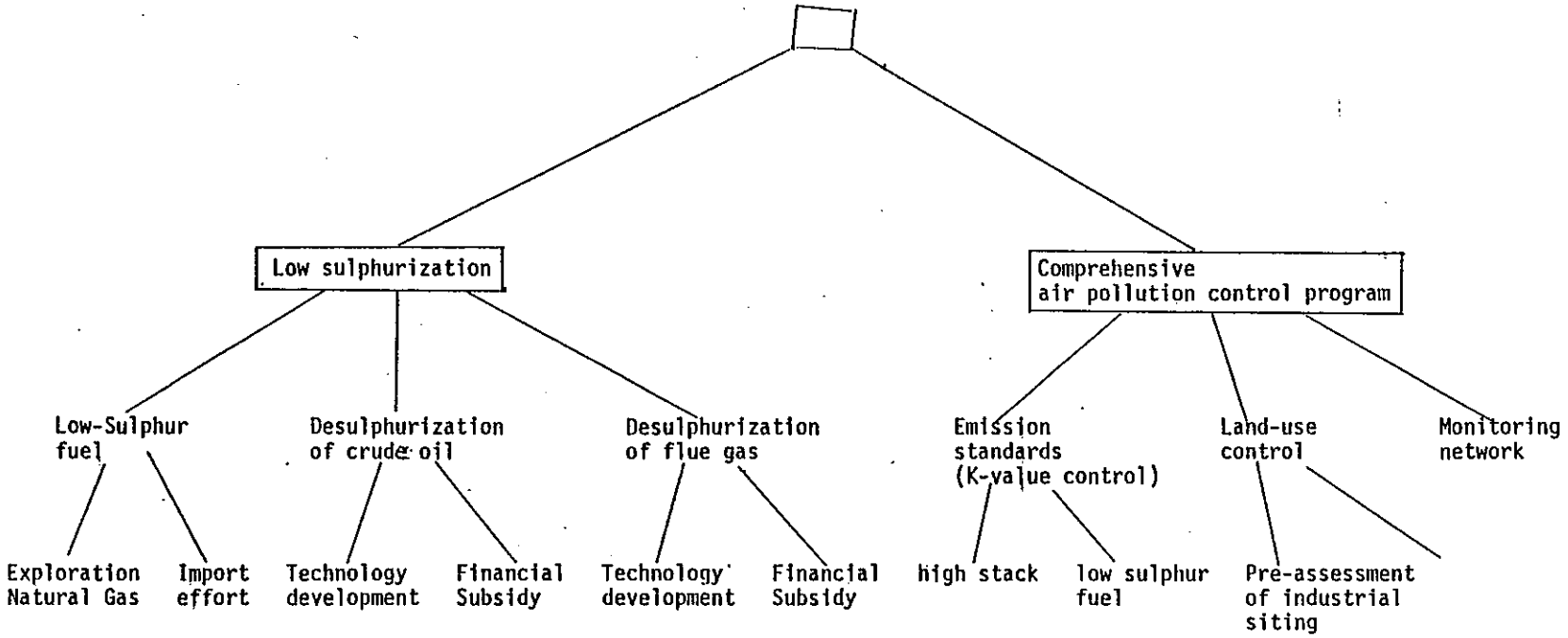
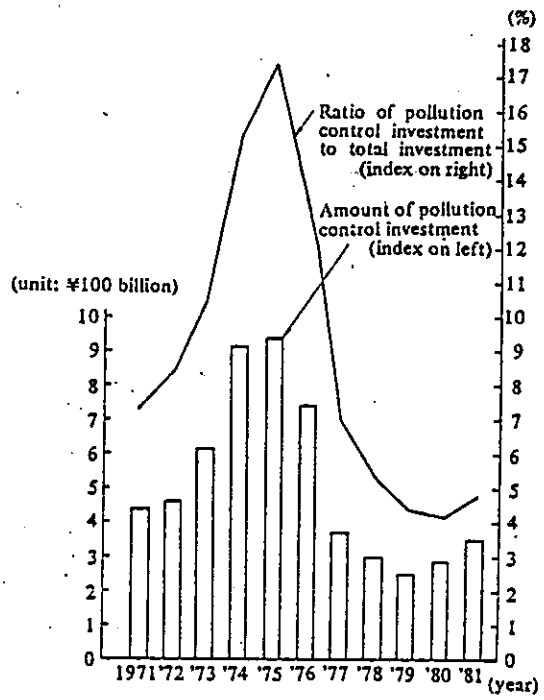


Figure 6 Policy measures of air pollution abatement for sulphur oxides emission taken by Japanese Government

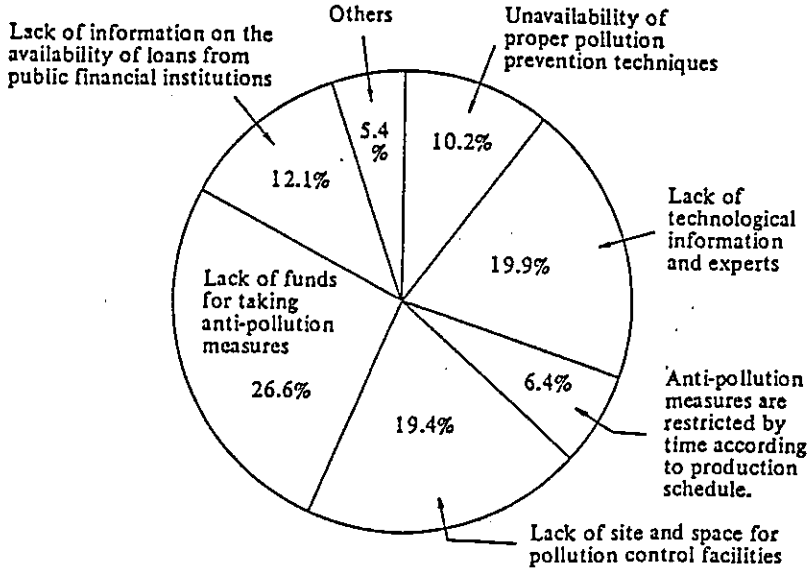
Fig.7 : Trends in Pollution Control Investment by Private Enterprise



Sources: Ministry of International Trade and Industry, *Trends in Investment in Industrial Pollution Control in the Private Sector*; Economic Planning Agency, *Annual Report on National Account*

Note: Amounts are expressed in the 1975 value of the yen.

Fig. 8 . Problems Facing Small- and Medium-scale Enterprises in Making Anti-pollution Investment

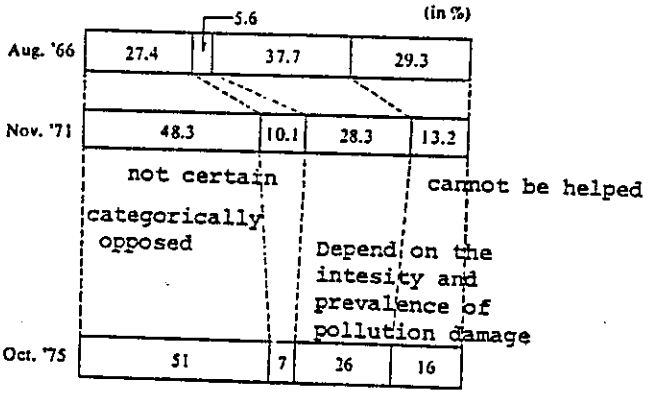


Source: "1982 Survey of Anti-pollution Investment by Small- and Medium-scale Enterprises," the Environment Agency and the Ministry of International Trade and Industry

Figure 9 Findings of opinion polls on public awareness of the need for environmental conservation

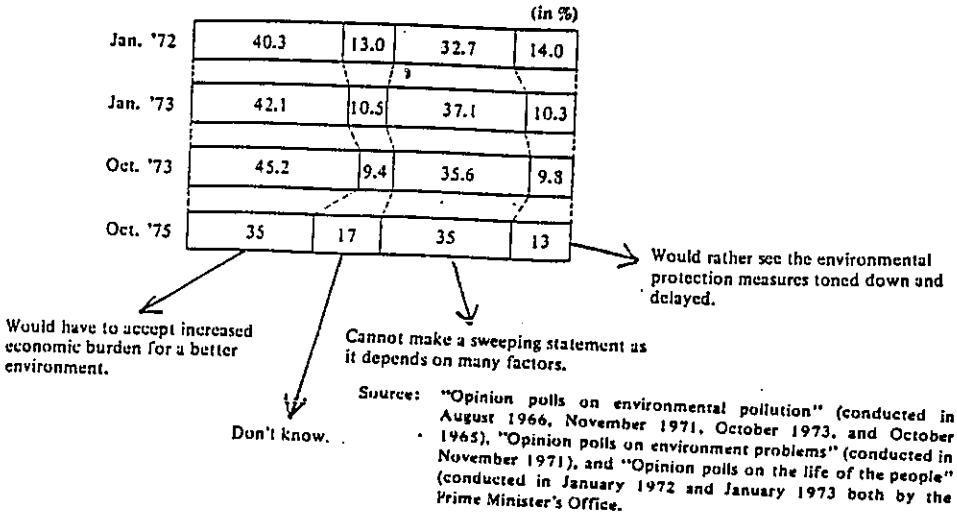
(1) Industrial development vs. pollution

Q: Do you feel that if adequate compensation is available for pollution damage, environmental pollution might necessarily be tolerated to a certain extent in the interests of the nation's industrial development? Or, are you categorically opposed to any and all forms of environmental pollution, however important the polluting industry might be?



(2) Environmental pollution vs. economic burden

Q: A quick, vigorous implementation of environmental protection measures would entail the expenditure of large sums of money. Do you feel that the implementation of such environmental protection measures should necessarily be made even if it means an increased economic burden on the taxpayers? Or, would you rather see the measures toned down than accept an increase in economic burden on the taxpayers?



Source: "Opinion polls on environmental pollution" (conducted in August 1966, November 1971, October 1973, and October 1965), "Opinion polls on environment problems" (conducted in November 1971), and "Opinion polls on the life of the people" (conducted in January 1972 and January 1973 both by the Prime Minister's Office.

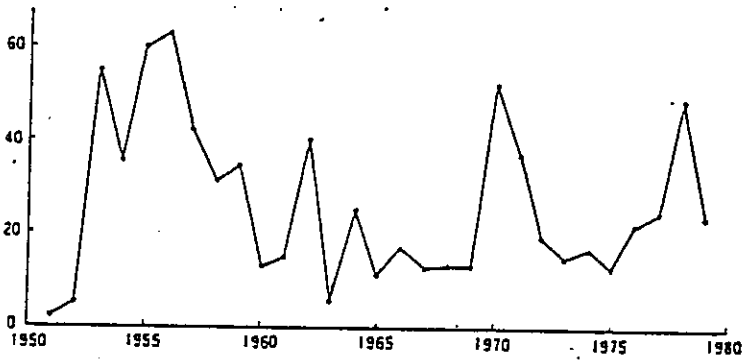


Fig. 10-(b) Number of articles associated with air pollution in "The Times (London)"

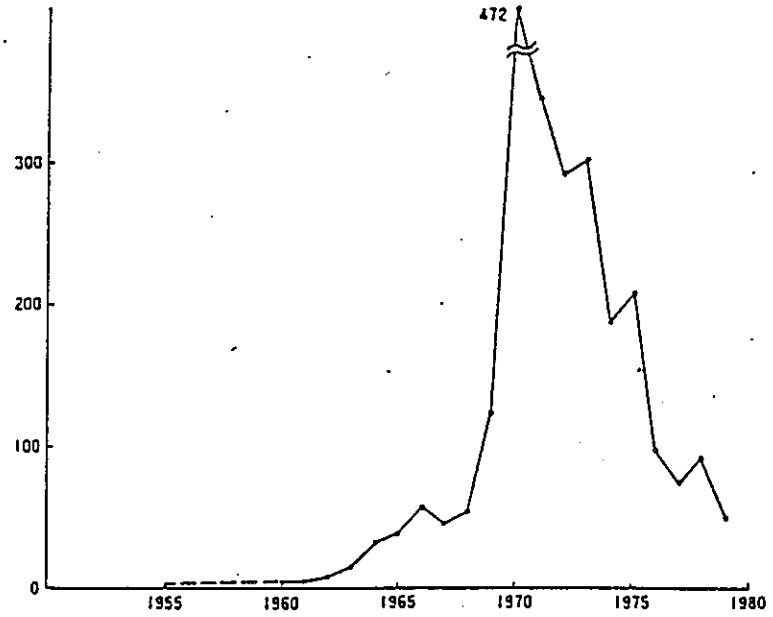


Fig. 10-(a) Number of articles associated with air pollution in "Asahi Shinbun (Japan)"

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