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ANALYSIS ON DIFFERENCE OF RISK PERCEPTION BETWEEN PEOPLE ENGAGED IN NUCLEAR BUSINESS AND GENERAL PUBLIC

– FROM SOCIAL SURVEY FOR NUCLEAR POWER PLANT –

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ABSTRACT

A new research project has started to develop two kinds of Internet communication systems which are aimed at effective social risk information on nuclear energy. One is mutual communication system for fostering safety culture among the workers in nuclear industry while the other is to enlighten general public about the risk issues on final disposal of high-level radioactive waste. Prior to the Internet systems development, social investigations have been conducted on risk perception for nuclear power for both the nuclear experts and women in the metropolitan area, in order to know how and what should be considered for the effective risk communication methods**.** It was found from the statistical analysis to the results of social investigation that the majority of nuclear people take business risk seriously but there is a fraction of nuclear people who are afraid of present practice of nuclear power operation while women in metropolitan area are evenly afraid of radioactive risk. The obtained results of social investigation gave useful insight for developing two kinds of risk communication systems and the related field study for enhancing safety culture in nuclear industries.

Keyword

Risk communication, Risk perception, Safety culture, High-level radioactive waste disposal

1. Introduction

As a new risk communication method for the construction of effective knowledge bases about “safety and non-anxiety for nuclear energy”, a study on new communication method of social risk information by means of electronic communication has been started, by noticing rapid expansion of Internet usage in the society [1]. The purpose of this research is to enhance the public acceptance to nuclear power in Japan by the following two aspects. The first is to develop the mutual communication system among the working persons involved in both the operation and maintenance activities for nuclear power plant, by which they will exchange their daily experiences to improve the safety conscious activities to foster “safety culture” attitude. The other is the development of an effective risk communication system between nuclear society and the general publics about the hot issues of “what are the concerns involved

in the final disposal of high-level radioactive waste?" and "what should we do to have social consensus to deal with this issue in future".

As the first step of the authors' three year research project which started in August 2003, social investigation by questionnaires by internet and postal mail, have been conducted on their risk perception for the nuclear power for the people engaged in nuclear business and women in the metropolitan area, respectively. This is to obtain the relevant information on how and what should be considered for effective risk communication methods of social risk information between the people within nuclear industries and the general public in society.

In which follows, the background and objective of the social risk information project with the definitions of risk and risk communication will be first described in **2**, conductance and the outline result of social investigation in **3**, and the conductance of detailed statistical analysis to the social investigation with respect to the reduction of insights for effective risk communication in **4**, and then the conclusion in **5**.

2. Social Risk Information Project

2.1. Background and Objectives

There have been many social studies about the past practice of risk communication by the nuclear industries and there is a typical criticism raised by social psychologist, which would be roughly summarized as the following statement:

The nuclear policy should not be determined by just scientists but it should be made open to all relevant stakeholders, such that all aspects of multi-sided opinions and their reasons of various specialists would be presented on the same place where general public would also be attending. And this is the right way of risk communication for nuclear power [2].

In accordance with the present social trend surrounding nuclear business in Japan, the second author of this paper had conducted on a questionnaire surveys for the people in nuclear society to ask their opinions about their business environment from the three aspects of social factors in order to propose new policies for nuclear power business [3]. The three aspects are: (i) technology inheritance, (ii) deregulation of electric power market, and (iii) effect of subsidies by Three Laws for Electric Power Development in order to promote nuclear power development. The premise used in this past investigation is shown in Figure 1, and the result of the conducted questionnaire survey seemed to support the given premise that the nuclear business would be brought in a worsening situation by the weak handling of social factors.

This is the motivation of the authors' initiating social risk information project in terms of co-operative risk communication between nuclear business and general public with the stance of " think together in symbiotic society". Over the past years a considerable number of studies have been made on risk communication for nuclear energy. But many of them have assumed the opposing two groups, i.e., 'nuclear specialists

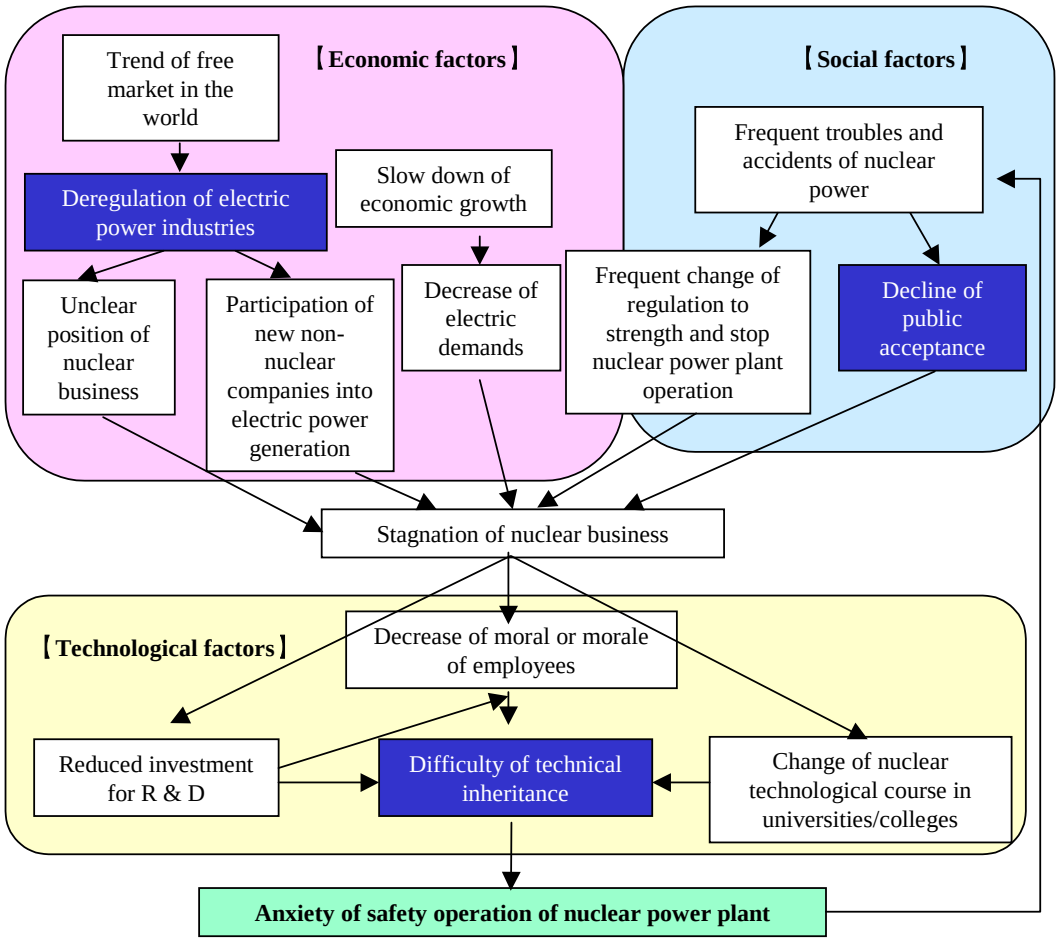

Figure 1: Image model of social issues on nuclear energy

(including government)' versus 'general public'. But our study focus on risk communication in symbiotic society in which people in different positions can coexist with each other. The purpose of this study is to develop an effective method for risk communication in the complex society in which people in different positions think together.

2.2. Definition of Risk and Risk Communication

In this project, the authors would like to redefine the words of "risk "and "risk communication", by reflecting on the modern people's tendency to expect safety and non-anxiety on their life by the introduction of modern technologies. The word "risk" is used in various fields such as medicine, health care, business and environment, with somewhat different meaning for "risk" in each field. Therefore, as a common understanding for different meanings of risk, we define 'risk 'as *something which may bring about any anxiousness directly or indirectly on our life /health or property*.

Risk communication has some definitions, too. For example, it is a communication process of information and opinions among individuals, organizations or groups [4]. Another one is to progress an interactive communication about understanding and action to the risk with expanding attendance and participant [5]. We define 'risk communication' on nuclear energy as that *the nuclear society should first understand general public's risk image on nuclear energy and then take the same viewpoint as general public*.

3. Conductance of Social Investigation

As the first step of the authors' three year research project which started in August 2003, social investigation by questionnaires by internet and postal mail, have been conducted on their risk perception for the nuclear power for the people engaged in nuclear business and women living in the metropolitan area, respectively. This was to obtain the relevant information on how and what should be considered for constructing effective risk communication methods of social risk information between the people within nuclear industries and the general public in society.

3.1 Method of Questionnaire Survey

A questionnaire survey was made for both the people who are engaged in nuclear power business (nuclear experts, for short) and ordinary citizens (female residents in metropolitan area). We used almost the same questionnaire items as those used in the past social poll so as to compare those results with our results. Specifically, we referenced 'the 16th public opinion poll on energy' by the Japan Productivity Center for Socio-Economic Development (2002)[6] and 'public opinion poll' by cabinet office (1998[7], 1999[8]). The outline of questionnaire items used in our social investigation is listed in Table 1.

In Table 1, the item h) on 'perceived risk for nuclear energy' is a new item used in the authors' questionnaires sheet both for nuclear experts and female residents in metropolitan area. In this question item, there are 19 predetermined alternatives that are supposed to become 'social risk matters' by the authors' definition of 'risk' by introduction of nuclear energy in the society. In addition, there is a column in which the respondent can put in freely if he/she feels any risk other than the 19 alternatives. The respondents were allowed to select maximum 3 items from 20 items. The detailed accounts of these 19 risk factors are given in the subsequent sections of this paper by listing up all of them in Table 5.

Table 1 Outline of our questionnaire items

a) Preference of both technology progress and life standard in future.
b) Levels of comprehension and knowledge about matters on energy in general
c) Whether or not anxious for nuclear energy in Japan and the reasons why
d) Knowledge level about matters on nuclear energy
e) Whether or not nuclear energy should progress in future
f) Necessary policies for nuclear energy
g) How much satisfaction do they feel for information disclosure on energy and nuclear energy
h) Major risk perception for nuclear energy
i) Major information sources for nuclear energy, the perceived reliable source, and what they want to know on nuclear energy
j) Effective method to enhance public understanding for energy and nuclear energy matters

3.2 Outline of Result

The social investigation for nuclear experts was conducted in the middle of August (two weeks) 2003 by Internet using the mailing lists from the Atomic Energy Society of Japan (the circulation number was ca. 1000). The number of available answers was 275, out of which 235 responses were from nuclear experts. And for general public, specifically, female citizens living in Tokyo megalopolis (the female citizens, for short), was administered by using post mail in the middle of September (two weeks) 2003. The number of available answers was 580 (the number of mail was 715). General public (living in big cities) and the female citizens have lived in energy consumption area (not power generation area). The other biological data for the both groups are shown in Tables 2 and 3.

Table2 By ages, nuclear experts and the female citizens

	age / sample	20-29	30-39	40-49	50-59	60-	unknown
nuclear experts	235 (numbers)	10	35	71	93	25	1
	100(%)	4.3	14.9	30.2	39.6	10.6	0.4

	age / sample	18-29	30-39	40-49	50-59
the female citizens	580 (numbers)	193	140	109	138
	100(%)	33.3	24.1	18.8	23.8

Table3 By jobs, nuclear experts, the female citizens and general public (living in big cities)

	jobs / sample	student	manager	public officer	worker	office worker	house holder
nuclear experts	235(numbers)	4	25	16	1	17	1
	100(%)	1.7	10.6	6.8	0.4	7.2	0.4

service	technical profession	free-lance profession	other	unknown
1	151	2	14	3
0.4	64.3	0.9	6	1.3

	jobs / sample	student	full-time worker(official)	full-time worker(technical	full-time worker (seller)	full-time worker (other)	part-time job
the female citizens	580(numbers)	42	59	18	18	5	132
	100(%)	7.2	10.2	3.1	3.1	0.9	22.8

free-lance profession	house holder	other
24	260	22
4.1	44.8	3.8

	jobs / sample	agri-culture	service	free-lance profession	company management	official worker	public officer /technical
general public	3609(numbers	52	426	69	159	124	835
	100(%)	1.4	11.8	1.9	4.4	3.4	23.1

worker	house holder	house holder (part-timer)	student	free	other
413	590	547	179	199	16
11.4	16.3	15.2	5	5.5	0.4

From Tables 2 and 3, it is seen that (i) about half of the female citizens are householders, (ii) about 90% of nuclear experts are male (male 214, female 20, unknown 1), (iii) general public and the female citizens have lived in energy consumptive area (not generative area) and (iv) about 60% of nuclear experts are technological experts.

Table 4 shows the outline results of questionnaire survey in of each group. The data of 'General public' in Table 4 are referred from the prior social polls in 'the 16th public opinion poll on energy' for living in some big cities by the Japan Productivity Center for Socio-Economic Development (2002) [6].

Table 4 Comparison nuclear experts and general public (outline)

	Nuclear experts	The female citizens	General public*
Life standard in future	'Keep present level with trying save energy' 50～60%		
Knowledge and comprehension on energy issues	More than 80%	10 ～ 77 % (average ca. 40%)	Less than 30%
Non-anxiety rate for Japanese Nuclear power plants	80%	5.7%	-
Knowledge level on nuclear energy	95.8%	23%	24.5%
Knowledge of relevant terms on radioactive waste (averaged except 'unknown') **	98.8%	65.3%	66.9%
Approval rate for careful development of nuclear energy	90.7%	50.7%	21.3%
Satisfying rate of information disclosure ('satisfied' + 'something satisfied')	About half	4%	Less than 10%
Most used information source	Newspaper (89.4%)	Newspaper (89.5%)	TV (80.5%)
Most reliable information source	Specialist opinions (57.4%)	Newspaper (73.6%)	Newspaper (76.1%)

*Based on past social investigation.

**The relevant terms on radioactive matters are 'nuclear fuel cycle', 'Pul-thermal (plutonium use in thermal neutron reactor)', 'radioactive waste treatment and disposal' and 'under ground radioactive waste disposal'.

As seen from Table 4, although the desired life level in future is similar in both nuclear experts and general public, there are striking differences between the both. They are: (i) general public do not know so much about energy or nuclear energy, (ii) although the both are not satisfied with information disclosure, especially general public are hardly satisfied, (iii) the female citizens have strong anxiety for nuclear although about half of them agree with the development of nuclear energy in future, and (iv) information source of nuclear energy for both are news media (newspaper or TV) and the general public (and the female citizens) deem mass media as reliable source. But many nuclear experts do not rely on mass media information but on specialists' opinions (more than 60% of nuclear experts believe nuclear specialists' opinions). Concerning IT communication such as Internet, more than 60 % of nuclear experts think it valuable.

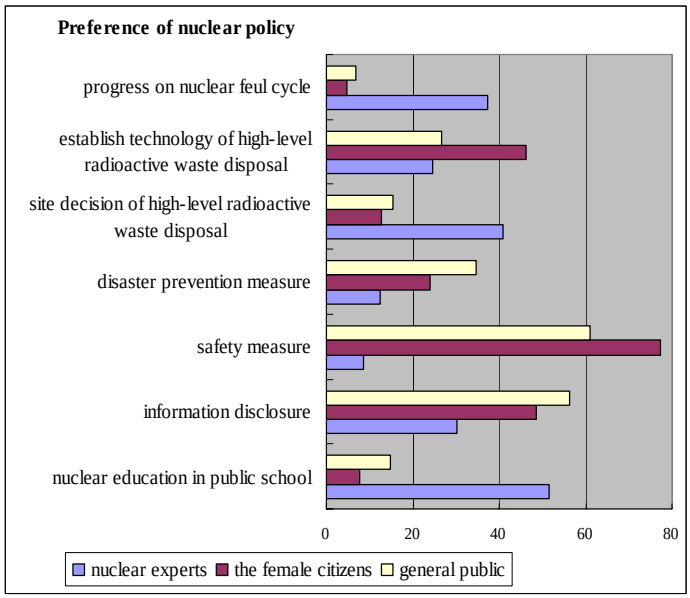

Figure 2: Inter-comparison on preference of nuclear policy

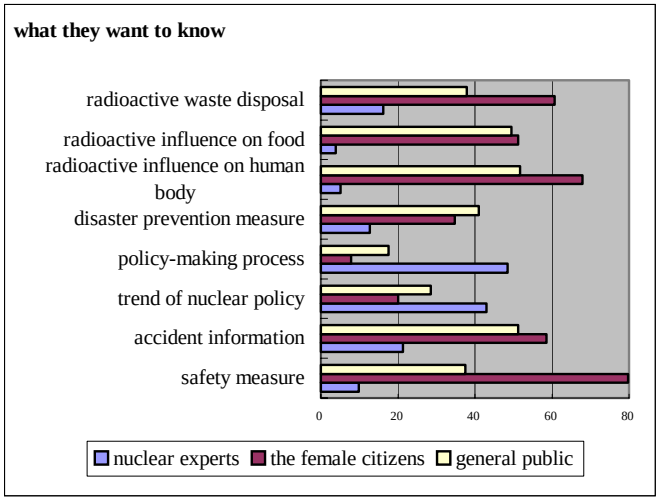

Figure 3: Inter-comparison on 'what they want to know'

Inter-comparisons among nuclear experts, the female citizens and general public are shown in Figures 2, 3 and 4, on nuclear political issues, what people want to know and the way to enhance understanding. In Figures 2 and 3, it is seen that nuclear experts were very concerned with the government's nuclear policy, especially nuclear fuel cycle, while the other two groups were rather concerned with safety issues caused by nuclear power, such as accidents of nuclear power plant or influence on radioactive pollutions. In Figure 4, it is seen that general public support mass media as the way to enhance understanding and that Internet has low support rates by the female citizens. Maybe Internet usage is not so prevailing in the female citizens. (**Note**: In Figures 2,3 and 4, all questions permit multiple answers. On the political issues, all respondents are allowed to select maximum 3 items (Figure 2). On 'what people want to know' and 'the way to enhance understanding', they were allowed to select as many as they had agreed (Figures 3 and 4). Every graph represents only items that were chosen by more than 40% any of nuclear experts, the female citizens or general public.)

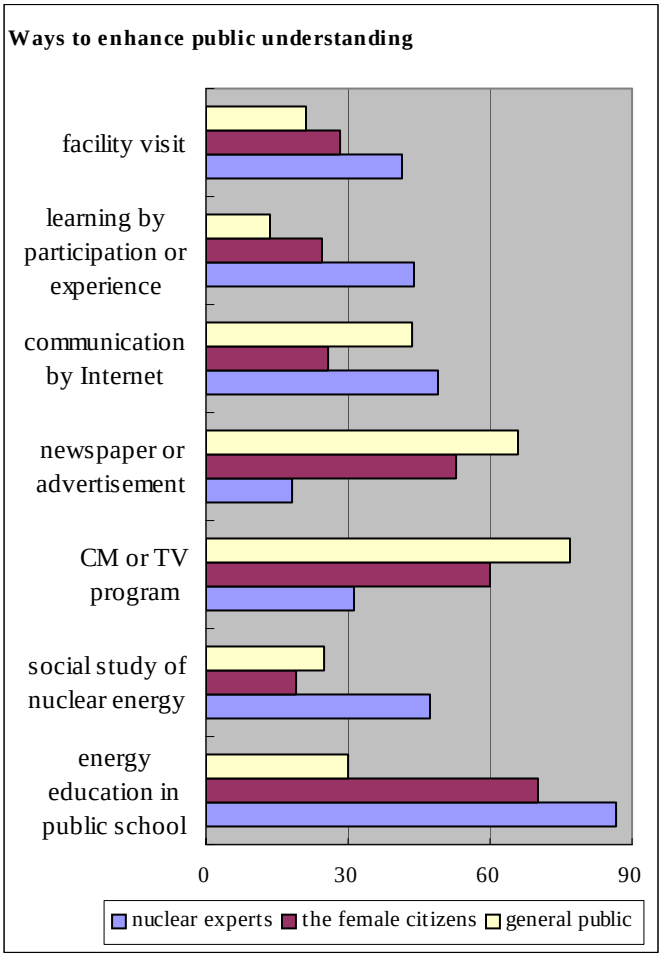

Figure 4: Inter-comparison on ways to enhance public understanding

Table 5 shows inter-comparison of perceived risk image both by nuclear experts and the female citizens. It is listed with the order of high percentage for both groups (the left-hand side represents for nuclear experts, while the right-hand side, for the female citizens). In this question items, there are 19 alternatives of predetermined words that are supposed to become social risk matters from the aspect of the risk definition adopted from second author's prior study [3]. In addition, there is a column in which the respondent can put in freely if he/she feels any risk other than the 19 alternatives. The respondents were allowed to select maximum 3 items from these 20 items.

It is seen from Table 5 that the female citizens strongly concerned with radioactive hazard both to human and environment caused by probable radioactive release from the nuclear facilities, while that nuclear experts strongly concerned with business risks caused by unfavorable situation of public acceptance to nuclear as well as the uncertainty of national nuclear policy towards nuclear fuel cycle development.

Table 5: Inter-comparison of unperceived risk image

Risk factors	Nuclear experts	Risk factors	The female citizens
The difficulties of recruitment of experts	47.7	Influence of accidents/troubles on environment	62.9
The decrease of moral or morale of employees	47.7	Genetic influence by radioactive waste	58.6
Fear of becoming targets of war or terrorism	34	Environment contamination by construction of nuclear power plant	34
Image-down of generative area by rumor	28.5	Exposure for employee	28.4
Acceleration of global warming by abolition of nuclear energy	22.6	Probable radioactive hazard in natural by disaster (ex. big earthquake)	27.1
Business crisis by nuclear policy shift	20.4	Fear of becoming targets of war or terrorism	19.7
Decrease of safety technology by financial difficulties	19.1	Anxiety of unstable supply and price rise by abolition of nuclear energy	15.3
Anxiety of unstable supply and price rise by abolition of nuclear energy	18.7	Technical transfer to nuclear weapons	7.8
Influence of accidents/troubles on environment	11.1	Acceleration of global warming by abolition of nuclear energy	7.1
Financial difficulties for nuclear fuel cycle development	10.2	Image-down of generative area by rumor	5
Exposure for employee	6.8	Financial difficulties for nuclear fuel cycle development	3.1
Genetic influence by radioactive waste	5.5	The decrease of moral or morale of employees	2.8
Layoff threat	5.1	Probable radioactive hazard by airplane crashing	2.4
Technical transfer to nuclear weapons	2.1	The difficulties of recruitment of experts	1.2
Probable radioactive hazard in natural by disaster (ex. big earthquake)	2.1	Decrease of safety technology by financial difficulties	1.2
Worsening of local industries by abolition of nuclear energy	1.7	Possibility of changing to police-controlled society	1.2
Possibility of changing to police-controlled society	0.9	Layoff threat	0.9
Probable radioactive hazard by airplane crashing	0.9	Worsening of local industries by abolition of nuclear energy	0.9
Environment contamination by construction of nuclear power plant	0	Business crisis by nuclear policy shift	0.7
Others	6	Others	0.2

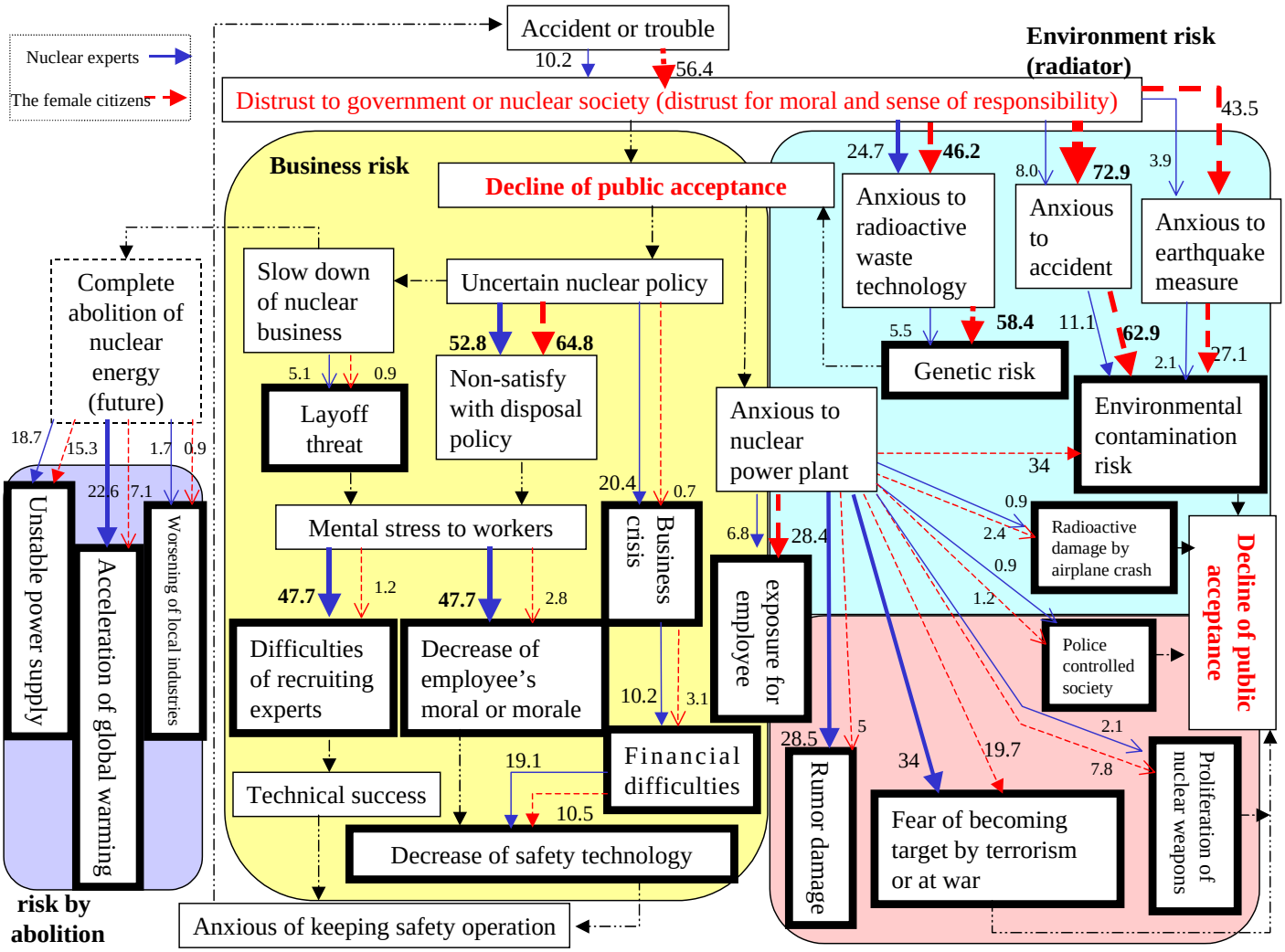

Figure 5: Image model of risk correlation of nuclear experts and the female citizens

The contrasting perceived risk for nuclear can be depicted as show in Figure 5 between nuclear experts and the female citizens. In Figure 5, various square boxes represent various nuclear power-related risks. The thick boxes correspond to the individual 19 risk factors in Table5 while the thin boxes are inserted to interpret the causal relationship between those risk factors. The straight arrows and broken ones between the boxes are for nuclear experts and the female citizens, respectively, and the attached numbers on those arrows are percentage scores of influence which are reduced from the result of social investigation.

The contrasting image as shown in Figure 5 can be summarized as that the female citizens mainly concern the radioactive risk, while nuclear experts mainly concern the risk of their worsening business environment. These would give us important hints on dealing with communication of social risk information between nuclear people on one hand and general public on other hand. In order to see the detailed trends in the both groups of nuclear people and general public and consider for effective risk communication method to be developed in this research, we conducted detailed statistical analysis to the result of social investigation as explained in the succeeding section.

4. Statistical Analysis

In the present study, nuclear power-related risks were classified depending on a questionnaire survey that was administered to both 234 nuclear experts and 578 female citizens. After 3 and 2 clusters of different risk perception groups were identified for nuclear experts and the female citizens, respectively, it was investigated how each clustered group of respondents for both shared the similar risk perception which is characterized by knowledge, opinions, and attitudes concerning nuclear power. Then, possible research strategy for exploring effective risk communication will be discussed based on the results of analysis above.

4.1 Method of analysis

1) Cluster analysis of inter relationship among risk factors (19 items except 'Others' and less than 5% of selected rates in Table 5) by Hayashi's Quantification for Classification of Response Patterns (Quantification Theory III) for both the nuclear experts and the female citizens,
2) Identification of major clusters of risk. (3 clusters for nuclear experts, and 2 clusters for the female citizens),

3) Picking-up of typical respondents who belong to each of the clusters, and
4) Identification of major characteristics variables that can discriminate respondents of each cluster by using AIC (Akaike's Information Criteria).

Quantification Theory III is one of multivariate analysis for categorical data like a response to a questionnaire item on risk cognitions in this study.

AIC = -2・（maximum logarithms likelihood of model）+ 2・（the number of free parameters of model）

It is normally recognized as a significant category data when AIC score becomes less than –1.

4.2 Results of analysis

4.2.1 Clustering nuclear experts

As shown in Table 6, it was found that the risk factors which emphasize nuclear experts were classified into 3 groups in terms of their risk perception. They are named as Type1, Type2, and Type3 with the following characters.

i) Type 1 is concerned with the risk of property loss either by person or by business,
ii) Type 2 is anxious for life or health caused by radioactive influences, and
iii) Type 3 worries about abolition of nuclear energy, and this group is considered as a sub-group of Type1.

Table 6: Risk factors by each type (nuclear experts)

Risk Type	Risk Factors
Type 1	Image-down of generative area by rumor Fear of becoming targets of war or terrorism Business crisis by nuclear policy shift Difficulties of recruitment of experts Layoff threat Decrease of moral or morale of employees Decrease of safety technology by financial difficulties Financial difficulties for nuclear fuel cycle development
Type 2	Influence of accidents/troubles on environment Genetic influence by radioactive waste Exposure for employee
Type 3	Anxiety of unstable power supply and rise of electric price by abolition of nuclear energy Acceleration of global warming by abolition of nuclear energy

The scale values of each respondent were computed for Type 1 and Type 2. The scale value for Type 1 represents the extent to which a respondent emphasizes on Type 1 risks and it is also true in the scale value for Type 2. The scale value for Type 1 is the number of risk items in Table 6 that were chosen by a respondent. As every respondent chose 3 items, the scale takes a value from 0 to 3. Table 7 shows the result of cross-tabulation of the scale values of Type 1 and Type 2 form Table 7. We chose 158 respondents whose original scale value of Type 1 was 2 or 3 and that of Type 2 was 0 as the “typical Type 1 group” , and chose 25 respondents whose original scale value of Type 1 was 0 or 1 and that of Type 2 was 1, 2 or 3 as the “typical Type 2 group”.

Table 7: Original scale value cross-tabulation for nuclear experts

		The scale value of Type2				
		0	1	2	3	Total
The scale value of Type1	0	1	3	3	0	7
	1	29	13	6	-	48
	2	64	21	-	-	85
	3	94	-	-	-	94
Total		188	37	9	0	234

Next, the major characters of the both typical Type 1 and 2 peoples were identified by using AIC.

We set the target (response) variable as 1 for typical Type 1 group and 2 for typical Type 2 group and we set the explanatory variables as “sex”, ”ages”, “jobs” and all question items in the question sheet but risk image. And we analyzed these variables using AIC. We examined each response patterns of two groups for effective top 9 question items from AIC scores (see Tables 8 and 9).

Typical Type 1 group: Majority group characterized by risk cognition emphasizing obstacle for stable continuation of nuclear business. Most of them agree with further progress of nuclear energy in future. They place high reliance on operation and management of nuclear power plant by electronic companies. Moreover about 40% of them hope to rise their life level more than now.

Typical Type 2 group: Minority group characterized by risk cognition emphasizing exposure and environment damage/pollution by accidents. About 40% of them ‘hold’ or ‘decrease’ on nuclear energy in the future. Slightly less than 30% of them place reliance on operation and management nuclear power plant by electronic companies. And they do not hope to rise their life level more than now.

Table 8: Result of AIC analysis for identification variables that can discriminate typical Type 1 and 2 peoples (nuclear experts).

RANK	EXPLANATORY VARIABLES	NUMBER OF CATEGORIES OF EXP. VAR.	A I C
1	[Q8] attitude toward promotion of nuclear energy	2	-20.19
2	[Q9-4] more strictly safety measure is the political issue	2	-18.09
3	[Q7-5] operation or management for NPP by electronic companies	2	-11.14
4	[Q3] life standard in the future	2	-10.43
5	[Q6-8] there will be no explosion in NPP like atomic bomb.	2	-9.76
6	[Q4-5] Japanese saving technology is more progressive	2	-9.59
7	[Q4-7] fossil fuel resource is limited	2	-8.98
8	[Q16-4] public information by government (effective ways to enhance public understanding)	2	-8.84
9	[Q16-6] advertisement or feature articles on newspapers or magazines(effective ways to enhance public understanding)	2	-8.49

Table 9: Comparison of typical Type1 group and typical Type2 group with respect of nuclear power development (in case of nuclear experts) (AIC = -20.19)

	Typical Type 1 group	Typical Type 2 group	Total
strongly or carefully progress on nuclear energy	95.6%	60.0%	90.7%
reduce or abolish on nuclear energy	44.0%	40.0%	9.3%
total	100%	100%	100%

4.2.2 Clustering female citizens

Secondly, it was found that risk perceptions of the female citizens were roughly classified into the following 2 types by Quantification Theory III analysis.

Type A: High score for anxieties for life or health caused by radioactive influences, and
Type B: High score for anxieties caused by decrease or abolition of nuclear energy

Table 10: Risk factors by each type (the female citizens)

Risk Type	Risk Factors
Type A	Exposure for employee Genetic influence by radioactive waste Influence of accidents/troubles on environment Fear of becoming targets of war or terrorism
	Environmental contamination by construction of nuclear power plant Probable radioactive hazard by natural by disaster (ex. big earthquake)
Type B	Technical transfer to nuclear weapon development Decline of safety technology by financial difficulties Anxiety of unstable power supply and rise of electric price by abolition of nuclear energy Acceleration of global warming by abolition of nuclear energy

The scale values of each respondent were computed for Type A and Type B by the same way as for nuclear experts. The scale value for Type A is the number of risk cognition items in Table 10 that were chosen by a respondent. As every respondent chose 3 items, the scale takes a value from 0 to 3. Table 11 shows the result of cross-tabulation of the scale values of Type A and Type B. We chose 358 respondents whose original scale value of Type A was 2 or 3 and that of Type B was 0 as "typical Type A group", and chose "typical 63 Type B people" whose original scale value of Type A was 0 and that of Type B was 1, 2 or 3.

Table 11:Original scale value cross-tabulation for the female citizens

		The scale value of Type B				Total
		0	1	2	3	
The scale value of Type A	0	2	4	4	0	10
	1	14	27	28	-	69
	2	87	141	-	-	228
	3	271	-	-	-	271
Total		374	172	32	0	578

Next, by the same way as for nuclear experts, the major characters of Type A and Type B were identified by using AIC. We examined each response patterns of two groups for effective top 9 question items from AIC scores (see Tables 12 and 13).

Table 12: Result of AIC analysis for the female citizens

RANK	EXPLANATORY VARIABLES	NUMBER OF CATEGORIES OF EXP. VAR.	A I C
1	[Q16-5] want to know about any earthquake	2	-15.43
2	[Q16-16] want to know about radioactive waste disposure method	2	-8.99
3	[Q6-3] knowledge of regularly test by year	2	-8.72
4	[Q7-8] fear of becoming target terror or war	2	-8.63
5	[Q16-4] want to know about safety measure	2	-5.64
6	[Q8] attitude toward promotion of nuclear	2	-5.09
7	[Q7-2] reliance on prevention measure for	3	-3.36
8	[Q6-11] knowledge of domination 1 of 3 for generation	2	-2.52
9	[Q9-6] it is political issue to establish on system reflecting their opinions because industries promote in power generation area	2	-2.47

Table 13: Comparison of typical Type A group and typical Type B group (the female citizens) (AIC = -15.43)

	Typical Type A group	Typical Type B group	Total
Not want to know	**46.6%**	**74.6%**	**50.8%**
Want to know	**53.4%**	**25.4%**	**49.2%**
Total	**100%**	**100%**	**100%**

Typical Type A group: Majority group characterized by major risk factors emphasizing on exposure and environment damage/pollution by accidents. 80%-strong of them are not satisfied with prevention measure and more than half of them want to know about earthquake measure, radioactive waste disposal method and safety measure. And 35.5% of them agree with decreasing or abolition on nuclear energy in the future.

Typical Type B group: Minority group characterized by risk cognition emphasizing on influences caused by decrease or abolition of nuclear energy. 60%-strong of them know that electric companies regularly do test by a year and 80%-strong of them agree with progress on nuclear energy in the future. But about 70% of them do not satisfy with prevention measure and about 60% of them want to know about any safety measures.

4.3 Implication for effective risk communication

The above result suggests direction of our further research on risk communication to develop safety culture. First, it might be possible to use the nuclear experts of Type 2 for effective risk communication in nuclear power. Because we can see they took a radioactive risk seriously as a momentum for discovering potential risks that would be overlooked by those who have confidence in everyday operation. They can be precious human resources for developing efficient risk communication if they maintain constructive attitude toward nuclear power.

Second, as for ordinary citizens, we learned from the present study that 1) they necessarily do not have any knowledge for nuclear energy. Their knowledge level is remarkably lower than nuclear society, 2) they have concerned with not the process (safety technology) but the effects (ex. radioactive influences) and the prevention measures. It looks necessary to remember that efforts to increase knowledge level of ordinary citizens step by step should be placed on a central position without being in a hurry for gaining their support.

5. Conclusion

As the first step towards effective risk communication of nuclear power, social survey was conducted on risk perception for nuclear power of both people who engaged in nuclear business and female citizens who resided in the metropolitan area in order to obtain relevant information on how and what should be considered to develop effective risk communication methods. Statistical analysis of survey data suggested possible directions for the next step of our research on risk communication not only among nuclear experts who tend to worry about the worsening of business environment but also between nuclear experts and ordinary citizens people who tend to focus on radioactive risk.

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