한국인의 위험인지에 대한 경험적 분석

정 익 재
서울산업대학교 행정학과
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An Empirical Review of Korean Perception for Technological Risks

Chung, Ik Jae
Department of Public Administration, Seoul National University of Technology
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Abstract : A survey of risk perception in Korea was conducted in 2001 with a special emphasis on industrial and technological risks. This article summarizes the characteristics of risk perception in consideration of socio-demographic background of respondents. The survey with sample size of 1,870 evaluates the perceived level of 25 risk items in the areas of transportation, chemicals, environment, industry, and nuclear power generation. Risks are categorized by using factor analysis to clarify attitudinal or behavioral properties of risk perception. Research findings show that the level of perceived risk does not correspond to the statistical level. Socio-demographic variables are significant predictors in explaining risk perception, or the discrepancies between "subjective" and "objective" risks. Effective risk communication can reduce the perceptional discrepancies, improve the awareness of technological risks, and ultimately facilitate the process of making and implementing policies for risk management and safety regulation. This article tries to provides policy guidelines for "Who is the target for risk communication" and "Which risk has the policy priority for safety improvement." Married females at the age of 30s and 40s with lower education and lower income in small cities are more vulnerable to risk misperception than other groups. More information and knowledge regarding unfamiliar, intangible, new technological risks should be delivered to the vulnerable groups for reducing perceptional bias. Society-wide safety can be improved by integrating policy, human, and social factors as well as techno-engineering advances.

초 록 : 본 연구는 기술위험에 대한 한국인의 인지수준을 경험적으로 분석하기 위하여 설문조사(표본 크기 1,870)를 실시하고, 응답자의 사회인구학적 변수를 배경으로 그 특성을 정리하였다. 설문에서 교통, 유해화학물질, 환경, 산업안전, 원자력 그리고 새로운 기술 등 6개 분야의 25개 위험에 대한 상대적인 위험수준을 평가하였다. 요인분석 결과, 응답자의 위험인지에서 독특한 행태적 특성을 발견하였다. 통계에 근거한 객관적 위험평가와 주관적 위험인지는 뚜렷한 차이를 보이며, 응답자의 사회인구학적 변수는 이러한 차이를 의미있게 설명하고 있다. 예를 들면, 중소도시에 거주하는 저소득 저학력의 30-40대 기혼 여성이 다른 사회집단 구성원보다 위험에 민감한 반응을 보였으며, 생소하거나 막연한 대상의 위험 수준을 높이 평가하는 경향이 있다. 이러한 연구결과는 위험인지에서 나타나는 개인 차원의 오류와 편견을 줄이고, 위험관리 정책과 안전규제를 효과적으로 집행하는데 요구되는 기반자료로서 활용할 수 있다. 특히, 위험인지의 사회집단별 차별성은 안전과 관련된 과학적인 지식과 정보를 누구에게 어떻게 전달할 것인지에 대한 정책적 함의를 제공한다. 현대사회의 위험관리는 기술공학적 접근과 더불어 사회문화적 변수를 고려하여 추진되어야 한다는 점을 재확인한다.
Key Words : technological risk, risk perception, safety policy

1. Introduction

Korea is now experiencing the aftermath of a rapid socio-economic change and industrialization process during the 1970s and 1980s which make the society expose to various technological risks, accidents and environmental pollution. During the 1990s, the society witnessed various disasters with unprecedentedly high casualty and social impact; for example, sinking of Sohae ferry in 1993, collapse of Songsoo bridge in 1994, collapse of Sampoong shopping mall in 1995,

chungij@snut.ac.kr

crash of Korean Airline in 1997, and fire at Sea Land Youth Camp site in 1999, just to name a few. Some researches explain that a series of anomalous accidents are caused either by a lack of safety awareness[1] or the reckless expansion and rush-to-development mindset that pervade the society[2]. Other studies diagnose an accident-ridden society as a system failure; that is, a symptom of post-modern society where unknown risk is embedded in highly rationalized and well articulated systems[3]. Whatever the causes of those accidents, their far-reaching impact on a society is serious enough to attract public attention for effective risk management and safety policies.

For a reliable management of technological and industrial risks, policy makers must take into account socio-cultural dimensions as well as technological aspects of risk. Risk management includes issues of technology as well as organization, culture, human behavior and psychology[4]. It is a well known practice in academic and professional circles to distinguish between "real" or "objective" risk and "perceived" or "subjective" risk. A risk could be quite differently understood by different societies. This discrepancy is influenced by a variety of socio-cultural factors[5]. In particular, the perceptional bias regarding technological risks in Korea shows distinctive characteristics in comparison with natural disaster.

This article summarizes Korean perception of technological and industrial risks. A nation-wide survey was conducted in 2001 to empirically review the characteristics of risk perception[6]. With a sample size of 1870, the survey included 6 groups of risks; nuclear risks, environmental risks, transportation risks, chemical materials, industrial risks, and other risks. A total of 25 risk items are examined across these groups Table 1. Data were collected by using a purposive quota sampling in consideration of population, occupation, and regional background of respondents. The perceived level of risk is evaluated with a seven-point scale; 1 means "very risky" and 7 "very safe". Respondents are asked to compare the level of each risk to that of "automobile" which is set to 4 implying "average". This means that risk perception in this study was estimated in comparison with a reference level of "automobile" accident.

Table 1. Risk items included in survey

Risk Groups	Risk Items
Nuclear	Nuclear power generation, Radioactivity leakage, Radioactive waste landfill
Environmental	Acid rain, Ozone layer depletion, Waste landfill, Water contamination
Transportation	Railway, Airplane, Marine transportation, Automobile
Chemical materials	Agricultural chemicals, LNG leakage, Benzene, Asbestos
Industrial	Subway construction field, Press operation, LPG transport, Coal mining, Elevator
Others	Genetically modified foods, Electromagnetic waves, Alcohol drinking, Antibiotics, Smoking

2. Perspectives on Risk Analysis and Management

A literature review in risk study reveals three broad categories of approaches; technological, psychometric, and socio-cultural approaches. Early approaches to risk evaluation used to focus narrowly on the impact of hazardous events in terms of the number of people killed or injured, or the amount of property damaged. Traditionally, professionals in the field of risk assessment have identified risk by systematically calculating the seriousness and frequency of a given risk. In the technical arena, risk is determined by the probability of death or injury to an individual or a population, or the probability of environmental damage. However, they are not enough to explain people's perception of risk and their attitude. While the technical reasoning on risk played a prescriptive role in managing risk, its narrow focus neglected other issues such as public attitude and perception on risk. That is, technical risk assessment tends to underestimate social, cultural, and psychological aspect of risk study[7].

Due to the shortcomings of the early approaches, another reasoning on risk study has evolved. An approach, called "psychometric paradigm", was developed by Slovic and his associates[8]. They argued that people's perception of risk can be influenced by various dimensions imbedded in a certain accident or

hazard. For example, research findings from factor analysis showed that unknown, involuntary, or catastrophic accidents elicited serious public concern more than risks perceived as known, voluntary, or ordinary. In recent years, various disciplines have made important contributions to the understanding of risk; especially, risk perception. For example, sociological, anthropological, and political studies have shown that perception and acceptance of risk can be explained by social and cultural factors[9].

Douglas and Wildavsky argue that risk is socially constructed, and that risk perception is culturally influenced[10]. Cultural and sociological studies explained that group, social and institutional context plays an important role in formulating risk perception rather than individual cognition does. The cultural approach to risk found that cultural biases of "hierarchy", "individualism", "egalitarianism", and "fatalism" were predictive of distinctive rankings of possible dangers and preferences for risk-taking at the social level. This means that cultural belief and world view determine how people experience, interpret, and evaluate risk. A key focus of "Cultural Theory" is on two cultural prototypes; entrepreneurs and hierarchy. The former tends to regard risk as opportunities for development, whereas the latter is willing to perceive risk as threat to life and values[11].

3. Overview of Risk Perception

People in Korea perceive as safer transportation risks like railway, airplane, ship, and automobile than other kinds of risks Table 2. It is interesting that the actual levels of transportation risks, especially automobile accident, in terms of probabilistic estimates are much higher than the other risks reviewed in this study. On the other hand, Koreans evaluate as very risky nuclear and environmental risks like water contamination, ozone layer depletion, and waste landfill, while the actual level of these risks is relatively low. Nuclear power generation is clearly distinguished from radioactivity leakage and radioactive waste landfill. The former is considered to be relatively safe; the latter highly dangerous.

Table 2. Rank Order of Perceived Risks

Radioactivity Leakage	1.55
Radioactive Waste Landfill	1.57
LNG Leakage	1.77
Water Contamination	1.88
Ozone Layer Depletion	1.93
Waste Landfill	2.25
Genetically Modified Foods	2.31
Coal Mining	2.37
Agricultural Chemicals	2.42
Acid Rain	2.48
Asbestos	2.50
Smoking	2.60
LPG Transportation	2.60
Press Operation	2.60
Benzene	2.67
Electromagnetic Waves	2.77
Subway Construction Field	2.98
Nuclear Power Generation	3.00
Antibiotics	3.10
Alcohol Drinking	3.25
Automobile Accidents	4.00
Marine Transportation	4.00
Airplane	4.16
Elevator	4.22
Railway	5.75
N = 1870	

People show sensitive response to newly-introduced risks such as genetically modified foods(GMFs) and electromagnetic waves. Even though the impact of GMFs and electromagnetic waves on human health is still unproven scientifically, people are sometimes hyped by information which is disseminated through mass media regrading possible negative hazard from those unfamiliar risks. Sensitive responses are also found to relatively unknown risks like asbestos and benzene, of which people have limited knowledge. These findings imply that people tend to overestimate the level of risks which are new or unfamiliar to themselves[12]. Smoking also attracts public concern in that smoking is perceived as risky as LPG transportation and press operation. According to health Statistics, the smoking rate of Korean males(15 years or older) was 64.1% in 1998 and was second only to Turkey(67.6%) among the OECD member countries. The rate dropped to 58.7% in 2001 because many anti-smoking education and social programs were introduced, and non-smoking areas has been drastically extended. However, the smoking rates of youths and females have been rapidly increasing[13]. Although the smoking population is still high, more and more people have been informed of harm from smoking.

In comparison, Koreans tend to make a generous evaluation for those risks from alcohol drinking and antibiotics.

4. Categorization of Risk Perception

Twenty five risks are categorized into 6 groups by using a factor analysis to clarify attitudinal or behavioral properties of risk perception Table 3. Each group shows clear differences in its characteristics. Nuclear risks except nuclear power generation are included in the first group which is evaluated as "most dangerous" in all of socio-demographic subgroups analyzed in this study. The rank order of radioactivity leakage and radioactive waste landfill stays consistent regardless of respondents' social background. Most of the industrial risks as well as water contamination, GM Foods, and asbestos are clustered into the second group. They are perceived as "very dangerous" in general, and the rank order is influenced by respondents' socio-demographic backgrounds. For example, the subgroups of gender, age, and marital status show differences in their rank orders for GM Foods and asbestos.

Table 3. Categorization of Perceived Risks

Category	Risks
1	Radioactivity Leakage Radioactive Waste Landfill
2	LNG Leakage Water Contamination GM Foods Coal Mining Asbestos Subway Construction Field Press Operation
3	Ozone Layer Depletion Waste Landfill Acid Rain
4	Agricultural Chemicals LPG Transportation Benzene Nuclear Power Generation
5	Smoking Electromagnetic Waves Antibiotics Alcohol Drinking
6	Marine Transportation Airplane Elevator Railway
KMO =.86 Significance = .000	

All of the environmental risks except water contamination consist of the third group which is perceived as "very dangerous" almost same as the second group. Perceived level and the rank order of risks in the group are consistent across most of social variables. Listed in the fourth group are chemical materials like agricultural chemicals and benzene, as well as LPG transportation and nuclear power generation. Those risks in the fourth group are rated as "somewhat dangerous", and they are diverse in terms of risk area which each risk item is affiliated. The rank orders of perceived risks in the group are stable in most socio-demographic variables; however, males evaluate nuclear power generation as relatively safe.

Newly-introduced risks except GM Foods are included in the fifth group which is perceived as less dangerous than the other technological risks except transportation risks. The rank orders of the risks vary with socio-demographic backgrounds. In particular, smoking is perceived as relatively safe by male, young, single, high-income, and student subgroups. The sixth group includes all of the transportation risks and elevator. Risk perception and rank order of these risks are very consistent and stable regardless of respondents' social background.

The categorization of risks shows that perceived risk does not correspond with so-called real risk which is measured statistically. Another finding is that risk items are grouped into categories, even with exceptions, according to risk areas which were made by researchers for the analytical purpose of this study. Exceptional cases in this generalization are nuclear power generation, GM Foods, water contamination, asbestos and elevator.

5. Risk Perception and Socio-Demographic Background

The perception of technological and industrial risks reviewed in this study shows interesting characteristics and tendencies against various socio-demographic variables Table 4. Males evaluate most of the technological risks as "safer" than females do. One exception is asbestos; males are a little more sensitive to asbestos than females, even though the difference is

Table 4. Risk Perception with Socio-Demographic variables

	Gender	Age	Education	Marital status	Income	Religion	Occupation	Residential area
Radio. Leakage	**							**
Radio. Waste Landfill	***							*
LNG Leakage	***	***		*			*	**
Water Contamination	**	**		*	***		**	***
Ozone Layer Depletion	*	**	**	*			**	**
Waste Landfill	**		**					**
Genetic Modified Food	***	**	*	**			***	
Coal Mining	**	**						**
Agricultural Chemicals	***	**					*	
Acid Rain	*	***	***	***		*	***	***
Asbestos		***		**			**	
LPG Transportation	***	**						**
Press Operation	***	***					*	***
Smoking	***	**		**			***	
Benzene	*	***		*			**	
Electromagnet Wave	***		***	**	**		***	***
Subway Construction Field	***	**						
Nuclear Power Generation	***		*		*		*	***
Antibiotics		***		**			**	***
Alcohol Drinking	***	**	*	**		*	**	
Marine Transportation	***		**	*			**	**
Airplane	*		**	*			**	**
Elevator	***		***		**		***	***
Railway	***	***	***	***	***		**	***

Statistical significance: * p<.05 ** p<.01 *** <.001

not statistically significant. Age is another factor which explains differences in risk perception. People in the age groups of 30s and 40s perceive many risks as "dangerous" than the other age groups. However, there are some interesting exceptions. People over 60s are very sensitive to agricultural chemicals, acid rain, and smoking. The age group under 20s evaluates railway as most dangerous. There is an overall tendency that people with lower education are relatively sensitive to technological risks than those with higher education. However, high school graduates perceive GM foods and electromagnet wave as most dangerous, and two-year college graduates evaluate ozone layer depletion and waste landfill as most dangerous.

Married group shows more sensitive response to most of risks than the single except railway. People with lower income tend to evaluate risks as more dangerous than those with higher income. Regarding water contamination, however, people with higher income are more sensitive than those with lower income. Religion is not a reliable factor to explain the differences in risk perception. Buddhists are sensitive to acid rain; Protestants to alcohol drinking. Occupation has a significant influence on risk perception. Homemakers are more cautious of most risks, especially unfamiliar ones, than the other occupational groups such as white collar, service, manufacture, professionals, and public servants. Farmers show interesting responses. While they perceive as most dangerous marine transportation, airplane and elevator, they evaluate as safest LNG leakage, water contamination, ozone layer depletion, GM foods, agricultural chemicals, asbestos, and electromagnetic wave. This means that farmers' risk perception is not stable. Students are least sensitive to most of risks. People with professional or white collar jobs respond that nuclear power generation is relatively safe. Generally, residents in small cities are sensitive to risks. Residents in large cities, however, are most sensitive to water contamination and ozone layer depletion; rural residents are sensitive to those transportation risks.

6. Conclusion and Policy Implications

It was found in this study that Koreans tend to develop almost reversed images of real risks when they perceive technological risks. They evaluate as safe technologies with high mortalities while perceiving as dangerous those with low mortalities. For example, people tend to regard 'automobile' as very

safe, even though it has the highest probability of 25 risks under the survey[14]. Those risks which are perceived as "very dangerous" are usually unfamiliar, intangible and related to new technologies about which lay people have little or limited knowledge. This propensity seems to be associated with social environment of the country, which has experienced such a fast process of industrialization and urbanization that people could not have enough time to fully understand and aware the social implications of technological advance as well as the scientific complexity of various technologies themselves.

Socio-demographic background of survey respondents is a significant predictor in explaining risk perception. It turned out quite clearly that gender, age, education, marital status, occupation and residential area have meaningful influences on Koreans in their evaluating technological risks.

Research findings from this survey reconfirm and extend previous studies regarding risk perception in Korea[15]. There are significant discrepancies between "subjective" risk and "objective" risk. The perceived level of risk does not always match well with statistically estimated risk. When risks are over-estimated, high social costs are induced in making and implementing safety policies because people show so sensitive responses to risks that they are unwilling to accept unfamiliar technologies or unfriendly facilities like low-level radioactive waste depository and solid waste incinerator. When risks are under-estimated, on the other hand, people tend to disregard possibility of happening accidents, and to reject safety policies or regulations required to maintain the minimum level of safety in our society. Driving while intoxicated(DWI) and working without safety helmet are examples of risky behavior or culture, which is influenced by the lower level of safety awareness and risk perception.

A practical implication of analysing risk perception is that an empirical basis is provided for setting policy priority in risk management and risk communication. Distorted risk perception in Korea itself must be the number one of policy issues in managing risk. Even with remarkable advances in the areas of economy, science and culture, public awareness and knowledge of risk are limited. This is another factor inducing further social conflict, or social risk. The discrepancies between 'perceived' and 'real' risks underline the importance of policy effort to reduce risk misperception by improving risk communication. Effective risk communication can improve the awareness of technological risks, and ultimately facilitate the process of making and implementing policies for risk management and safety regulation. A successful risk communication requires well-designed plans for making full use of limited social resources and political supports. The summary of risk perception against respondents' socio-demographic background provides a policy guideline for "Who" and "Which risk item" is the policy target for risk communication. Married females in age groups of 30s and 40s with lower education and income in small cities are more vulnerable to risk misperception than other groups. More information and knowledge regarding unfamiliar and intangible technological risks should be delivered to the vulnerable groups for reducing their perceptional biases. This article, in sum, emphasizes that society-wide safety can be achieved by integrating policy, human, and social factors as well as techno-engineering advances.

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