Self-introduction and Research

RAMS Seminar

Tzioutzios Dimitrios

Department of Mechanical and Industrial Engineering (MTP)

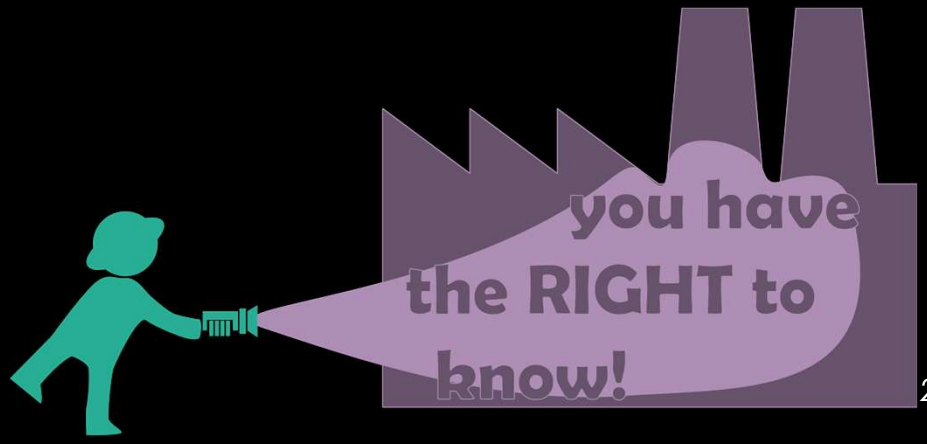
Norwegian University of Science and Technology (NTNU)

17th Nov 2022,
NTNU Trondheim

NTNU

OUTLINE

- *Short Intro*
- *Exploring Natech Risk Communication*
  - *Comparing Citizens' Communicative Behaviour in Japan and Korea*
  - *EGNARIA: Educational Game for Natech Risk Awareness*
- *SUSHy Project – **SUS**tainability and cost-reduction of **Hy**drogen stations through risk-based, multidisciplinary approaches*



MINI SELF-INTRO

Short Intro

- Tzioutzios Dimitrios (Dimi)
- Spatial Planning and Regional Development Engineer
- MEng & PhD (Eng): Urban Management, Human Security Egineering

PREVIOUS RESEARCH

Exploring Natech Risk Communication and Information Disclosure for Participatory Risk Management

Investigating Citizens' Communicative Behaviour Through a Comparative Study and an Educational Game

Supervisor: *Prof. CRUZ Ana Maria*

NTNU

RESEARCH INTRODUCTION

Community Participation

- ***Community engagement*** in disaster risk management (DRM) is essential for ***effective disaster risk reduction*** *(Samaddar et al., 2017; Pandey & Okazaki, 2005)*
- ***Communities*** are often ***not actively involved*** in risk reduction *(Samaddar et al., 2017)*
- ***'Open'*** the risk-related ***decision-making*** processes to the ***public***

Risk Communication and Information Disclosure

- ***Transparency*** and ***information dissemination*** throughout the risk reduction processes *(Figueroa, 2013; Fekete, 2012; Burby et al., 2003)*
- Shift away from ***top-down***, ***structured*** and purely ***scientific*** DRM to ***engagement***, ***emotion***, ***peer-to-peer*** relationships, ***horizontal communication***, and ***cooperation*** recognising participatory approaches, e.g. ***gaming*** *(Solinska-Nowak et al., 2018; Yamori, 2009; 2008)*

RESEARCH QUESTIONS

- ***Natech risk communication*** recently started to be explored *(e.g., Yu et al., 2017; Tzioutzios & Cruz, 2021; Tzioutzios et al., 2022)*
  - ***Na****tural-Hazard-Triggered* ***Tech****nological Accident –* ***Natech*** *(WHO, 2020)*

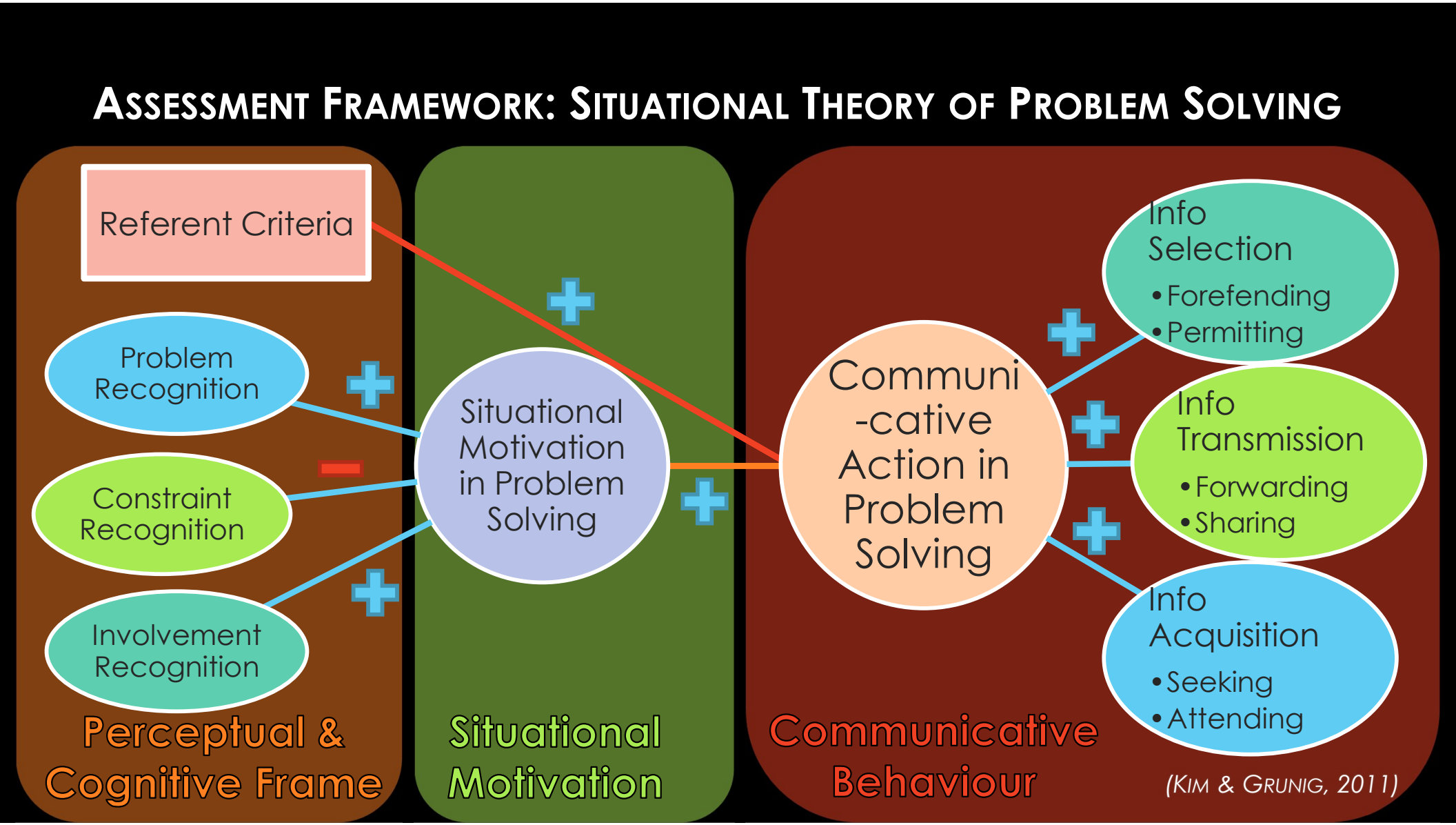
What are the ***effects*** of ***chemical risk information disclosure legislation*** on ***citizens' communicative behaviour*** concerning ***Natech risk***?

Could serious gaming be applied to ***raise Natech risk awareness*** and ***stimulate stakeholder engagement*** in disaster risk management?

Research Objectives

- Examine the ***differences*** in ***communicative behaviour*** concerning Natech risk ***information disclosure*** between ***Japanese*** and ***Koreans***
- Develop a novel, ***serious game*** with emphasis on ***information disclosure for Natech preparedness*** to ***involve communities*** in Natech DRM

Assessment Framework: Situational Theory of Problem Solving



Study Area, Data and Methods

Comparative Study - Why S. Korea?

- Relative ***similarities in organisational culture*** between Japan and S. Korea *(see e.g. House, 2004; Hofstede, 2010)*
- S. Korea has ***established chemical risk information disclosure regulation***, i.e. Chemical Controls Act *(amend. 2017)*, while ***Japan still has not***

Survey

- ***Households*** near ***industrial complexes***
- Osaka and Kobe in ***Japan*** – 328 responses (mail survey / 12,5% response rate)
- Yeosu, Suncheon, Gwangyang and Ulsan in ***S. Korea*** – 300 responses (online panel survey)

Analysis

- ***Inferential statistics*** – Independent Samples t-Tests
- ***Public segmentation*** – Summation method

Sample Profile	Japan	Korea
Gender Ratio	138,52	105,48
Median Age Group	60 – 74	40 – 49
Median Educ. Level	Bachelor Degree	Bachelor Degree

NATECH AND INFO DEFICIENCY PERCEPTIONS – JAPAN VS S. KOREA

Aspect	Jap.	Korea	t-Test
Natech Accident			
Perceived Severity	5.92	5.71	.009
Perceived Likelihood	5.70	5.82	.161
Response	2.75	4.00	.000
Lack of Chemical Risk Info – Situational Elements			
Problem	5.89	5.74	.053
Involvement	5.21	5.31	.294
Perceived Barriers (R)	4.67	4.12	.000
Ideas for Solution	3.37	4.12	.000
Curiosity/Motivation	4.43	4.69	.005
	N= 317	*N= 300*	

'I am concerned about natural disasters causing potential chemical accidents at the nearby industrial park'

'I know how to respond during a chemical accident…'

'I believe I can improve the situation regarding this problem'

'I have a clear idea about how to deal with this problem'

'I am curious about this problem'

Note: Disagree / Agree
Scale: Strongly Disagree (1) → Strongly Agree (7)

COMMUNICATIVE BEHAVIOUR – JAPAN VS S. KOREA

Aspect	Jap.	Korea	t-Test
Lack of Chemical Risk Info – Communicative Action			
Info Selecting	2.66	3.60	.000
Info Permitting	4.83	4.58	.005
Info Forwarding	3.72	4.31	.000
Info Sharing	4.02	4.56	.000
Info Seeking	3.29	3.89	.000
Info Attending	4.92	4.87	.560
Trust and Decision Power			
Institutional Trust	3.41	4.22	.000
Decision-making Mutuality	3.16	3.82	.000
	N= 317	*N= 300*	

"I have invested a lot of time and energy learning about this problem"

"I listen even to opposite views regarding this problem"

"I believe this organisation can be relied upon…"

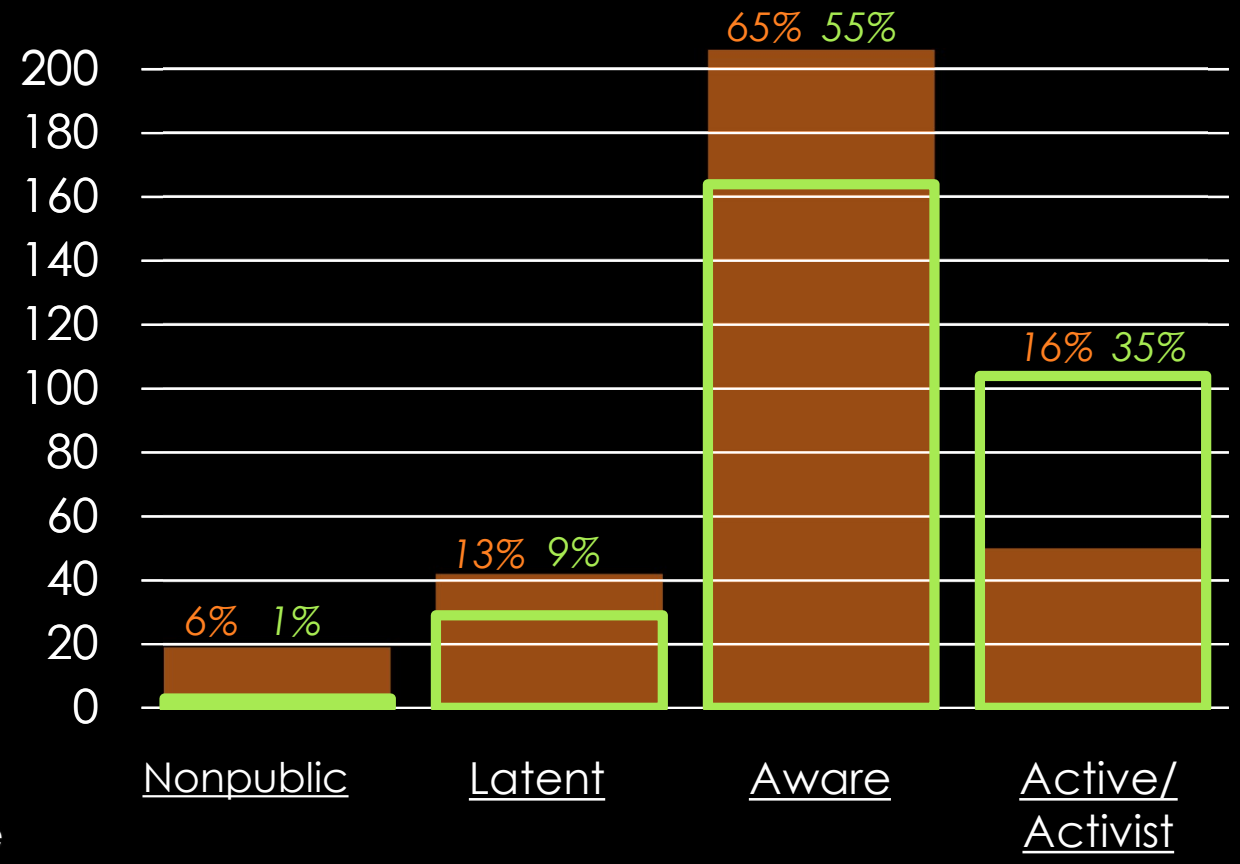
"The management of this organisation allows [citizens] to participate enough in decisions"

Note: Disagree / Agree
Scale: Strongly Disagree (1) → Strongly Agree (7)

PUBLIC SEGMENTATION – JAPAN VS S. KOREA

- ***Recoding*** *Problem, Involvement* and *Constraint Recognition* into ***High*** = 1 and ***Low*** = 0
- ***Summation method*** to categorise into publics

- ***Strong public 'appetite'*** for chemical and Natech risk information (>80% in both)
  - ***Elevated concern*** about risk information deficiency and ***high motivation*** to resolve it
  - ***Larger active/activist public*** in Korean sample



Japan | *N= 317*

S. Korea | *N= 300*

SERIOUS GAMING APPROACH FOR RISK COMMUNICATION*

- *'[…]may be played seriously or casually, [but]… **are not intended to be played primarily for amusement**' (Abt, 1970)*

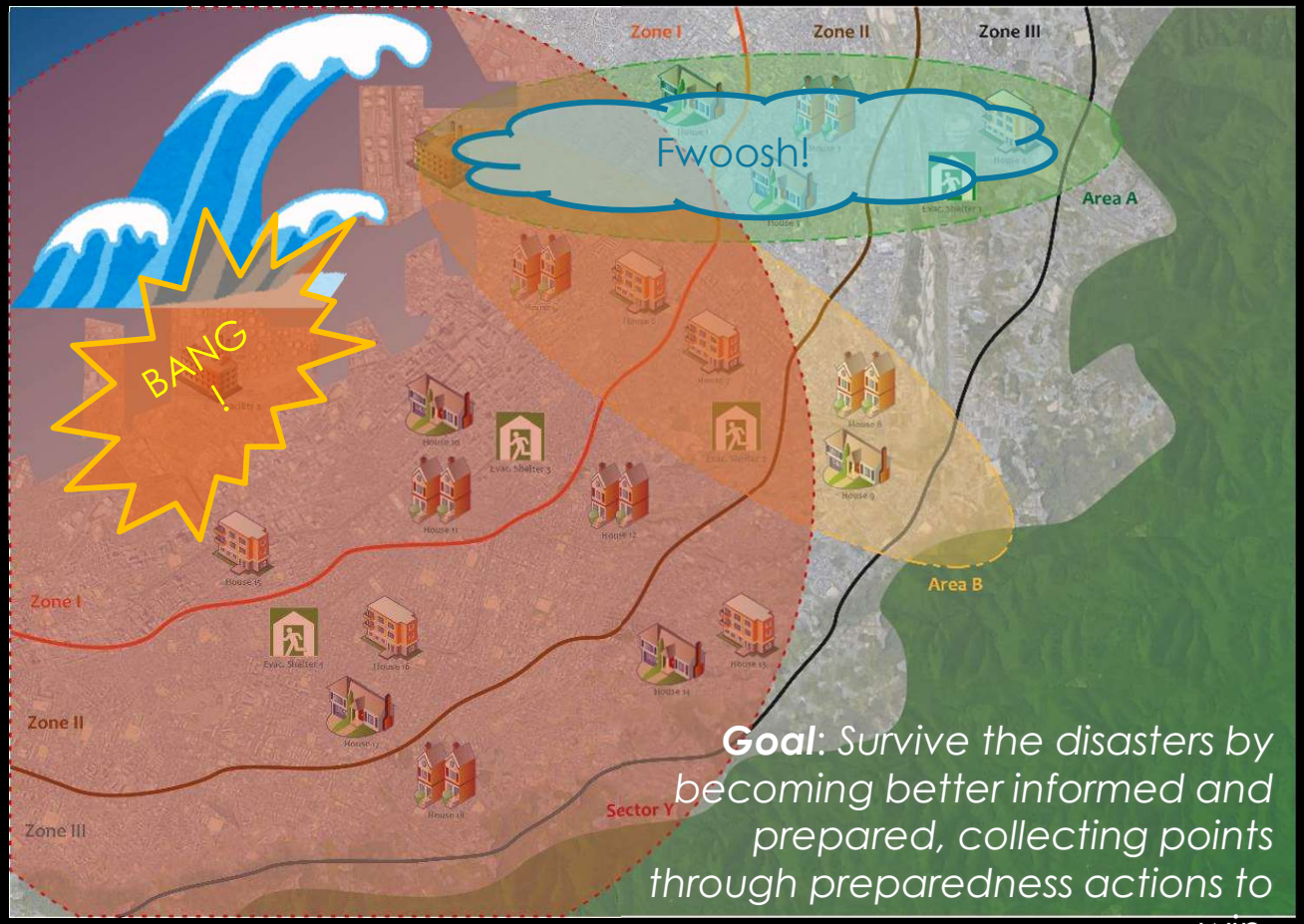
- ***Complex issues*** (e.g. Natech) pose additional challenges to risk communication and trust-building demanding ***inclusive decision-making*** *(Mechler, 2016)*

Mutual Learning and Collaborative Decision-making

- ***Face-to-face***, ***role-playing*** game → Opportunity for '***multilogue***' *(Duke, 1974)* and ***multi-stakeholder deliberation***
- Experiential, ***procedural learning*** → Tackle (simplified) ***realistic game problems*** and reflect on ***real-life mechanisms*** *(Bogost, 2008)*
- Deal with ***incomplete information*** → Collaboration

*(SEE SOLINSKA-NOWAK ET AL., 2018; MOSSOUX ET AL., 2016; PEREIRA ET AL., 2015; YAMORI, 2008)

EGNARIA – EDUCATIONAL GAME FOR NATECH



Goal: *Survive the disasters by becoming better informed and prepared, collecting points through preparedness actions to win.*

Emergency Action Card

Shelter-in-Place

When you receive an early warning about an earthquake or tsunami, take shelter in your house

Emergency Action Card

Evacuate to Shelter

When you receive an early warning about an earthquake or tsunami, choose an available evacuation shelter on the board

Preparedness Action Card

Community Disaster Drill

Cost (per turn): 100₹

Benefit: 1 Player (per turn), 30% loss reduction; 2 Players, 40% loss reduction; 3 or more Players, 50% loss reduction
+1 Preparedness Point per use

Preparedness Action Card

House Reinforcement Against EQ

Cost: 50% of House Price
Can be used only once

Benefit: -60% loss reduction from earthquake
+3 Preparedness Points

Game Application with Kyoto Uni Affiliates

Quasi-experimental Research Design

- Pre- and Post-game questionnaire

Friday, 5th November 2021	
12:30-12:45	Introduction
12:45-14:30	Game Session
19:00-19:30	Short discussion

Sample Profile

- 9 participants (6 female)
- Educated (Bachelor-PhD)
- Relatively young (20-49)
- And mostly single (3 married)
- Multi-ethnic (China, Taiwan, Myanmar, Germany, Japan, Indonesia, Kenya, Fiji)

PLAYERS' IMPRESSIONS – DISASTER EDUCATION

Low Chemical Accident Risk Awareness Initially

- Improved players' ***spatial awareness*** for ***chemical accidents***
  - *'I think this game [gave me a kind of] "**enlightenment**" to chemical hazards'*

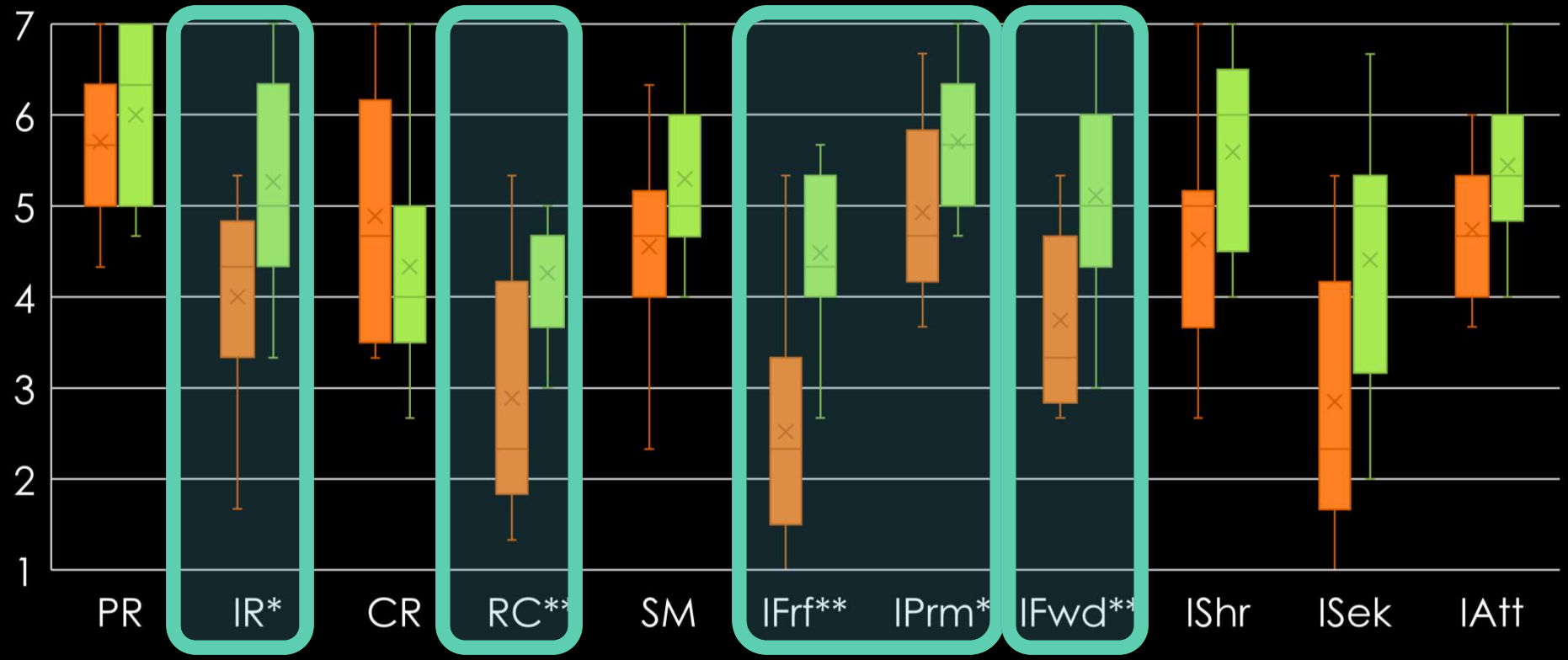
Access to Chemical Risk Information

- Completely ***changed discussions*** among players → Noted initial deficiency for housing location options
- Facilitated players' decision-making about ***preparedness actions individually*** and as a ***community***
  - *'If we knew what kind of **chemical** was going to be released, we were able to **better prepare** for it according to the **location** of the industry'*
- Information-sharing is crucial, such as Natech ***risk assessment maps***

'Communicative Space' for Communities *(see Okada, 2021)*

- ***Implement EGNARIA*** to raise Natech risk awareness and ***generate discussion*** about DRM practices → ***Collaborative decision-making*** among stakeholders

Changes in Communicative Behaviour



Pre-game ***Post-game***

Scale: Strongly Disagree (1) → Strongly Agree (7)
*t-Test: * significant at p< .05, ** significant at p< .01*

N=9

KEY RESEARCH FINDINGS

- Both ***Japanese and Koreans*** perceive Natech risk info deficiency as a ***significant problem*** that are ***motivated to communicate*** about – Perceived Natech risk is ***severe in both cases***
  - ***Japanese*** seem ***more constrained in dealing*** with this deficiency problem
- ***Korean*** respondents seem ***more communicatively active*** concerning this issue
  - ***Institutional trust*** and ***decision-making power*** were comparatively elevated in S. Korea as well
  - Perhaps the ***chemical risk info regulation framework*** has contributed positively, considering ***perceived efficacy*** to respond to potential Natech accidents and ***expectations***

Game Evaluation

- Survey results suggested an overall positive impact in ***raising awareness*** about Natech accidents and ***increasing communicative activeness***
- Generally ***positively received*** by participants as an ***educational tool***
  - ***Motivated*** players to ***learn more*** and ***discuss*** about chemical and Natech accidents

Contribution, Limitations and Outlook

Contribution

- Provided ***empirical evidence*** to pursue and promote chemical and ***Natech risk information disclosure***
- Developed a ***gaming approach*** for ***Natech risk communication***

Study Limitations

- ***Cultural values*** not assessed in this study
- Result ***generalisation difficult*** – Sampling shortcomings at country level / limited participation in game trial workshop

Future Research

- Conduct further trial ***applications*** of the ***serious game*** to better understand its ***impact*** on communities
- Expand the game with ***different versions*** for ***various settings*** (e.g. chemical substances, geographic areas, translation)

CURRENT RESEARCH

SUSHy Project – **SUS**tainability and cost-reduction of **Hy**drogen stations through risk-based, multidisciplinary approaches

EIG CONCERT JAPAN

Connecting and Coordinating European Research and Technology Development with Japan

Norwegian University of Science and Technology

NTNU

SUSHy Project: what?

- ***European-Japanese*** research project for the advancement of ***sustainable hydrogen technologies***
- Launched in the ***spring of 2022***
- ***3-year*** research project

NTNU
Norwegian University of Science and Technology

名古屋大学
Nagoya University

Silesian University of Technology

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

Ciemat
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

NİĞDE ÖMER HALİSDEMİR UNIVERSITY

SUSHy Project: why?

Enhancing the efficiency, reliability and cost-effectiveness of hydrogen technologies

- Developing an ***interdisciplinary, integrated and risk-based approach to improve safety, promote public acceptance and ensure economic viability*** concerning the operation of hydrogen production and fuelling stations
- System modelling and analysis of ***hybrid renewable-energy-powered hydrogen production and fuelling facilities***, considering aspects of
  - ***accident risk reduction***
  - ***occupational safety*** and
  - ***process management*** and optimization
  - through the lens of sustainability

SUSHy Project: how?

- **WP1: What are the risks**
  - To understand risks around HREP hydrogen stations
- **WP2: Operational and organisational safety**
  - To prevent accidents and reduce risk through operational means
- **WP3: Emergency safety**
  - To mitigate risks through technical means
- **WP4: Community perception and preparedness**
  - To reduce societal risk and address community concerns
- **WP5: Economic viability**
  - To reduce financial risks

TZIOUTZIOS DIMITRIOS, PHD

POSTDOCTORAL FELLOW

DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING (MTP)

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (NTNU)

*SUSHY PROJECT (**sushyproject.com**)*

*E-MAIL: **dimitrios.tzioutzios@ntnu.no***

THANK YOU

ありがとう ございました

Tusen takk

REFERENCES

- Bogost, I. (2008). The Rhetoric of Video Games, in: Salen, K. (Ed.), *The Ecology of Games: Connecting Youth, Games, and Learning*, (pp. 117–139). The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge, MA: The MIT Press.
- Burby, R.J., Steinberg, L.J., Basolo, V., (2003). The Tenure Trap: The Vulnerability of Renters to Joint Natural and Technological Disasters. Urban Aff. Rev. 39, 32–58. https://doi.org/10.1177/1078087403253053
- Duke, R. D. (1974). *Gaming: The Future's Language,*. Beverly Hills, Calif.: Sage Publications; [distributed by] Halsted Press, New York.
- Fekete, A. (2012). Spatial Disaster Vulnerability and Risk Assessments: Challenges in Their Quality and Acceptance. *Natural Hazards*, 61(3), 1161–1178.
- Figueroa, P. M. (2013). Risk Communication Surrounding the Fukushima Nuclear Disaster: An Anthropological Approach. *Asia Europe Journal*, 11(1), 53–64.
- Grunig, J.E., Grunig, L.A., (2001). Guidelines for Formative and Evaluative Research in Public Affairs, A Report for the Department of Energy Office of Science. Department of Communication University of Maryland College Park, MD 20742, Maryland, USA.
- Grunig, J. E. (1997). A Situational Theory of Publics: Conceptual History, Recent Challenges and New Research, in: Grunig, J. E. (Ed.), *Public relations research: an international perspective*, (pp. 3–47). London: International Thomson Business Press.
- Hofstede, G. H. (2001). *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations*. Thousand Oaks, CA: SAGE.
- House, R. J. & Global Leadership and Organizational Behavior Effectiveness Research Program. (2004). *Culture, Leadership, and Organizations: The GLOBE Study of 62 Societies*. Thousand Oaks, Calif.: Sage Publications.
- Huang, Y.-H., (2001). OPRA: A Cross-Cultural, Multiple-Item Scale for Measuring Organization-Public Relationships. J. Public Relat. Res. 13, 61–90. https://doi.org/10.1207/S1532754XJPRR1301_4
- Kim, J.-N., Jung, Y. R., Park, S. C. & Dutta, M. (2009). Gossiping Science: Lay Diffusers of Science Knowledge and Information, in: *Chicago, IL: Applied Communication Division, National Communication Association*.

REFERENCES

- Kim, J.-N., Ni, L., Kim, S.-H. & Kim, J. R. (2012). What Makes People Hot? Applying the Situational Theory of Problem Solving to Hot-Issue Publics. *Journal of Public Relations Research*, 24(2), 144–164.
- Kim, J.-N., Grunig, J.E., (2011). Problem Solving and Communicative Action: A Situational Theory of Problem Solving. J. Commun. 61, 120–149. https://doi.org/10.1111/j.1460-2466.2010.01529.x
- Mechler, R. (2016). Reviewing Estimates of the Economic Efficiency of Disaster Risk Management: Opportunities and Limitations of Using Risk-Based Cost–Benefit Analysis. *Natural Hazards*, 81(3), 2121–2147.
- Mossoux, S., Delcamp, A., Poppe, S., Michellier, C., Canters, F. & Kervyn, M. (2015). HAZAGORA: Will You Survive the next Disaster? – A Serious Game to Raise Awareness about Geohazards and Disaster Risk Reduction. *Natural Hazards and Earth System Sciences Discussions*, 3, 5209–5245.
- Pandey, B., Okazaki, K., (2005). Community Based Disaster Management: Empowering Communities to Cope with Disaster Risks. Reg. Dev. Dialogue 26, 52–57.
- Pereira, G., Prada, R. & Paiva, A. (2015). Disaster Prevention Social Awareness: The Stop Disasters! Case Study. *2014 6th International Conference on Games and Virtual Worlds for Serious Applications, VS-GAMES 2014*.
- Samaddar, S., Okada, N., Choi, J. & Tatano, H. (2017). What Constitutes Successful Participatory Disaster Risk Management? Insights from Post-Earthquake Reconstruction Work in Rural Gujarat, India. *Natural Hazards*, 85(1), 111–138.
- Solinska-Nowak, A., Magnuszewski, P., Curl, M., French, A., Keating, A., Mochizuki, J., Liu, W., Mechler, R., Kulakowska, M. & Jarzabek, L. (2018). An Overview of Serious Games for Disaster Risk Management – Prospects and Limitations for Informing Actions to Arrest Increasing Risk. *International Journal of Disaster Risk Reduction*, 31, 1013–1029.
- Sund, B., Svensson, M. & Andersson, H. (2017). Demographic Determinants of Incident Experience and Risk Perception: Do High-Risk Groups Accurately Perceive Themselves as High-Risk? *Journal of Risk Research*, 20(1), 99–117.
- Yamori, K. (2009). Action Research on Disaster Reduction Education: Building a “Community of Practice” through a Gaming Approach. *Journal of Natural Disaster Science*, 30(2), 83–96.
- Yamori, K. (2008). Narrative Mode of Thought in Disaster Damage Reduction: A Crossroad for Narrative and Gaming Approaches, in: Sugiman, T., Gergen, K. J., Wagner, W., and Yamada, Y. (Eds.), *Meaning in Action: Constructions, Narratives, and Representations*, (pp. 241–252). Tokyo: Springer Japan. Retrieved November 23, 2020, from https://doi.org/10.1007/978-4-431-74680-5_14