出國報告（出國類別：國際會議）

第 23 屆歐洲風險分析學會研討會
The 23rd SRA-E Conference

服務機關：台灣中油股份有限公司
姓名職稱：周宜成 化學工程師
派赴國家：土耳其
出國期間：103 年 6 月 14 日至 103 年 6 月 19 日
報告日期：103 年 9 月 1 日

摘要

Society for Risk Analysis Europe 2014 研討會議程涵蓋風險及災難性事件的治理、風險溝通、降低風險、公眾健康和食品安全風險、政策，法規和風險治理的成果等。新興風險的治理是目前在風險管理上相當熱門的議題，第 23 屆歐洲風險分析學會研討會的主題為「超越界線的風險分析和治理」(Analysis and Governance of Risks beyond Boundaries)，強調風險可以跨越地區、疆土、國家的虛擬界線，以新穎的科學方法減低風險，並針對已知悉與未完全知悉的風險制定新的因應策略。

綜觀歐洲之風險相關議題，可見歐洲對於健康風險及環境保護的意識較臺灣高上許多，主要執行的相關議題大多著重在預防及風險治理上，如頁岩氣開發及發展的環保隱憂等。此外，美國能源部已委託學術單位針對採行生質航空用油後，供應鏈的完整及供應能力進行評估，若未來美國採行生質航空用油，臺灣是否需要跟進，都是未來可能需要評估的議題。

目次

本文

壹、 目的

本次赴土耳其伊斯坦堡參加 2014 年歐洲風險分析學會研討會，了解歐洲對健康風險及職業安全風險的情況及未來趨勢。Society for Risk Analysis Europe 2014 研討會議程涵蓋風險及災難性事件的治理、風險溝通、降低風險、公眾健康和食品安全風險、政策，法規和風險治理的成果等。藉由參加此研討會，接觸歐洲地區對工業相關風險的管理及管制概念，以及目前最新之健康風險評估相關發展，對中油相關健康風險議題及國內法規未來走向具有前瞻性的參考意義。

貳、 過程

本次 Society for Risk Analysis Europe 2014 研討會，在土耳其伊斯坦堡的 Istanbul Technical University 舉行。本次出國之行程如出國行程表內容，由於臺灣並沒有直飛伊斯坦堡的班機，故由台灣先飛往東京轉機，再搭乘土耳其航空到達伊斯坦堡的 Ataturk 國際機場。由於經費有限，於是從機場到旅館及會場均以搭乘伊斯坦堡捷運(Istanbul Metro)或步行為主。

出國行程表

預定日期	到達地點	詳細工作內容
103/6/14	台北-東京-土耳其伊斯坦堡	啟程前往土耳其伊斯坦堡
103/6/15	土耳其伊斯坦堡	研討會
103/6/16	土耳其伊斯坦堡	研討會
103/6/17	土耳其伊斯坦堡	研討會
103/6/18	土耳其伊斯坦堡	研討會
103/6/19	土耳其伊斯坦堡-曼谷-台北	返回台北

正式議程於 6/16 展開，研討會的議程共分成專題演講(keynotes)、主要風險(Major Risk)、風險溝通(Risk Communication)、風險管理(Risk Management)、健康風險(Health Risks)、安全與防護(Safety and Security)、風險感知(Risk Perception)、氣候變遷(Climate Change)、都市與結構風險(Urban and Structural Risks)、不確定性與風險複雜度(Uncertainty and Complexity of Risks)、風險具象化(Risk Visualisation)、輸送風險(Risk in Transportation)、經濟損失及保險(Economic Losses and Insurance)、決策(Decision Making)、以及一般討論(Symposium)等 15 項主題進行。

	Sunday, June 15	Monday, June 16	Tuesday, June 17	Wednesday, June 18
08:00 – 09:00	Welcome to Istanbul	Registration	Registration	Registration
09:00 – 10:30		Plenary Session/Opening	Plenary Session/Student Award Ceremony	Plenary Session
10:30 – 11:00		Coffee Break		
11:00 – 12:30		Paralel Sessions	Paralel Sessions	Paralel Sessions
12:30 – 13:30		Lunch Break		
13:30 – 15:00		Paralel Sessions	Paralel Sessions	Paralel Sessions
15:00 – 15:30		Coffee Break		We are looking forward to meeting you again
15:30 – 17:00	Registration	Paralel Sessions	Paralel Sessions	
Evening Program	17:00 -19:00 Ice breaking – Cocktail	17:00 -19:00 Poster Session Cocktail	17:15 – 18:15 SRA-E Annual General Assembly 19:00 – 23:00 Conference Dinner	

Society for Risk Analysis Europe 2014 研討會議程表

開幕式由 SRA-E 及主辦單位表達歡迎來賓之意，接著由德國 Ortwin Renn 及 Juergen Weichselgartner 進行演講。其演講中提出一個新的災害風險概念，如氣候變化，金融海嘯等對跨國甚至全世界都會產生影響的事件，已不單一區域或國家可以獨立預防，而是以一個現代概念的邊界，針對不同的災害(如地震、洪水)找出脆弱因子，並據以探討脆弱度(vulnerability)及共同可接受的回復力(resilience)政策方案。此外，Louise K. Comfort 也指出對於可能的極端事件，也應對事件內容、不確定性、及複雜度等探討制訂實際的政策。

由於各主題錯落於各天的議程中，因此在會場完成報到手續後的首要工作即是挑選出各時段需聆聽的演講場次。本次研討會主要聚焦在風險治理及災害管理上，對於目前工作相關主題以化學品管理、風險評估、風險溝通、以及風險感知為主。

在化學品管理方面，歐洲化學品管理局(European Chemicals Agency)的官員 Tomas Öberg，說明 REACH 法案以危害、風險及衝擊評估化學品取代的可能性。演講中指出，歐盟化學品政策主要以確保人體及環境能處於較高的保護標準，同時也要確保歐盟內部市場的運作及競爭力。演講中也特別提到，若某項化學品在現今工業中具有不可替代性，就算對人體或環境有所影響，在考量經濟評估的結果，歐洲化學品管理局仍會核准使用該項化學品。並不會因環境而犧牲經濟，而是以兩者雙贏局面作為考量，十分值得國內借鑑。中山醫學大學李文亮副教授(Wen-Lian William Lee)也由其對科學園區所制訂的有害物質管理系統進行說明，分享實際應用於科學園區的方法及成果。會中也與李老師交換名片，期待未來能有進一步合作的議題。

在風險評估議題方面，與中油公司相關的有包含天然氣廠的特殊工業區風險評估、頁岩氣開採風險評估、以及生質航空燃油產業鏈的安全風險評估。在天然氣廠的特殊工業區風險評估議題，Preben H. Lindne 報導以國際風險管理會(International Risk Governance Council, IRGC)框架應用於評估具有貯存、製程、傳輸能源綜合工業區對健康、安全、環境風險。其中一個案例為港口內的液化天然氣廠貯存和配送的安全，雖然液化天然氣廠在計畫、建造及操作階段都有考量到安全因素，但其鄰

近的居民仍會感到憂心。台灣與此一案例有相似的情形，但報告中對相關的風險溝通情況並未有進一步著墨，較為可惜。

在頁岩氣開採時風險評估議題，瑞士的 Paul Scherrer Institut 國家級研究單位的 Emilie Sutra 回顧現有文獻，分別評估應用水力破裂法(Hydraulic Fracturing)與深層地熱系統(Deep Geothermal Systems)於開採頁岩氣時可能的風險並加以比較。報告中指出，由於採用水力破裂法仍有可能產生潛在的環境影響及引發地震，因此開採頁岩氣仍然有不少爭議存在。而可能產生的環境影響則需持續觀察，才能有所定論。

生質航空燃油產業鏈的安全風險評估議題則是由美國 University of Virginia 的博士侯選人 Elizabeth B. Connelly，分享協助美國環保署進行生質航空燃油產業鏈的安全風險評估階段性成果。報告指出天然災害與突然增加的運量(如世界盃及奧運會等事件)均有可能造成生質航空燃油產業鏈因產量減少或需求增加而供應不及的風險，因此如何擬訂完善的緊急應變方案是未來要面對的議題。會後也與 Connelly 小姐討論生質航空燃油國際化產生的品質管理問題，如果因油品問題產生飛航安全事件，可能就會立即扼阻生質航空燃油產業鏈的發展。Connelly 小姐也表示目前在美國環保署相關計畫中尚未考量到此一要點，未來有機會再建議美國環保署納入考量。

在風險溝通上，來自日本北海道大學的 S. Ohnuma(大沼 進)副教授以日本選擇核廢料掩埋場的經歷，說明日本人對於相關政策並不是很了解，而其訪問結果顯示，與臺灣相似的是在離掩埋場越近的居民，對相關議題敏感度越高，越遠則越少關心。日本在設置時也遇到相關人士的抗議，但是後來政府介入提出相關承諾而得以完成建設。會後有與大沼博士進行請益，在風險溝通上的困難點應如何克服。大沼博士認為在遇到較激進的人士時，若無法理性溝通，的確是一大難題，在必要時也許以政府提出具體的承諾難保證，會是一個較不完美的解決方案。

風險感知的議題較為廣泛，會中 Mustafa Erdik 也以伊斯坦堡地震風險為例說明，一般人在災害發生前後的風險感知會有所改變，但在風險管理上，針對地震風險管理以了解和現有的風險危害的量化、減少未來與既存風險(新建及維護現有建

築的抗震度)、或以保險方式轉移風險、並完善應急管理體系等作為風險管理及轉移的基本原則。Richard Eiser 認為，風險感知應該被看作是一類特殊的態度，從個人和別人的經驗來評估，並且風險感知很難被改變。此外，如酒駕的問題，都是由於酒駕一次、二次後都幸運地沒發生事故，所以風險感知會有酒駕不危險的感知強化；反之，工安事故經過媒體的大幅報導，會逐漸強化大眾對工業安全的不信任感，造成風險感知的錯誤認知。

參、 心得及建議

一、心得

歐洲風險分析學會主要著重歐洲地區之風險評估、風險管理、以及風險溝通等領域。本次研討會中，與傳統風險不一樣的部分，主要是災害風險延伸特性的討論；如風險空間特性(Spatial)、疊圖具象化(Mapping)、風險的脆弱度(vulnerability)、以及回復力(Resilience)為本次歐洲研討會討論的主流議題。脆弱度主要討論在受到危害時系統的敏感性及弱點因子，而回復力則是了解其恢復至原來能力的相關因子。本次會議舉辦的伊斯坦堡技術大學(Istanbul Technical University)，即針對伊斯坦堡城市受到地震災害的脆弱度及回復力，進行風險減輕規劃。

歐洲化學品管理局的 REACH 法案，主要是保護人體健康及環境免於暴露於化學品的風險，並增進歐盟內部化學品工業的競爭力。歐洲化學品管理局中社會經濟分析委員會 Tomas Ö berg 也針對「以危害、風險及衝擊評估為基礎之化學替代品」，說明歐洲化學品管理局除了風險評估委員會外，社會經濟分析委員會在化學品管理上將人體健康及環境衝擊、經濟衝擊、社會衝擊進行定量、定性評估。並說明在風險可以得到充分的控制，或者在沒有適當替代品的情況且社會經濟利益大於風險時，是可以批准授權。

綜觀中油公司目前的風險管理相關工作，對於較大的可能潛在風險均已努力進行改善，且獲得可見的成果，但在風險溝通上有較大的困難。在研討會中遇到風險

溝通的專家並交換意見，其中大沼 進博士認為在理性的溝通上，可以努力取得更多的研究資料來說服大眾及持反對意見的專家，努力落實透明化的風險溝通，但遇到非理性的抗爭時，風險溝通專家能夠發揮的功能其實不大，以日本為例則是需由公權力介入協調，由政府承諾未來監督及執行事項，讓心眾得以安心。

在能源工業相關風險方面，臺灣環保署許多政策均參照美國環保署的方案，如目前國內推展的生質柴油政策，未來環保署如果決定跟隨美國生質航空燃油的政策，則國內油品的相關規定、品質品管、以及供應需求都為可能面對的議題應提早因應。此外，液化天然氣廠、頁岩氣的開採都與國內的能源價格有十分密切的相關性。研討會中所提液化天然氣廠，附近居心也表達會對於發生意外事故的擔憂，但並沒有抗議等激烈的事件發生，評估的風險也沒有特別顯著的情形。Paul Scherrer Institute 比較頁岩氣水力破裂法及深層地熱系統的風險評估，其結果指出在開採頁岩氣中的可能存在的環保相關議題，可能會導致頁岩氣的價格波動，甚至由於環保法規的介入而使得頁岩氣的開發被迫終止。

二、建議

1. 在化學品管理方面，中油公司已經有應用歐盟 REACH 概念相關案例，可於適當場合中宣傳對環境及安全的努力。本次歐洲化學品管理局 REACH 法案，實際應用的工業經濟發展與環境健康並重的概念與作法具有相當重要的參考價值。
5. 風險溝通涉及心理學，科學，經濟學和哲學研究等不同領域，在國內較缺乏相關產業人才。未來有風險溝通訓練相關需求，可聘請國外風險溝通專家協助。

附錄

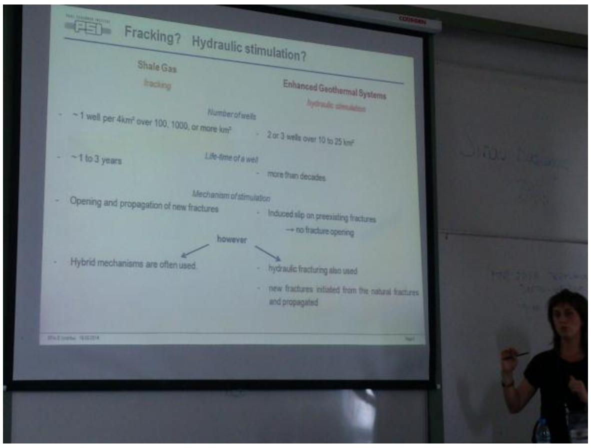
研討會開幕

Ortwin Renn

Juergen Weichselgartner

Tomas Ö berg

李文亮



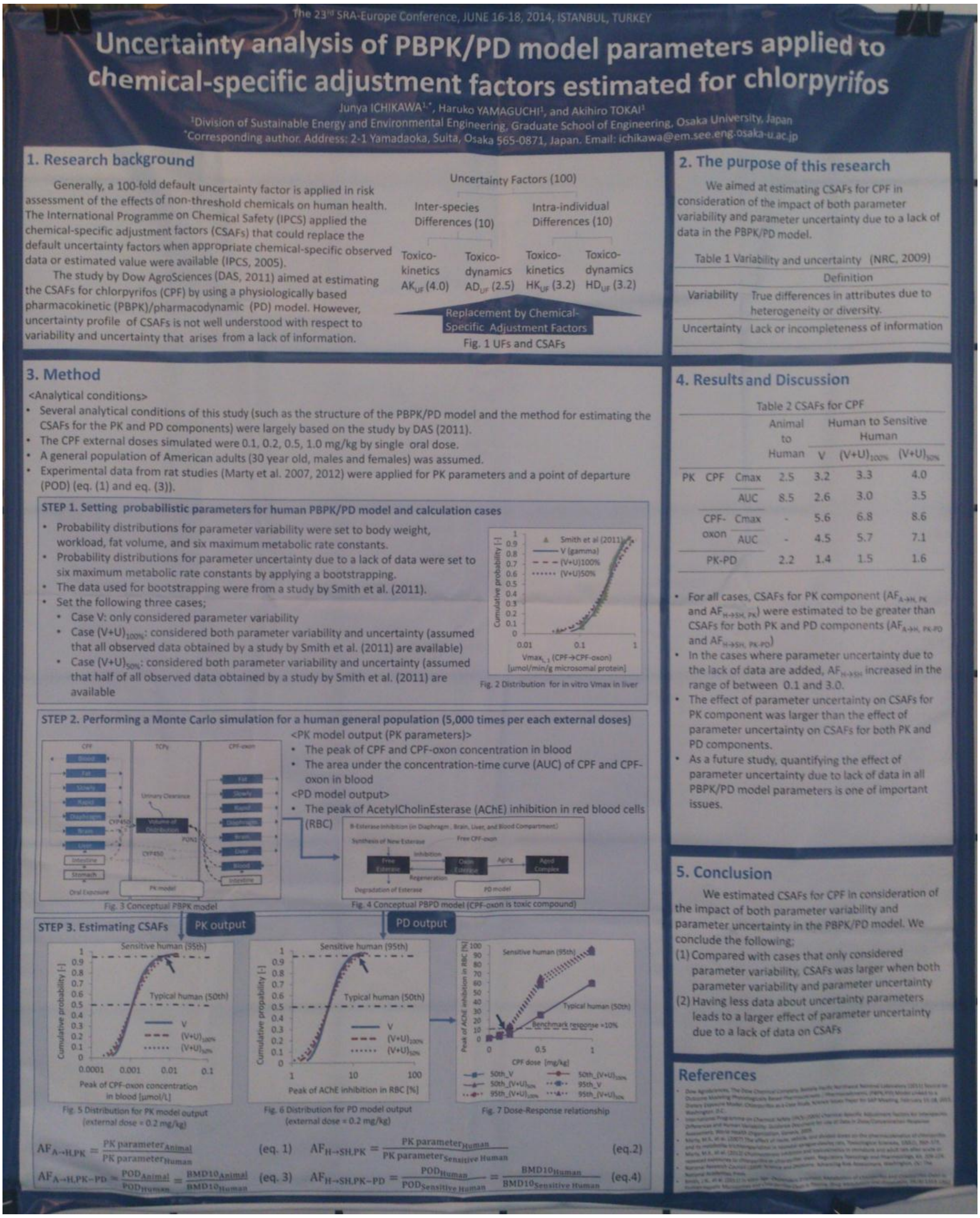
Emilie Sutra

Elizabeth B. Connelly
(SRA-E 拍攝)

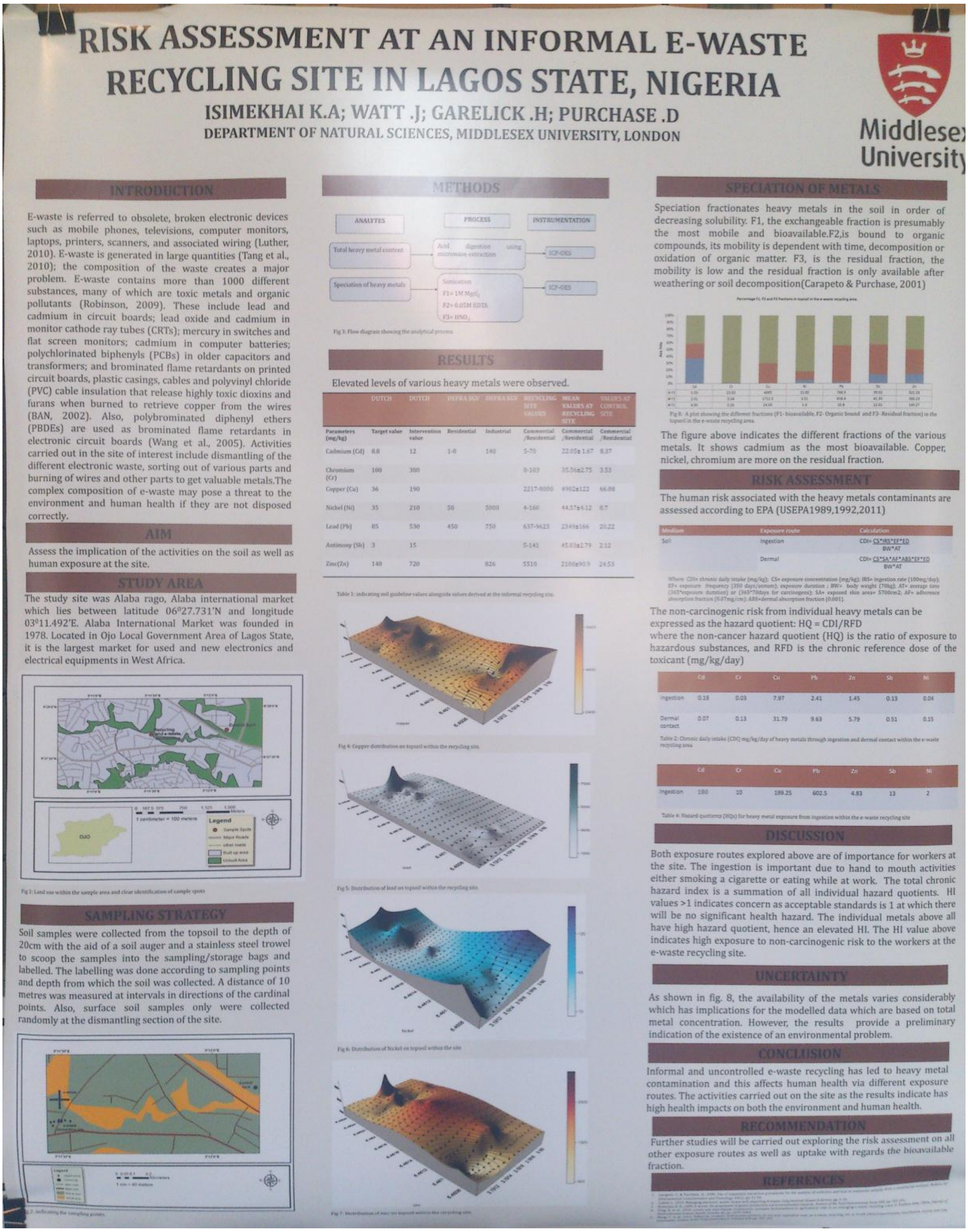
會場內照片 1
(SRA-E 拍攝)

會場內照片 2
(SRA-E 拍攝)

會場內照片 3
(SRA-E 拍攝)

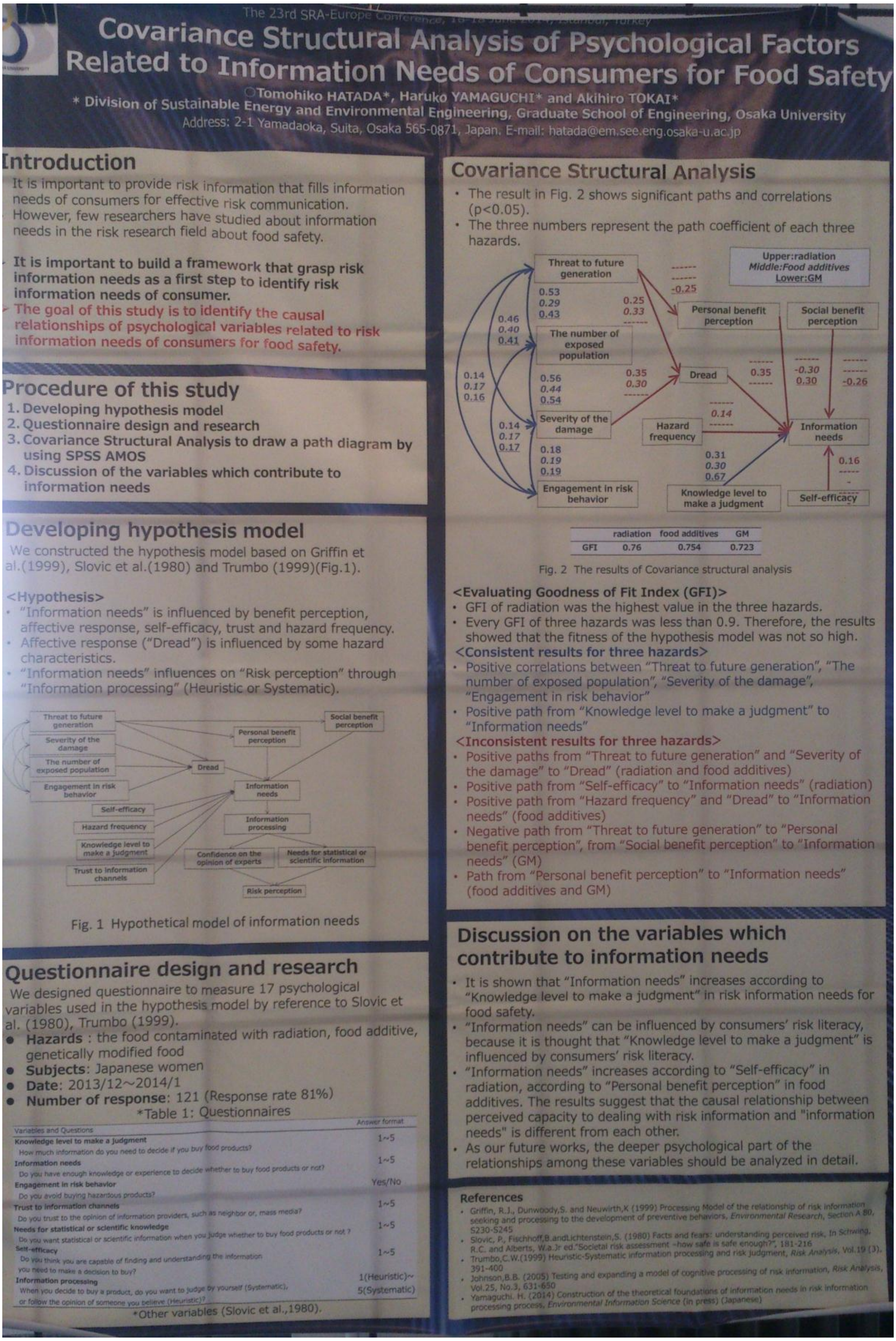

The 23rd SRA-Europe Conference, JUNE 16-18, 2014, ISTANBUL, TURKEY
Uncertainty analysis of PBPK/PD model parameters applied to chemical-specific adjustment factors estimated for chlorpyrifos
Junya ICHIKAWA1,*, Haruko YAMAGUCHI1, and Akihiro TOKAI1
1Division of Sustainable Energy and Environmental Engineering, Graduate School of Engineering, Osaka University, Japan
*Corresponding author. Address: 2-1 Yamadaoka, Suita, Osaka 565-0871, Japan. Email: ichikawa@em.see.eng.osaka-u.ac.jp
1. Research background
Generally, a 100-fold default uncertainty factor is applied in risk assessment of the effects of non-threshold chemicals on human health. The International Programme on Chemical Safety (IPCS) applied the chemical-specific adjustment factors (CSAFs) that could replace the default uncertainty factors when appropriate chemical-specific observed data or estimated value were available (IPCS, 2005).
The study by Dow AgroSciences (DAS, 2011) aimed at estimating the CSAFs for chlorpyrifos (CPF) by using a physiologically based pharmacokinetic (PBPK)/pharmacodynamic (PD) model. However, uncertainty profile of CSAFs is not well understood with respect to variability and uncertainty that arises from a lack of information.
Uncertainty Factors (100)
Inter-species Differences (10)
Intra-individual Differences (10)
Toxico-kinetics AKUF (4.0)
Toxico-dynamics ADUF (2.5)
Toxico-kinetics HKUF (3.2)
Toxico-dynamics HDUF (3.2)
Replacement by Chemical-Specific Adjustment Factors
Fig. 1 UFs and CSAFs
2. The purpose of this research
We aimed at estimating CSAFs for CPF in consideration of the impact of both parameter variability and parameter uncertainty due to a lack of data in the PBPK/PD model.
Table 1 Variability and uncertainty (NRC, 2009)
Definition
Variability True differences in attributes due to heterogeneity or diversity.
Uncertainty Lack or incompleteness of information
3. Method
<Analytical conditions>
Several analytical conditions of this study (such as the structure of the PBPK/PD model and the method for estimating the CSAFs for the PK and PD components) were largely based on the study by DAS (2011).
The CPF external doses simulated were 0.1, 0.2, 0.5, 1.0 mg/kg by single oral dose.
A general population of American adults (30 year old, males and females) was assumed.
Experimental data from rat studies (Marty et al. 2007, 2012) were applied for PK parameters and a point of departure (POD) (eq. (1) and eq. (3)).
STEP 1. Setting probabilistic parameters for human PBPK/PD model and calculation cases
Probability distributions for parameter variability were set to body weight, workload, fat volume, and six maximum metabolic rate constants.
Probability distributions for parameter uncertainty due to a lack of data were set to six maximum metabolic rate constants by applying a bootstrapping.
The data used for bootstrapping were from a study by Smith et al. (2011).
Set the following three cases;
Case V: only considered parameter variability
Case (V+U)100%: considered both parameter variability and uncertainty (assumed that all observed data obtained by a study by Smith et al. (2011) are available)
Case (V+U)50%: considered both parameter variability and uncertainty (assumed that half of all observed data obtained by a study by Smith et al. (2011) are available
Fig. 2 Distribution for in vitro Vmax in liver
STEP 2. Performing a Monte Carlo simulation for a human general population (5,000 times per each external doses)
<PK model output (PK parameters)>
The peak of CPF and CPF-oxon concentration in blood
The area under the concentration-time curve (AUC) of CPF and CPF-oxon in blood
<PD model output>
The peak of AcetylCholinEsterase (AChE) inhibition in red blood cells (RBC)
Fig. 3 Conceptual PBPK model
Fig. 4 Conceptual PBPD model (CPF-oxon is toxic compound)
STEP 3. Estimating CSAFs
PK output
PD output
Sensitive human (95th)
Typical human (50th)
Fig. 5 Distribution for PK model output (external dose = 0.2 mg/kg)
Fig. 6 Distribution for PD model output (external dose = 0.2 mg/kg)
Fig. 7 Dose-Response relationship
AFA→H,PK = PK parameterAnimal / PK parameterHuman (eq. 1)
AFH→SH,PK = PK parameterHuman / PK parameterSensitive Human (eq.2)
AFA→H,PK-PD = PODAnimal / PODHuman = BMD10Animal / BMD10Human (eq. 3)
AFH→SH,PK-PD = PODHuman / PODSensitive Human = BMD10Human / BMD10Sensitive Human (eq.4)
4. Results and Discussion
Table 2 CSAFs for CPF
Animal to Human | Human to Sensitive Human | V | (V+U)100% | (V+U)50%
PK CPF Cmax 2.5 3.2 3.3 4.0
AUC 8.5 2.6 3.0 3.5
CPF-oxon Cmax - 5.6 6.8 8.6
AUC - 4.5 5.7 7.1
PK-PD 2.2 1.4 1.5 1.6
For all cases, CSAFs for PK component (AFA→SH, PK and AFH→SH, PK) were estimated to be greater than CSAFs for both PK and PD components (AFA→SH, PK-PD and AFH→SH, PK-PD)
In the cases where parameter uncertainty due to the lack of data are added, AFH→SH increased in the range of between 0.1 and 3.0.
The effect of parameter uncertainty on CSAFs for PK component was larger than the effect of parameter uncertainty on CSAFs for both PK and PD components.
As a future study, quantifying the effect of parameter uncertainty due to lack of data in all PBPK/PD model parameters is one of important issues.
5. Conclusion
We estimated CSAFs for CPF in consideration of the impact of both parameter variability and parameter uncertainty in the PBPK/PD model. We conclude the following;
(1) Compared with cases that only considered parameter variability, CSAFs was larger when both parameter variability and parameter uncertainty
(2) Having less data about uncertainty parameters leads to a larger effect of parameter uncertainty due to a lack of data on CSAFs
References

研討會海報 1



RISK ASSESSMENT AT AN INFORMAL E-WASTE RECYCLING SITE IN LAGOS STATE, NIGERIA
ISIMEKHAI K.A; WATT .J; GARELICK .H; PURCHASE .D
DEPARTMENT OF NATURAL SCIENCES, MIDDLESEX UNIVERSITY, LONDON
Middlesex University
INTRODUCTION
E-waste is referred to obsolete, broken electronic devices such as mobile phones, televisions, computer monitors, laptops, printers, scanners, and associated wiring (Luther, 2010). E-waste is generated in large quantities (Tang et al., 2010); the composition of the waste creates a major problem. E-waste contains more than 1000 different substances, many of which are toxic metals and organic pollutants (Robinson, 2009). These include lead and cadmium in circuit boards; lead oxide and cadmium in monitor cathode ray tubes (CRTs); mercury in switches and flat screen monitors; cadmium in computer batteries; polychlorinated biphenyls (PCBs) in older capacitors and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and polyvinyl chloride (PVC) cable insulation that release highly toxic dioxins and furans when burned to retrieve copper from the wires (BAN, 2002). Also, polybrominated diphenyl ethers (PBDEs) are used as brominated flame retardants in electronic circuit boards (Wang et al., 2005). Activities carried out in the site of interest include dismantling of the different electronic waste, sorting out of various parts and burning of wires and other parts to get valuable metals.The complex composition of e-waste may pose a threat to the environment and human health if they are not disposed correctly.
AIM
Assess the implication of the activities on the soil as well as human exposure at the site.
STUDY AREA
The study site was Alaba rago, Alaba international market which lies between latitude 06°27.731'N and longitude 03°11.492'E. Alaba International Market was founded in 1978. Located in Ojo Local Government Area of Lagos State, it is the largest market for used and new electronics and electrical equipments in West Africa.
SAMPLING STRATEGY
Soil samples were collected from the topsoil to the depth of 20cm with the aid of a soil auger and a stainless steel trowel to scoop the samples into the sampling/storage bags and labelled. The labelling was done according to sampling points and depth from which the soil was collected. A distance of 10 metres was measured at intervals in directions of the cardinal points. Also, surface soil samples only were collected randomly at the dismantling section of the site.
METHODS
ANALYTES
PROCESS
INSTRUMENTATION
Total heavy metal content
Acid digestion using microwave extraction
ICP-OES
Speciation of heavy metals
ICP-OES
RESULTS
Elevated levels of various heavy metals were observed.
SPECIATION OF METALS
Speciation fractionates heavy metals in the soil in order of decreasing solubility. F1, the exchangeable fraction is presumably the most mobile and bioavailable.F2,is bound to organic compounds, its mobility is dependent with time, decomposition or oxidation of organic matter. F3, is the residual fraction, the mobility is low and the residual fraction is only available after weathering or soil decomposition(Carapeto & Purchase, 2001)
The figure above indicates the different fractions of the various metals. It shows cadmium as the most bioavailable. Copper, nickel, chromium are more on the residual fraction.
RISK ASSESSMENT
The human risk associated with the heavy metals contaminants are assessed according to EPA (USEPA1989,1992,2011)
Medium
Exposure route
Calculation
Soil
Ingestion
CDI= CS*IRS*EF*ED / BW*AT
Dermal
CDI= CS*SA*AF*ABS*EF*ED / BW*AT
The non-carcinogenic risk from individual heavy metals can be expressed as the hazard quotient: HQ = CDI/RFD
where the non-cancer hazard quotient (HQ) is the ratio of exposure to hazardous substances, and RFD is the chronic reference dose of the toxicant (mg/kg/day)
Cd
Cr
Cu
Pb
Zn
Sb
Ni
Ingestion
180
10
199.25
602.5
4.83
13
2
DISCUSSION
Both exposure routes explored above are of importance for workers at the site. The ingestion is important due to hand to mouth activities either smoking a cigarette or eating while at work. The total chronic hazard index is a summation of all individual hazard quotients. HI values >1 indicates concern as acceptable standards is 1 at which there will be no significant health hazard. The individual metals above all have high hazard quotient, hence an elevated HI. The HI value above indicates high exposure to non-carcinogenic risk to the workers at the e-waste recycling site.
UNCERTAINTY
As shown in fig. 8, the availability of the metals varies considerably which has implications for the modelled data which are based on total metal concentration. However, the results provide a preliminary indication of the existence of an environmental problem.
CONCLUSION
Informal and uncontrolled e-waste recycling has led to heavy metal contamination and this affects human health via different exposure routes. The activities carried out on the site as the results indicate has high health impacts on both the environment and human health.
RECOMMENDATION
Further studies will be carried out exploring the risk assessment on all other exposure routes as well as uptake with regards the bioavailable fraction.
REFERENCES

研討會海報 2



The 23rd SRA-Europe Conference, 16-18 June 2014, Istanbul, Turkey

Covariance Structural Analysis of Psychological Factors Related to Information Needs of Consumers for Food Safety

○Tomohiko HATADA*, Haruko YAMAGUCHI* and Akihiro TOKAI*
* Division of Sustainable Energy and Environmental Engineering, Graduate School of Engineering, Osaka University
Address: 2-1 Yamadaoka, Suita, Osaka 565-0871, Japan. E-mail: hatada@em.see.eng.osaka-u.ac.jp

Introduction

It is important to provide risk information that fills information needs of consumers for effective risk communication. However, few researchers have studied about information needs in the risk research field about food safety.

It is important to build a framework that grasp risk information needs as a first step to identify risk information needs of consumer.

➢ The goal of this study is to identify the causal relationships of psychological variables related to risk information needs of consumers for food safety.

Procedure of this study

1. Developing hypothesis model
2. Questionnaire design and research
3. Covariance Structural Analysis to draw a path diagram by using SPSS AMOS
4. Discussion of the variables which contribute to information needs

Developing hypothesis model

We constructed the hypothesis model based on Griffin et al.(1999), Slovic et al.(1980) and Trumbo (1999)(Fig.1).

<Hypothesis>

- "Information needs" is influenced by benefit perception, affective response, self-efficacy, trust and hazard frequency.
- Affective response ("Dread") is influenced by some hazard characteristics.
- "Information needs" influences on "Risk perception" through "Information processing" (Heuristic or Systematic).

Fig. 1 Hypothetical model of information needs

Questionnaire design and research

We designed questionnaire to measure 17 psychological variables used in the hypothesis model by reference to Slovic et al. (1980), Trumbo (1999).

- **Hazards** : the food contaminated with radiation, food additive, genetically modified food
- **Subjects**: Japanese women
- **Date**: 2013/12~2014/1
- **Number of response**: 121 (Response rate 81%)

*Table 1: Questionnaires

Variables and Questions	Answer format
Knowledge level to make a judgment How much information do you need to decide if you buy food products?	1~5
Information needs Do you have enough knowledge or experience to decide whether to buy food products or not?	1~5
Engagement in risk behavior Do you avoid buying hazardous products?	Yes/No
Trust to information channels Do you trust to the opinion of information providers, such as neighbor or, mass media?	1~5
Needs for statistical or scientific knowledge Do you want statistical or scientific information when you judge whether to buy food products or not ?	1~5
Self-efficacy Do you think you are capable of finding and understanding the information you need to make a decision to buy?	1~5
Information processing When you decide to buy a product, do you want to judge by yourself (Systematic), or follow the opinion of someone you believe (Heuristic)?	1(Heuristic)~5(Systematic)

*Other variables (Slovic et al.,1980).

Covariance Structural Analysis

- The result in Fig. 2 shows significant paths and correlations ($p<0.05$).
- The three numbers represent the path coefficient of each three hazards.

Upper:radiation
Middle:Food additives
Lower:GM

	radiation	food additives	GM
GFI	0.76	0.754	0.723

Fig. 2 The results of Covariance structural analysis

<Evaluating Goodness of Fit Index (GFI)>

- GFI of radiation was the highest value in the three hazards.
- Every GFI of three hazards was less than 0.9. Therefore, the results showed that the fitness of the hypothesis model was not so high.

<Consistent results for three hazards>

- Positive correlations between "Threat to future generation", "The number of exposed population", "Severity of the damage", "Engagement in risk behavior"
- Positive path from "Knowledge level to make a judgment" to "Information needs"

<Inconsistent results for three hazards>

- Positive paths from "Threat to future generation" and "Severity of the damage" to "Dread" (radiation and food additives)
- Positive path from "Self-efficacy" to "Information needs" (radiation)
- Positive path from "Hazard frequency" and "Dread" to "Information needs" (food additives)
- Negative path from "Threat to future generation" to "Personal benefit perception", from "Social benefit perception" to "Information needs" (GM)
- Path from "Personal benefit perception" to "Information needs" (food additives and GM)

Discussion on the variables which contribute to information needs

- It is shown that "Information needs" increases according to "Knowledge level to make a judgment" in risk information needs for food safety.
- "Information needs" can be influenced by consumers' risk literacy, because it is thought that "Knowledge level to make a judgment" is influenced by consumers' risk literacy.
- "Information needs" increases according to "Self-efficacy" in radiation, according to "Personal benefit perception" in food additives. The results suggest that the causal relationship between perceived capacity to dealing with risk information and "information needs" is different from each other.
- As our future works, the deeper psychological part of the relationships among these variables should be analyzed in detail.

References

- Griffin, R.J., Dunwoody,S. and Neuwirth,K (1999) Processing Model of the relationship of risk information seeking and processing to the development of preventive behaviors, *Environmental Research*, Section A 80, S230-S245
- Slovic, P., Fischhoff,B.andLichtenstein,S. (1980) Facts and fears: understanding perceived risk, In Schwing, R.C. and Alberts, W.a.Jr ed."Societal risk assessment –how safe is safe enough?", 181-216
- Trumbo,C.W.(1999) Heuristic-Systematic information processing and risk judgment, *Risk Analysis*, Vol.19 (3), 391-400
- Johnson,B.B. (2005) Testing and expanding a model of cognitive processing of risk information, *Risk Analysis*, Vol.25, No.3, 631-650
- Yamaguchi. H. (2014) Construction of the theoretical foundations of information needs in risk information processing process, *Environmental Information Science* (in press) (Japanese)

研討會海報 3