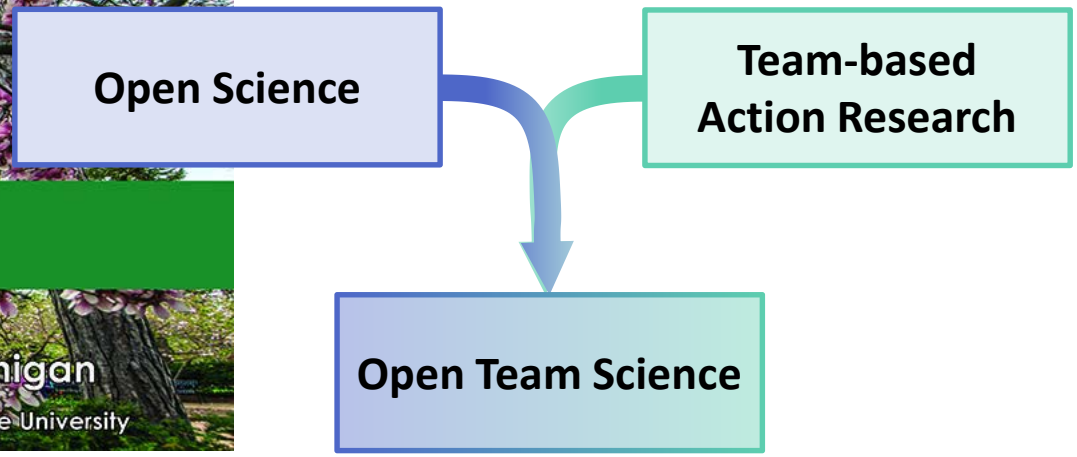

Interlinking Open Science to Team-based Action Research

for Socio-environmental Cases

Yasuhisa Kondo*, Akihiro Miyata, Ui Ikeuchi, Satoe Nakahara, Ken'ichiro Nakashima, Hideyuki Onishi, Takeshi Osawa, Kazuhiko Ota, Kenichi Sato, Ken Ushijima, Bianca Vienni Baptista, Terukazu Kumazawa, Kazuhiro Hayashi, Yasuhiro Murayama, Noboru Okuda, Hisae Nakanishi

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Inter-University Research Institute Corporation
National Institutes for the Humanities
Research Institute for Humanity and Nature

Open Team Science

Making Open Science a Reality

OECD Report, October 2015

doi: 10.1787/5jrs2f963zs1-en

"**Open science** commonly refers to efforts to make the output of **publicly funded research** more widely accessible in digital format to the scientific community, the business sector, or society more generally." (p.9)

Open Science has became a Paradigm

Global Research Infrastructure

16. We affirm the principle that efforts should be directed to promote a widespread participation of researchers in the network of global research infrastructures, taking account of the opportunities offered by **open science paradigms**.

— G7 Science Ministers' Communiqué (September 28, 2017)

In the Era of Open Science…

Scientific research will be

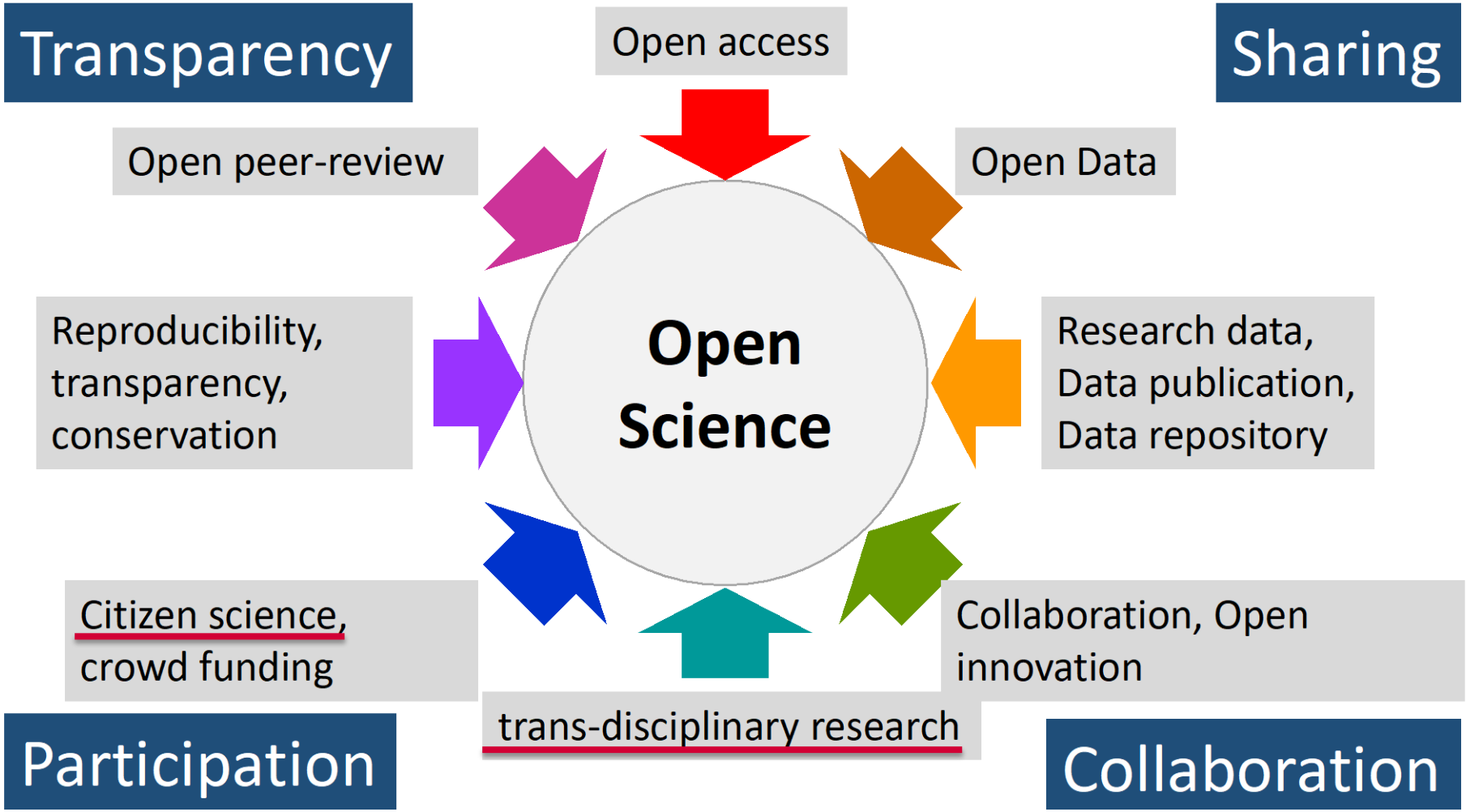
Open by Default.

Open data and content can be **freely used, modified, and shared** by **anyone** for **any purpose**.

—— http://opendefinition.org

Open Science Paradigms

↓Top-down Open Science Knowledge Policies



↑Bottom-up Engagement Approaches

(Adapted from Kitamoto 2017)

Knowledge Integration in Team Science

The US National Research Council defined Team Science as **scientific collaboration conducted by more than one individual in an interdependent fashion.** (Cooke & Hilton eds. 2015)

(Adapted from Rosenfield 1992; Falk-Krzesinski 2014)

Smoothie = Transdisciplinary (TD)

Researchers from *different disciplines work jointly* to develop and use a shared conceptual framework that synthesizes and extends discipline-specific theories, concepts, and methods, to create *new approaches* to address a common problem

Plate =

Multidisciplinary (MD)

Researchers from *different disciplines work sequentially,* each from their own discipline-specific perspective, with a goal of eventually combining results to address a common problem

Across

Disciplines

Within

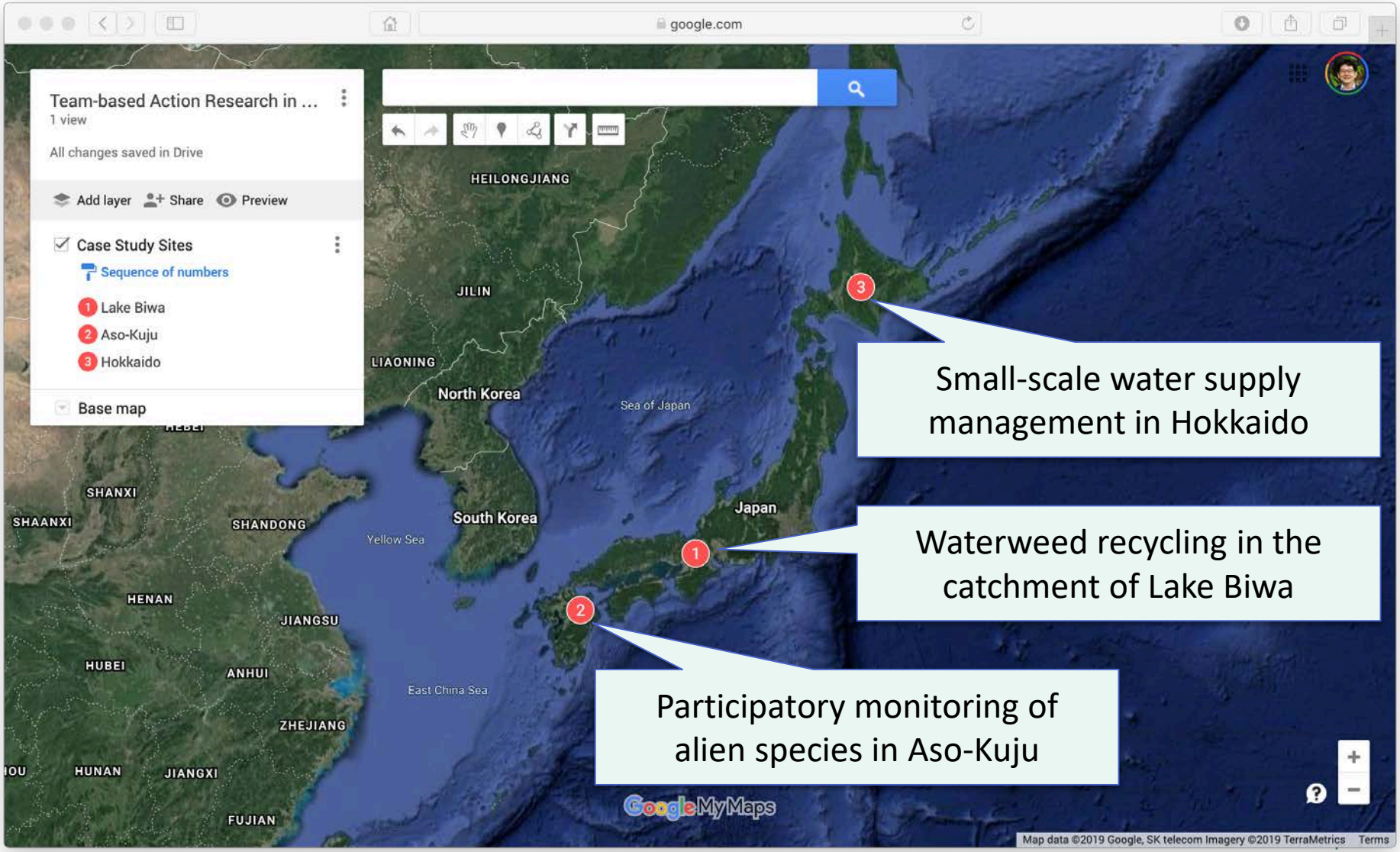
Interdisciplinary (ID) **= Salad**

Researchers from *different disciplines work jointly* to address a common problem. Some integration of perspectives occurs, but contributions remain anchored in their own disciplines.

Unidisciplinary (UD) **= Apple**

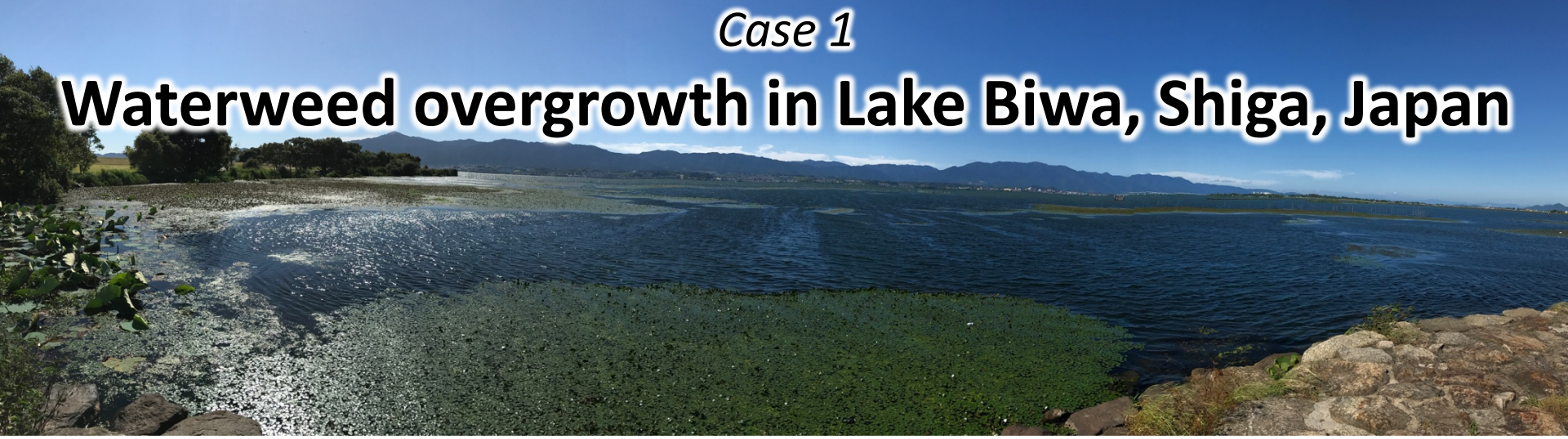
Researchers from a *single discipline* work together to address a common problem

Three Case Studies in Japan

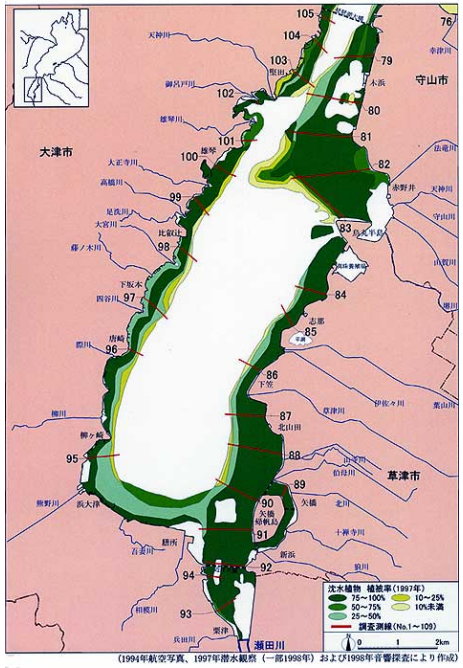


Case 1

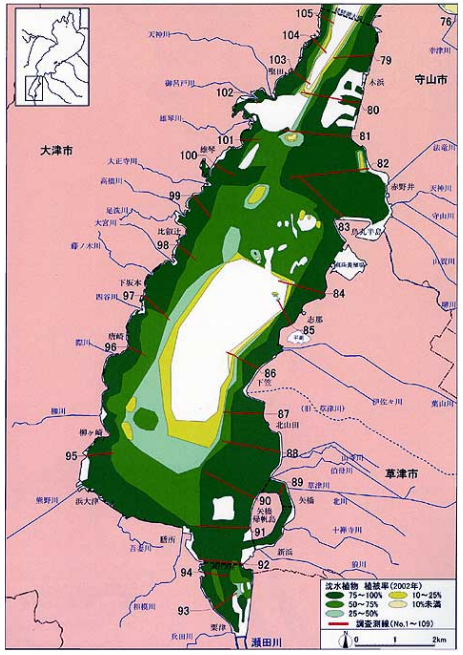
Waterweed overgrowth in Lake Biwa, Shiga, Japan



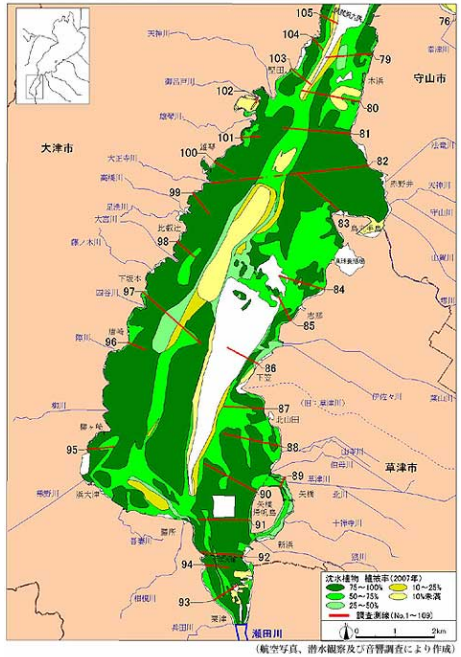
1997



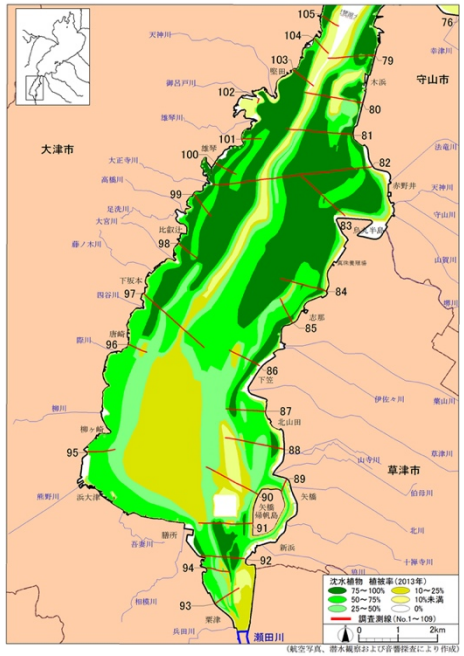
2002



2007



2013



Maps: https://www.water.go.jp/kansai/biwako/html/report/report_03_2.html

Funding: Mitsui & Co. Environmental Fund (2017–19)

Perceptual Boundaries among Actors

Waterweed issue is differently understood in different socio-geographical contexts

Mother Lake 滋賀県 Shiga Prefecture

Cost: 600M yen/year

Courtesy Shiga Pref. Lake Biwa Policy Div.

Courtesy Eiji Yamada

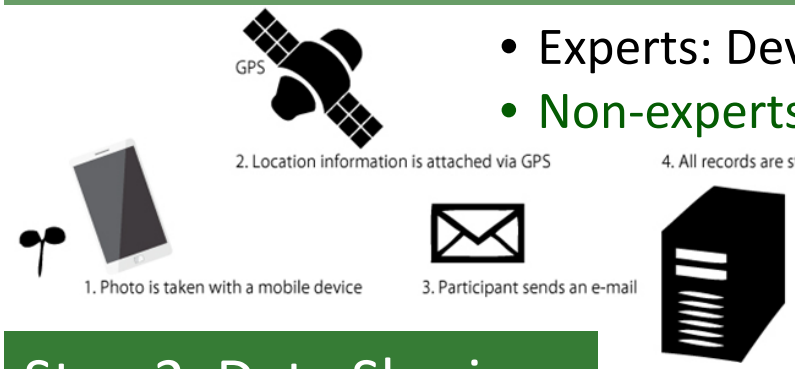
Major actors

Actor	Research experts & Prefectural office	Coastal residents & Municipality office	Fishermen	Student volunteers union	Unengaged public in urbanized areas	Village farmers before 1960s
Water weed is a…	**Ecological issue**	**Social issue** (Bad odor & rubbish)	Way to make a living in dual meaning	Event for Fun or social goodness	Of less interest, but loving Lake Biwa*	Compost, highly demanded resource

* Validated by a postal questionnaire (N=4578, Matsushita et al. 2018)

Case 2. Participatory monitoring of alien species in Aso-Kuju

Step 1. Data Collection



- Experts: Develop a Web-based system
- Non-experts: Collect distribution data

Rudbeckia laciniata L.
(Alien Invasive Plant)

Step 2. Data Sharing

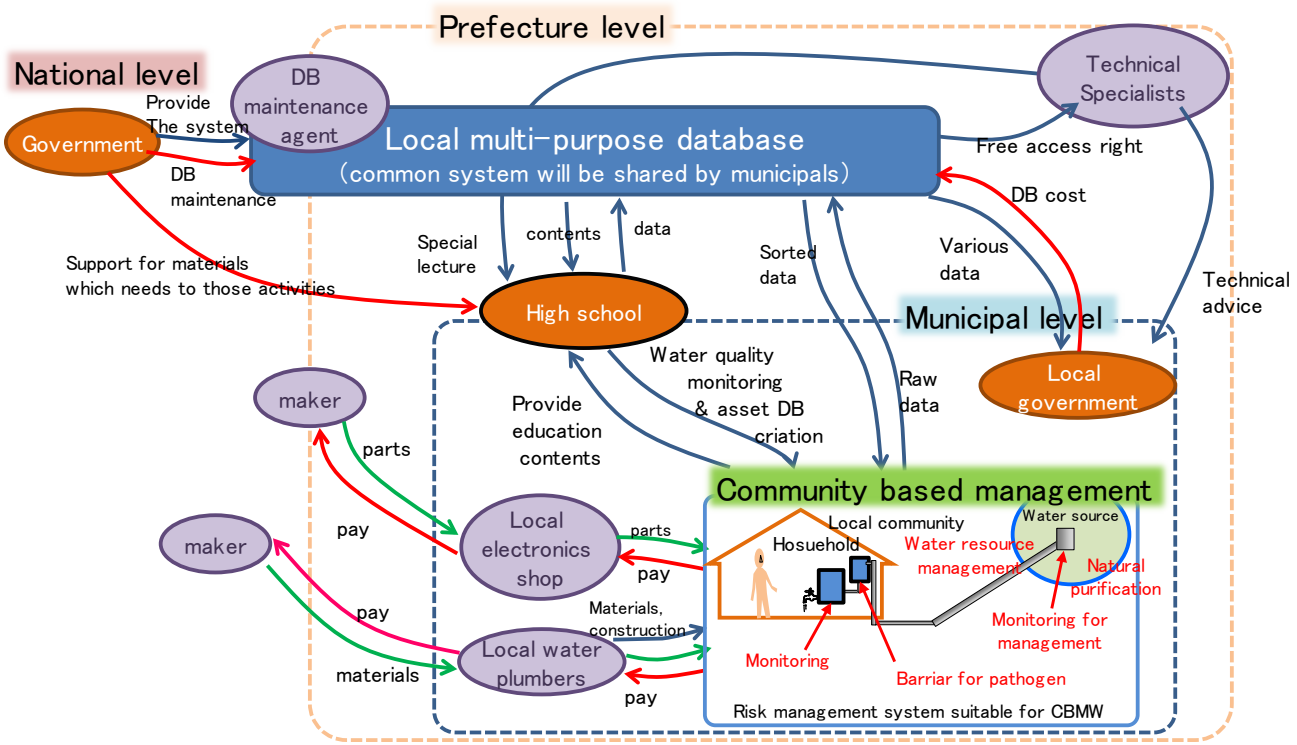
- Experts: Launch web site for visualization and sharing
- Non-experts: Data-based outreach (e.g. flyer)

Expert ecologists and non-experts contributed equally, beyond a research-implementation gap.

Step 3. Implementation

- Experts: Publish a management plan
- Non-experts: Advices to the governmental strategy

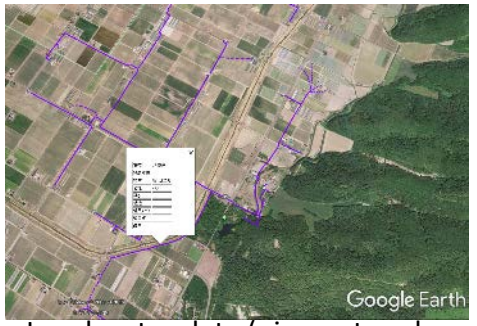
Case 3. Management of Small-scale Water Supply in Hokkaido



Proposed supporting network for the Community-based managed water supply (CBMW)

Data co-creation by various actor including high school students

Feedback meeting with local water managers



Local water data (pipe network GIS) shared by various actors

- CBMW have been succeeded on the bases of their agriculture related skills, machines, community bound and network
- The weak points are (a) lack of barrier to reduce health risk, (b) lack of sufficient asset information such as pipe network map.
- In order to overcome those weak points, the SIP project composed supporting network for CBMW.
- Although open data policy is difficult to apply for water safety issue, data sharing with wide variety of actors in limited scale worked effectively.

Observation & Research Question

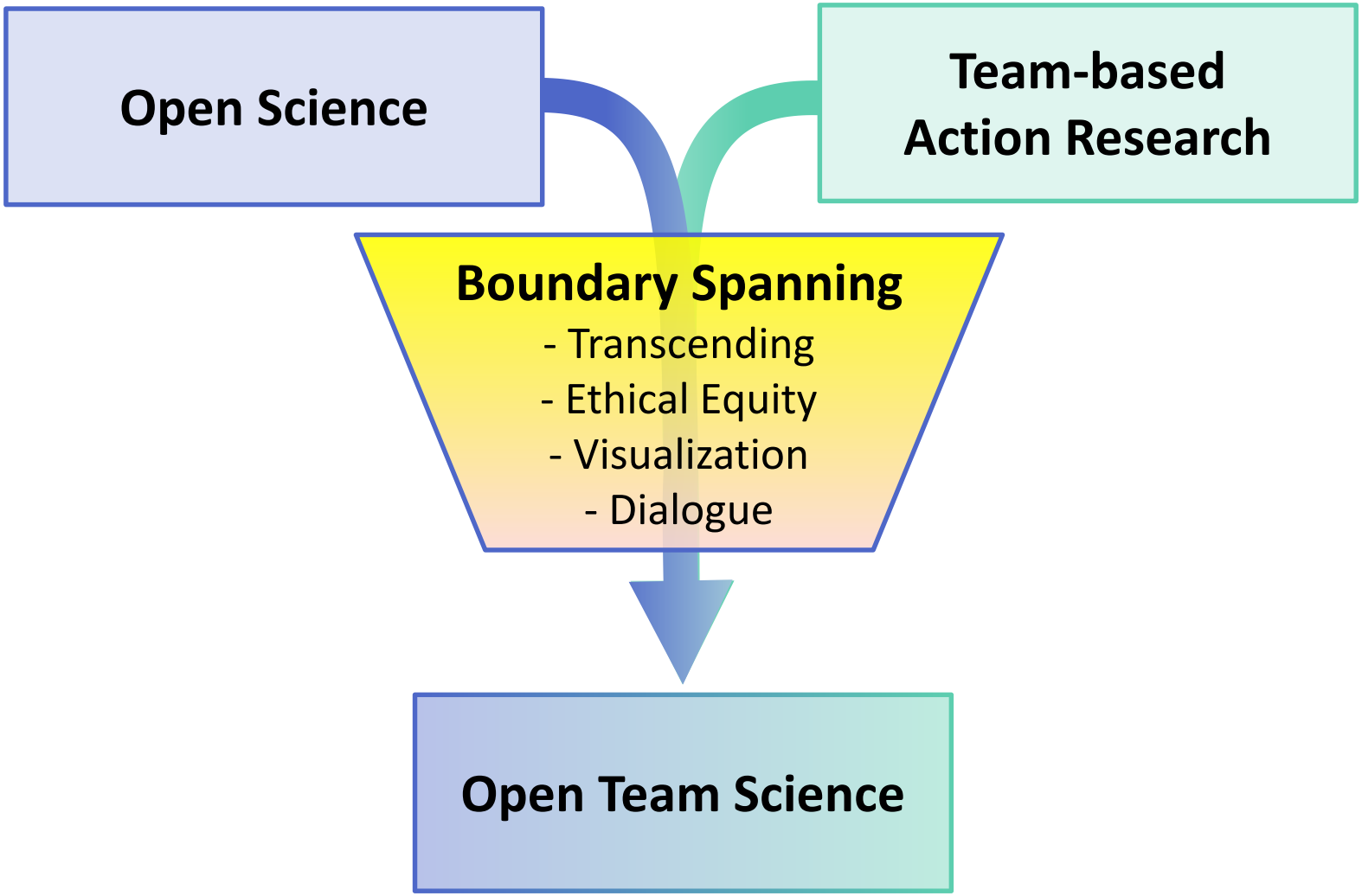
Team-based action research is often disrupted by **socio-psychological boundaries**, generated by asymmetric information, knowledge, value, socio-economic status, and power among actors.

→ How can we span such a boundary?

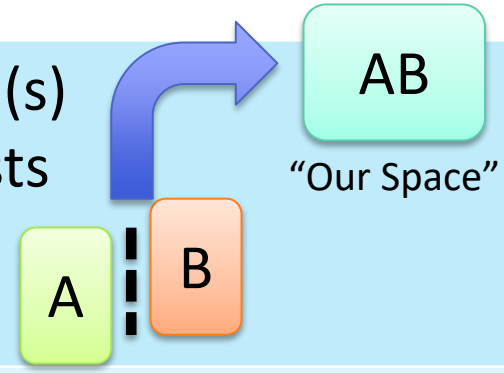
Our Suggestion

Interlinking Open Science and Team-based Action Research

towards a new research paradigm of Open Team Science



Concepts and Approaches for Boundary Spanning

Concepts	**Transcending**	Discovering and sharing the goal(s) that actors with different interests can pursue together. • Multipaths are allowed 
	Ethical Equity	• Be **inclusive** (anyone can join, anyone can leave) • Encourage participation and **empowerment** of marginalized (or "small voice") actors • Eliminate socio-economic inequity
Approaches	**Visualization**	Visualizing and sharing discourses and data • e.g. **Graphic facilitation** in workshops
	Dialogue	Mutual conversation to understand other views, not like a discussion or argument for (dis-)agreement • e.g. Questioning workshop, GAME JAM

Civic Tech for a Holistic Approach

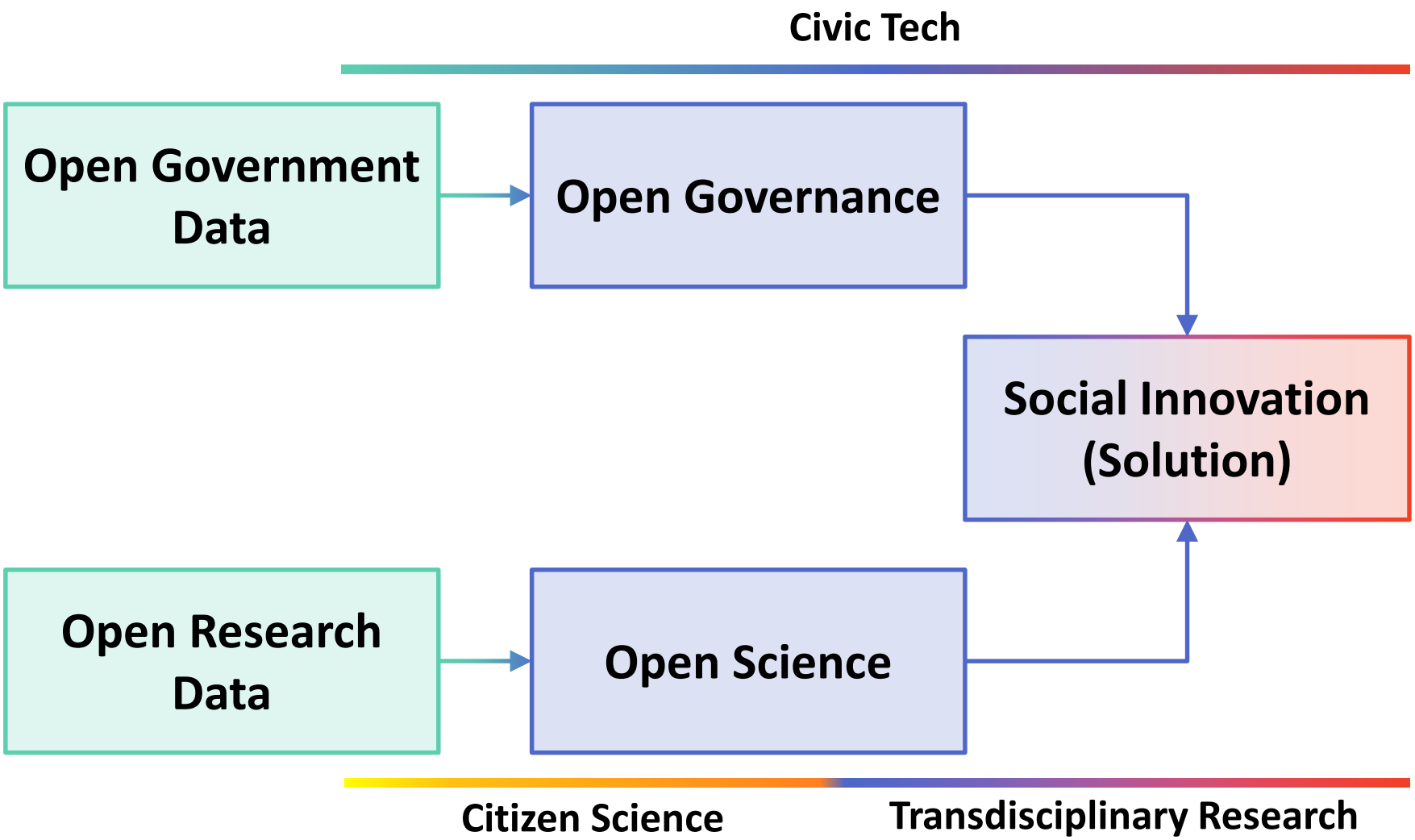
Graphic Recording & Facilitation

A participatory co-production of solution for local issues by self-motivated civic engineers using information and communication technologies and open data

Range Capability of Civic Tech

Process of Research	Current Transdisciplinary Theory (Mauser et al. 2013)	Open Science	Civic Tech
1. Problem identification	Co-design of research agenda	---	✔
2. Approach selection	--- (Experts decide)	--- (Experts decide)	✔
3. Problem solution	Co-production of knowledge	Civic participation	✔
4. Publication	Co-dissemination of results	Open Access Open Data	✔

Two Pathways of Open Data to Social Innovation



The Open Team Science Methodology

applied to the case of waterweed recycling in Lake Biwa

Open Science | **Transdisciplinarity**

Open Team Science = **Open Scientific Knowledge Production** + **Boundary Spanning**

Waterweed overgrowth [Real world problem]

Questionnaire Survey [The FAIR Data Principle]

Research experts, civic engineers, and local residents work together

Local Workshop [Civic Tech]

to create an electronic gift system to acknowledge voluntary labor

Knowledge Production

Input → Output → Outcome

Action

Transformation of waterweed value **[Living space extension]**

Resource

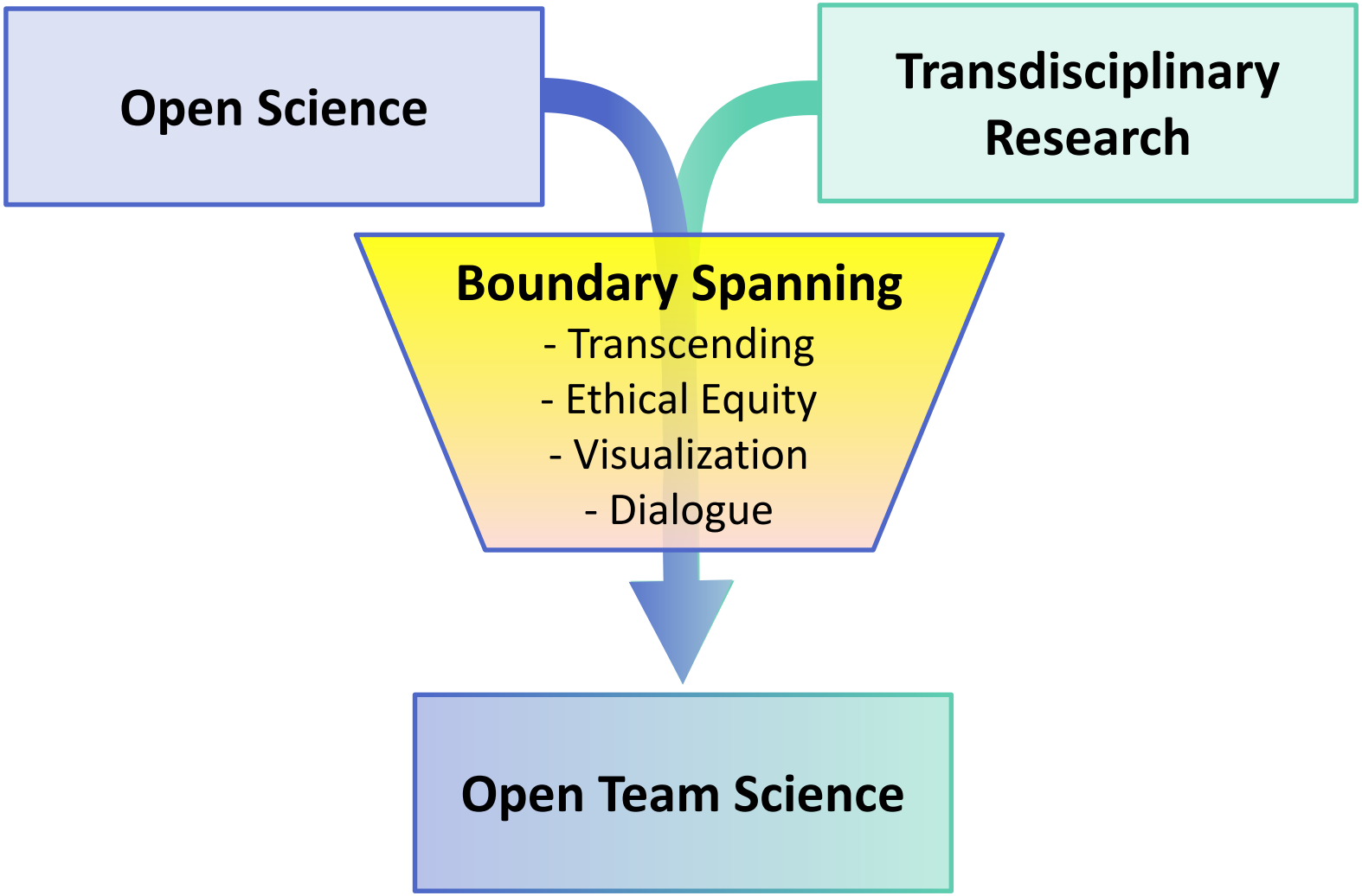
Networking = KAN

Feedback

Conclusion and Future Direction

Interlinking Open Science and TD Theories

towards a new research paradigm of Open Team Science

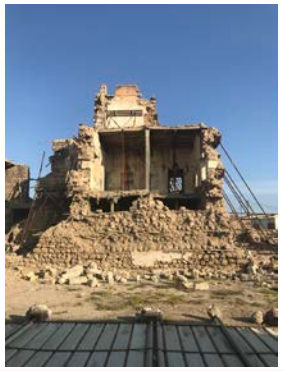


Supplementary slides

RIHN Open Team Science Project

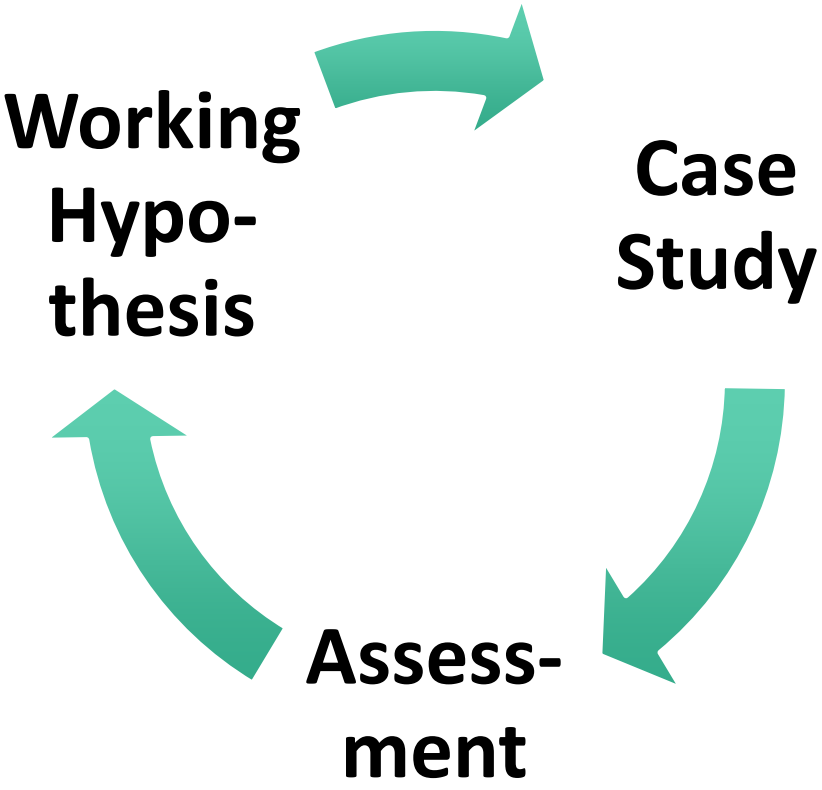
https://openteamscience.jp/en/

Case 4. Community-based Built Heritage Management in Salalah, Oman

Problems	Vernacular buildings are decaying rapidly		
Causes	• **Economic**: Old settlements were abandoned in the 1970s in the course of national modernization ("renaissance"). • **Social**: Omanis feel comfortable in living together with family & neighbors. • **Cultural**: Discontinuous reuse by low income expats • **Natural**: Coastal settlement at high risk of cyclone floods and tsunamis		
Actors	**Government** wants to control but no fund = Top-down actions without public engagement	**House owners**, some of whom are interested in renovating their old house, but others not.	**Low income expats** occupying as "a labor barrack" without cultural linkage
Action targets	Local community leaders, including house owners		
Approach	**Community empowerment**, co-working with local historians and architects		
Researchers	GIS mapping (inventory); preserving disappearing local knowledge		

Iterative Assessments and Checkpoints

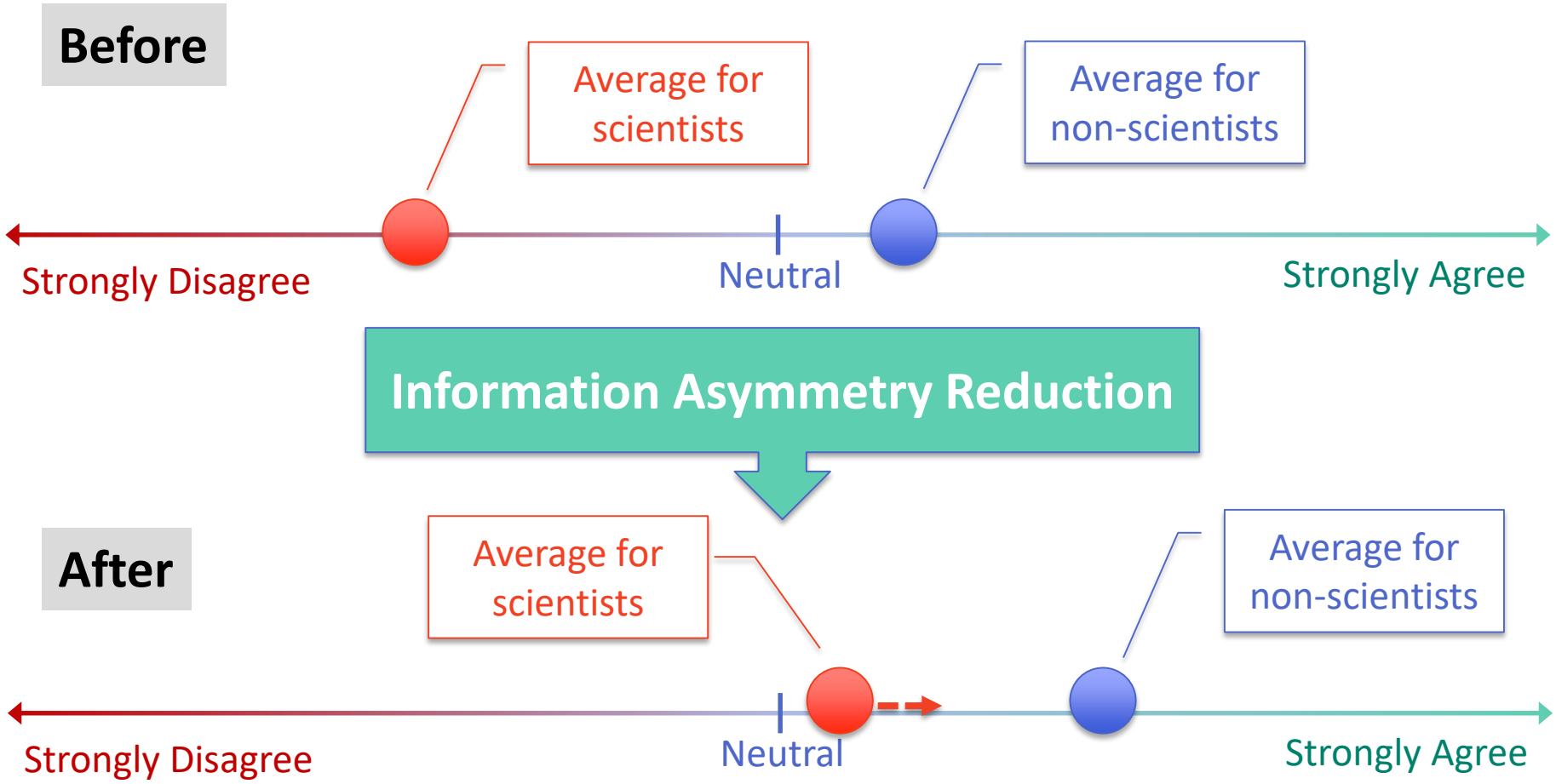


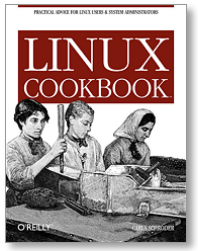
- Participatory Observation
- Semi-structured Interview
- Periodical Questionnaire

Indicator	Checkpoints
Outcome	Has the target issue been solved?
Process	• Transcending • Ethical Equity • Visualization • Dialogue 
Perception	How have epistemic living spaces (values and thoughts) of participants transformed through the project?

How to Assess Perceptual Transformation

Example question: Do you agree that local traditional knowledge is important to create solutions to socio-environmental issues?





Outputs and Outcome

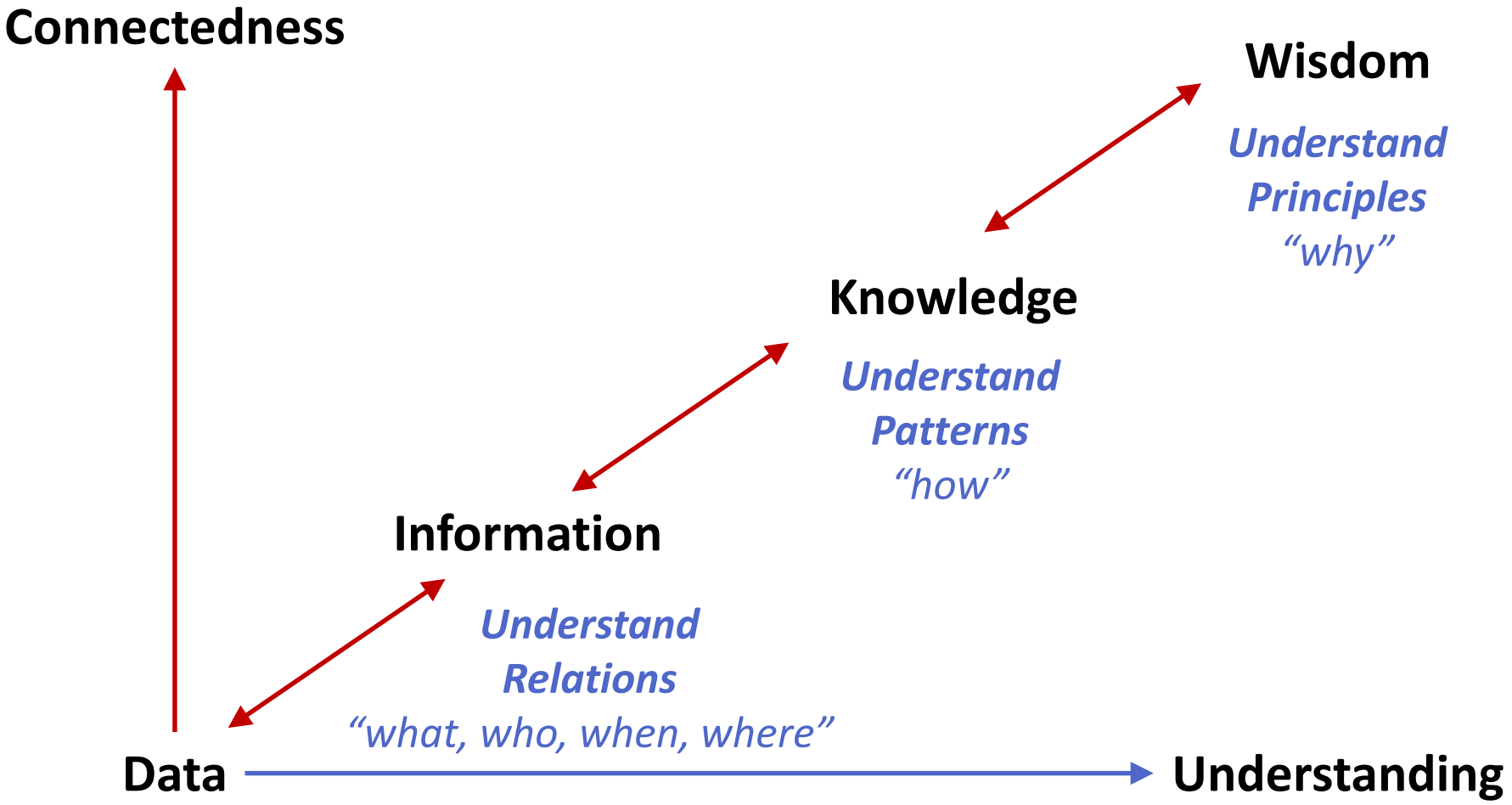
Goals	This three-year project will clarify: • Causes to information asymmetry between actors; • Effective combination of visualization tools and dialogue techniques; and • Methods to measure the effects of the tools applied.
Outputs	International journal papers, **mini book**, and portal website • Targets: Post-doc & Assist. Prof. level researchers and relevant practitioners who will lead a project in near future. • Contents will be published as **open source.**
Outcome	• Volunteers will improve the cookbook and portal website. • The methodology will be implemented to upcoming RIHN projects and the evaluation criteria. • Development of the Open Team Science (**OpenTS**) theory as a result of the integration of Open Science and TD theories

Output

A Portal Website for Open Team Science

http://www.teamsciencetoolkit.cancer.gov

Data, Information, Knowledge, and Wisdom

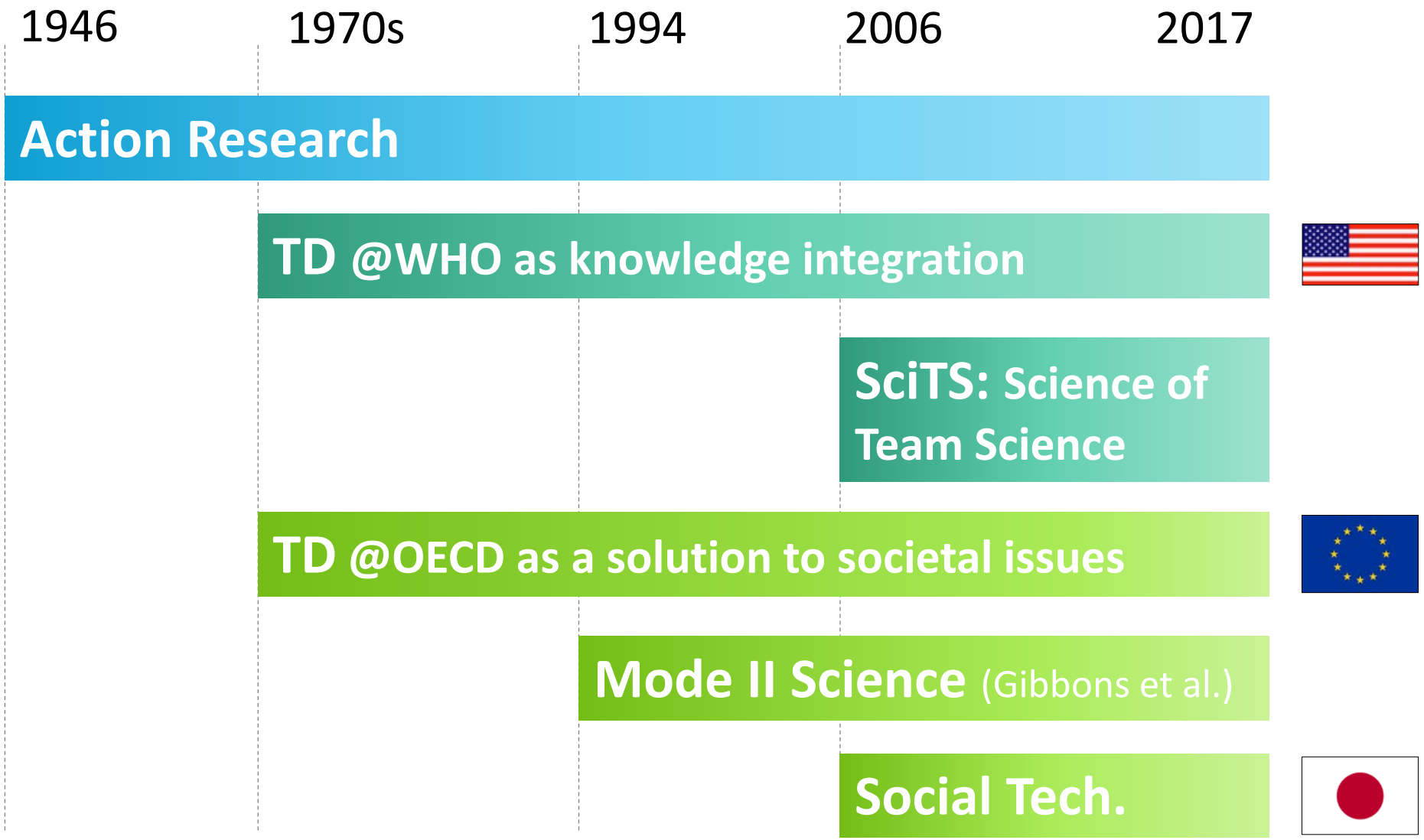


Adapted from Bellinger et al. 2004 http://www.systems-thinking.org/dikw/dikw.htm

Social-issue-oriented Research

Approach	Characteristics	Reference
Mode II Science	Multidisciplinary teams working together for short periods of time on specific problems in the real world	Gibbons et al. 1994
Citizen Science	Public participation in organized research efforts	Leach et al. 2005 Dickinson & Bonney 2012
Action Research	A comparative research on the conditions and effects of various forms of social action and research leading to social action	Lewin 1946 Stinger 2007
Transdisciplinary Research (TD)	A team science with societal stakeholders, targeting a real world problem	Hadorn et al. 2007 Lang et al. 2011 Mauser et al. 2013

History of Transdisciplinary Theories



(Kessel & Rosendield 2008; Cummings et al. 2013; Wang 2017)

Transdisciplinary Research (TD)

"Science with Society"

- **Co-design** of research agenda
- **Co-production** of knowledge
- **Co-dissemination** of the results

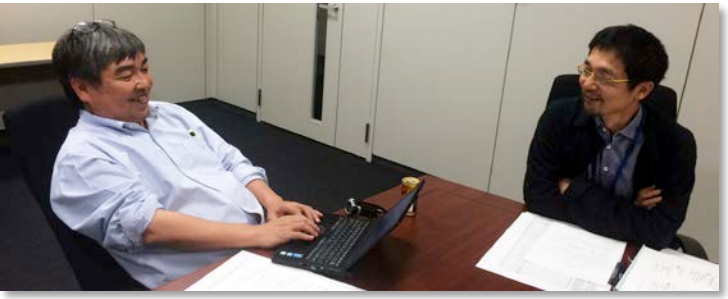
with societal stakeholders (actors) such as governmental agencies, funders, industries, NPOs and civil society

(Mauser et al. 2013 https://doi.org/10.1016/j.cosust.2013.07.001)

Transdisciplinary research is always a **team science**, targeting a **real world problem**, and should ideally be a **participatory action research**.

(after Hadorn et al. eds. 2007; Lang et al. 2012 https://doi.org/10.1007/s11625-011-0149-x)

RIHN Projects as Team Science



Interviews to seven completed projects have revealed:

- Every project is a team science with substantial interdependency between natural and social sciences.
- **Every project suffers from a gap** in understanding focal issues among different disciplines and stakeholders.
- The research resource accumulated to the RIHN is human resources and case study know-hows rather than data.

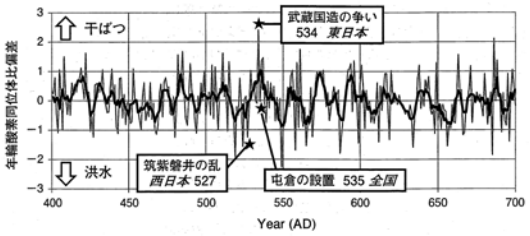
Gap = **Information Asymmetry**

(Originally: one party has relevant information, whereas others do not; Akerlof 1970)

- **"Different views to the same thing"**
- Information asymmetry between actors **obstacle solution-oriented team science** because it may lead to different understandings in focal issues and other actors.
- Such asymmetry could be caused by actors' difference in:
  - Knowledge and technology;
  - Thought and value; and
  - Socioeconomic status and power.

Information Asymmetry in interdisciplinary projects

Interpretation of protohistoric settlement dynamics in the Okayama region, Japan



Climate change (Nakatsuka 2015)

Climatologists think climate change drove the settlement dynamics.

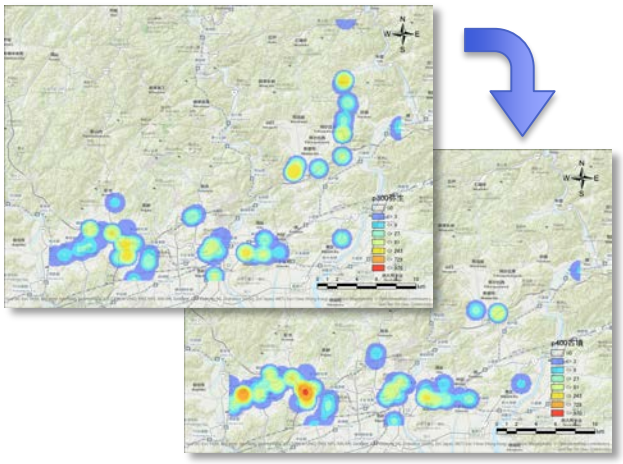
Wetter climate condition
(Large-scale climate change)

More flash floods
(changes in local topography)

Shift of settlements
(Changes in local land use)

"Social evolution"

State formation
(Changes in social organization)

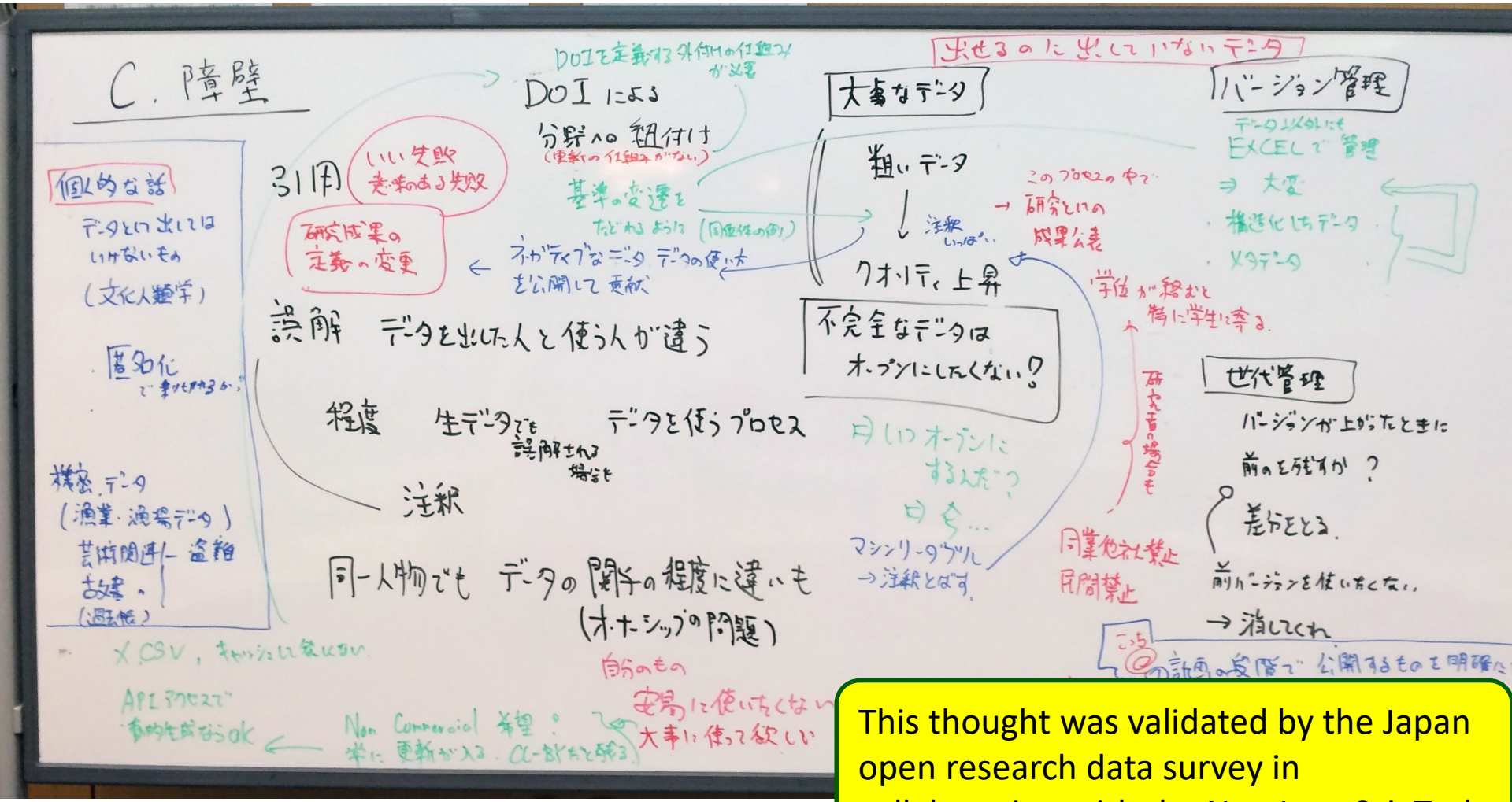


Settlement dynamics in a region
(Matsugi & Kondo in prep.)

Archaeologists think local hazards and social transformation drove the settlement dynamics.

Difference in research thoughts

Uneasiness of researchers is the most serious obstacle to open science

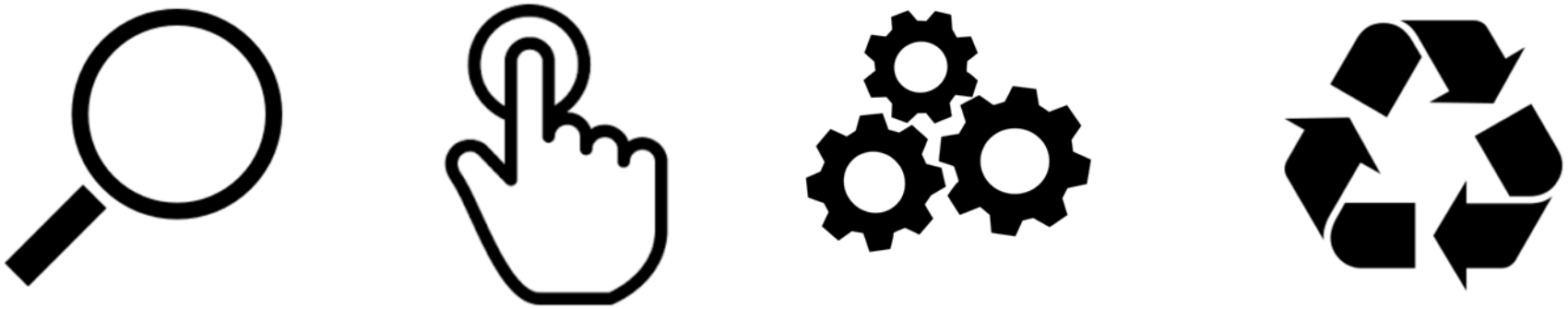


This thought was validated by the Japan open research data survey in collaboration with the Nat. Inst. Sci. Tech. Policy (Ikeuchi et al. 2017)

The FAIR Data Principles

as a realistic solution to open research data

Findable Accessible Interoperable Reusable



FORCE11

The Future of Research Communications and e-Scholarship

https://www.force11.org/group/fairgroup/fairprinciples

A New Issue Arisen

Ethical Inequity in Citizen Participatory Science

Labor, Knowledge, Idea, …

Rewards (low fixed rate), Entertainment, …

Research experts
Governmental agents

Civic participants

- Incentives for researchers (publication and promotion) would not be applicable to civic volunteers.
- Even voluntary work for public goodness should properly be acknowledged.