1. Back grounds
   A) NISTEP foresight activity
   B) Digital Transformation and Cultural Change
2. Case trials utilizing Citizen Science (Open Science)
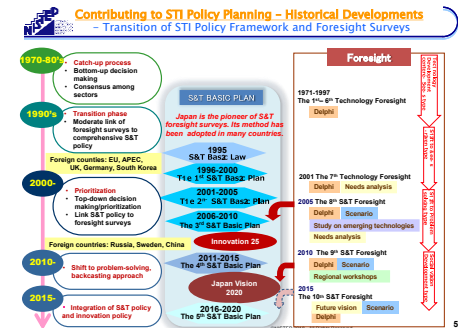   A) Asymmetric to Symmetric structural change of Science and Society
   B) Multifaceted workshops of Open Science with Society
3. Open Public Platform for foresight as a potential solution
   A) Current Platform for Foresight toward Open Platform
   B) Potential of Future Public Platform for Foresight

I'm going to introduce

- Digital Transformation of Foresight Activity itself
  - Based on the long history of S&T Foresight Activity at NISTEP
  - Exploiting Open Science and its implementation as social engagement
  - Towards next paradigm, digital native society

1.Back grounds

NISTEP NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY POLICY

1970-80's
- **Catch-up process**
  - **Bottom-up decision making**
  - **Consensus among sectors**

1990's
- **Transition phase**
  - **Moderate link of foresight surveys to comprehensive S&T policy**

Foreign counties: EU, APEC, UK, Germany, South Korea

2000-
- **Prioritization**
  - **Top-down decision making/prioritization**
  - **Link S&T policy to foresight surveys**

Foreign countries: Russia, Sweden, China

2010-
- **Shift to problem-solving, backcasting approach**

2015-
- **Integration of S&T policy and innovation policy**

S&T BASIC PLAN

Japan is the pioneer of S&T foresight surveys. Its method has been adopted in many countries.

1995 S&T Basic Law

1996-2000 The 1st S&T Basic Plan

2001-2005 The 2nd S&T Basic Plan

2006-2010 The 3rd S&T Basic Plan

Innovation 25

2011-2015 The 4th S&T Basic Plan

Japan Vision 2020

2016-2020 The 5th S&T Basic Plan

Foresight

1971-1997
The 1st– 6th Technology Foresight
- Delphi

2001 The 7th Technology Foresight
- Delphi | Needs analysis

2005 The 8th S&T Foresight
- Delphi | Scenario
- Study on emerging technologies
- Needs analysis

2010 The 9th S&T Foresight
- Delphi | Scenario
- Regional workshops

2015
The 10th S&T Foresight
- Future vision | Scenario
- Delphi

Technology Development centered Seeds type

Shift to Needs driven type

Shift to Problem-solving type

Social vision Development type

5

NISTEP Foresight process

Horizon Scanning

Visioning

Desirable future society
◆Consider directions of future development and desirable society

S&T

Future Perspectives on S&T
◆Extract promising S&T and their evaluation by experts

Scenario

Future stories and strategies
◆Identify cross-cutting/interdisciplinary challenges and consider solutions toward desirable future

Stakeholder involvement in visioning

The 10th Foresight

● Workshops

- ✓ 7 themes related to social changes
- ✓ Around 50 participants from academia, industry, public research institutes, etc.
  - S&T experts, social scientists, entrepreneurs, journalists, SF writers, etc.
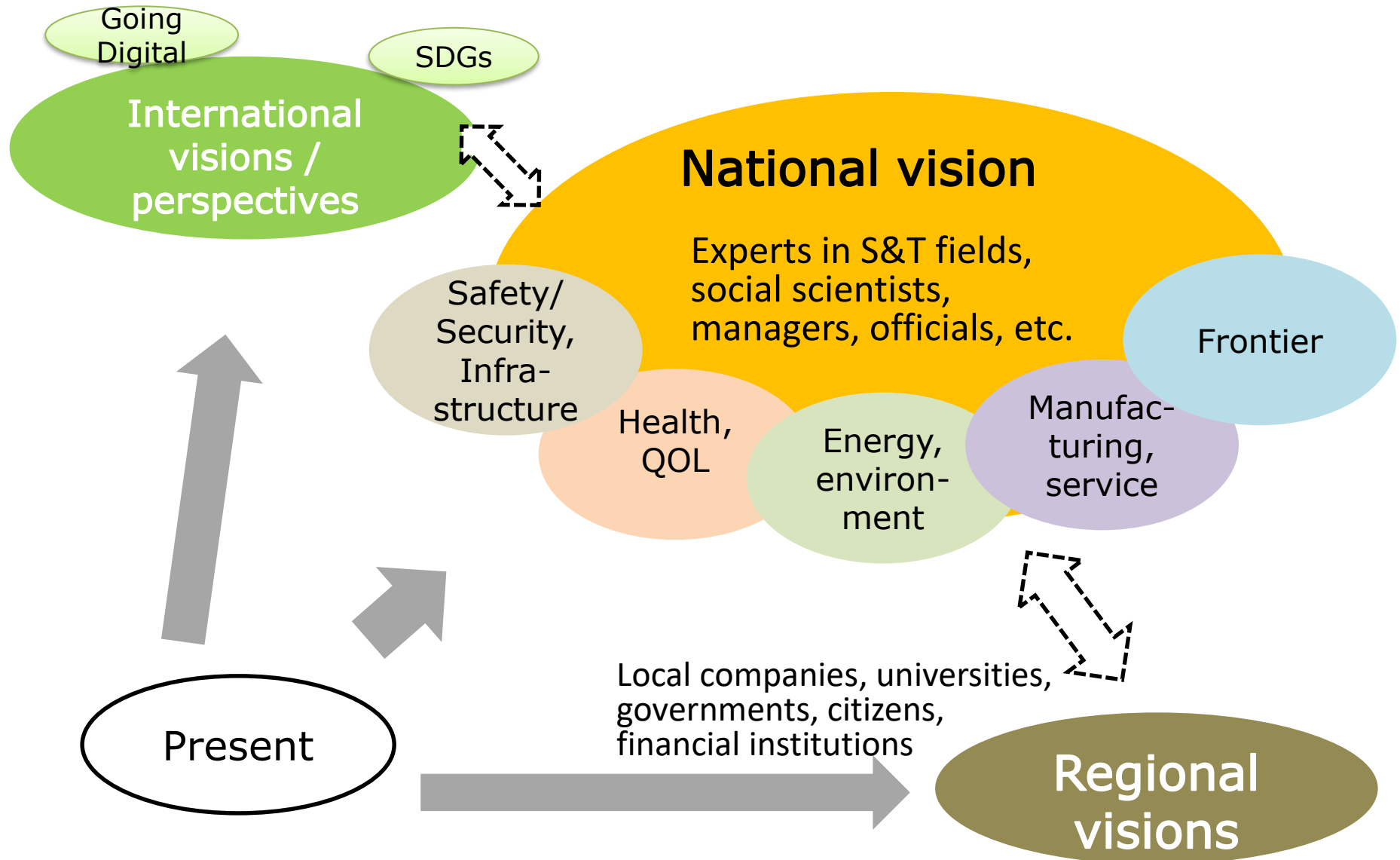- ✓ Discussion mainly from industrial point of view.

The 11th Foresight

● Workshop

- ✓ Group work by participants with different background
- ✓ Around 100 participants from academia, industry, research institutes, funding agencies, ministries
- ✓ Discussion on desirable society with sharing ideas of emerging issues that may change our society.
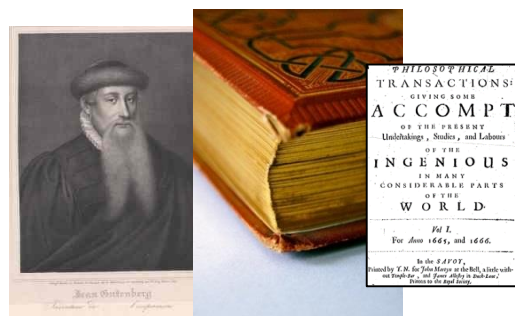
➢ Regional/citizens' perspectives

Discussion on future society in the 11th Foresight

Going Digital

SDGs

International visions / perspectives

National vision

Experts in S&T fields, social scientists, managers, officials, etc.

Safety/ Security, Infra-structure

Health, QOL

Energy, environ-ment

Manufac-turing, service

Frontier

Present

Local companies, universities, governments, citizens, financial institutions

Regional visions

Open Science movement

- Open Science is a movement to transform Science, Society, and "Science and Society" driven by the advancement of ICT.
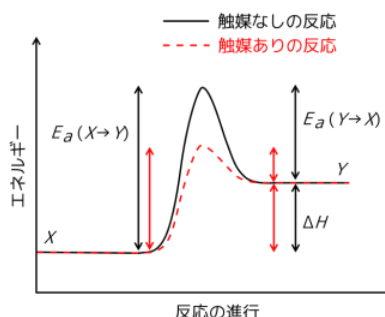
Print based dissemination

Digital native dissemination

PDF

slideshare figshare
SCIENTIFIC DATA
ResearchGate
MENDELEY
?

Publish or Perish

Transition State

Share or Perish

Past Design

- 触媒なしの反応
--- 触媒ありの反応

$E_a(X \to Y)$ $E_a(Y \to X)$

エネルギー

X Y ΔH

反応の進行

http://commons.wikimedia.org/wiki/File:Activation_energy_ja.svg

Future Design

Reinvention of Scholarly activities

- We already exploited openness once in the 15ᵗʰ Century

Letter, Hand-writing Hand-copy

Book, Journals Mass-printing

Open Infrastructure
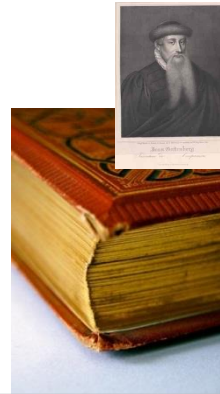
Explosion of information

PHILOSOPHICAL TRANSACTIONS: GIVING SOME ACCOMPT OF THE PRESENT Undertakings, Studies, and Labours OF THE INGENIOUS IN MANY CONSIDERABLE PARTS OF THE WORLD. Vol I. For Anno 1665, and 1666. In the SAVOY, Printed by T. N. for John Martyn at the Bell, a little without Temple-Bar, and Fames Allestry in Duck-Lane, Printers to the Royal Society.
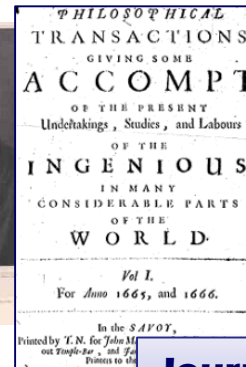
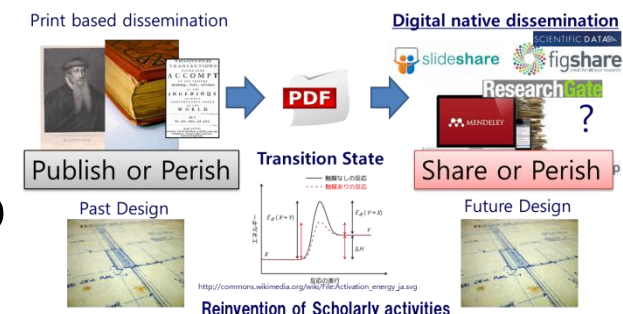**Journal development and Scientific revolution**

『**THE BOOK IN THE RENAISSANCE**』

「印刷という革命」 白水社

Printed book had changed the society in 200 years (Business, Religions, Culture, Education) Connected to science revolution
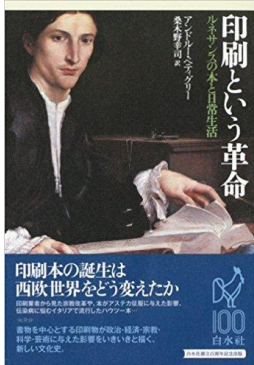
- Open Science is aiming cultural change of science and society.

- Citizens could contribute to various ways, one of which is engagement to the Science and Technology Policy development represented by Open Research Agenda setting.

- This change, especially potential of openness, transforms society from asymmetric structure of Science and Society to symmetric one to share knowledge more efficiently or more rapidly, democratizing Science to Citizens.

Print based dissemination — Digital native dissemination

Publish or Perish — Transition State — Share or Perish

Past Design — Future Design

Reinvention of Scholarly activities

K. Hayashi, "Current States of Impact Assessment of Research Outputs in Japan and Some Challenges to Measure New Impacts for Japan's Stakeholders," OECD-ESTONIA WORKSHOP ON IMPACT ASSESSMENT: PRACTICES, TECHNIQUES AND POLICY CHALLENGES, May 15-16, Estonia. (revised)

OECDpublishing
OPEN RESEARCH AGENDA SETTING
OECD SCIENCE, TECHNOLOGY AND INNOVATION POLICY PAPERS
December 2017 No. 50

OECD

Asymmetric structure
    -Public fund by Country (citizens) via tax
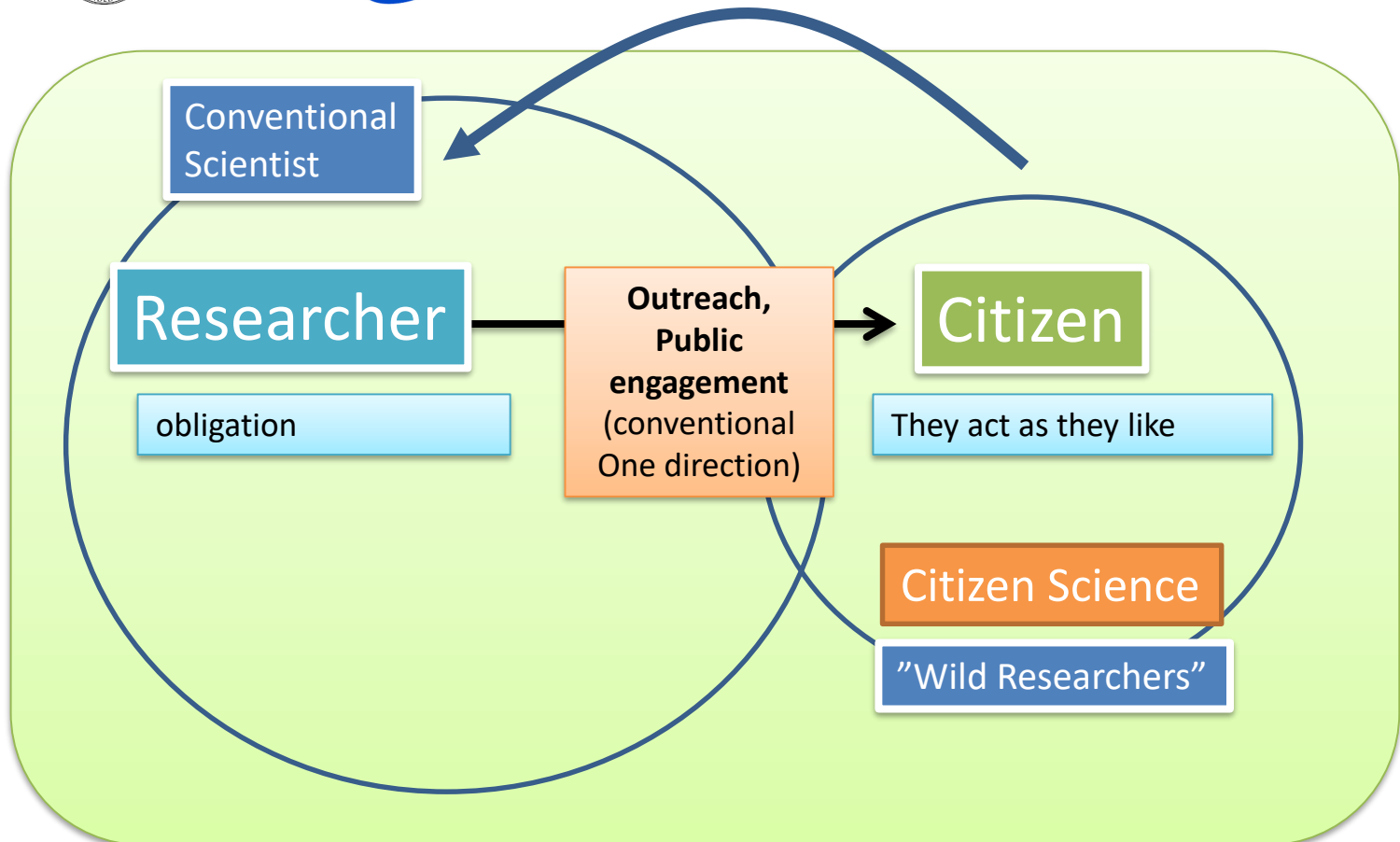   -Outreach, public engagement is likely to be one direction
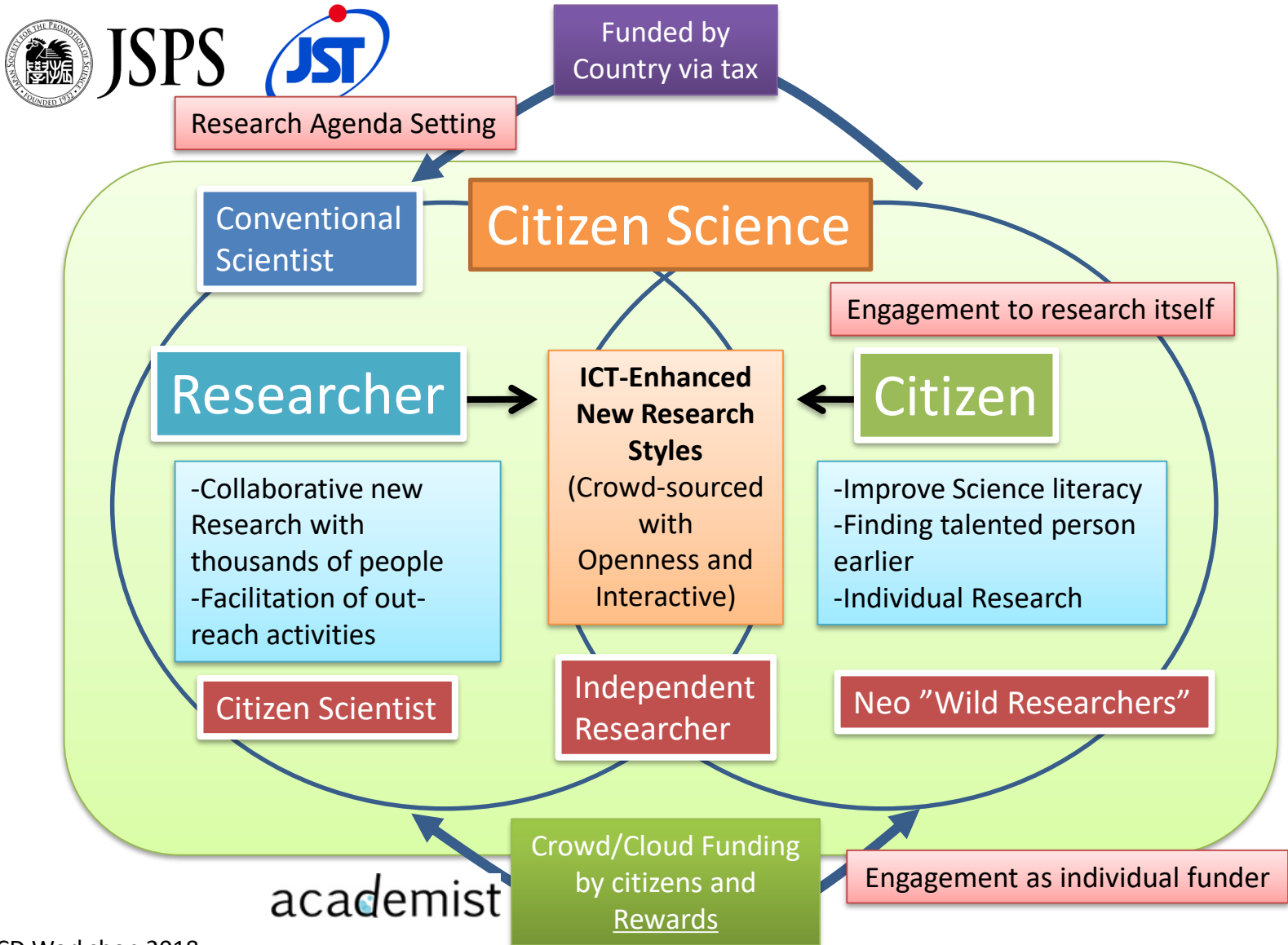There are already "Wild Researchers"

JSPS

JST

Funded by Country via tax

Conventional Scientist

Researcher

obligation

Outreach, Public engagement (conventional One direction)

Citizen

They act as they like

Citizen Science

"Wild Researchers"

More Symmetric structure
-utilizing ICT-Enhanced research with an interactive scheme
-Adding crowd/cloud funding to public fund

JSPS · **JST**

Funded by Country via tax

Research Agenda Setting

Conventional Scientist

Citizen Science

Engagement to research itself

Researcher → ICT-Enhanced New Research Styles (Crowd-sourced with Openness and Interactive) ← Citizen

-Collaborative new Research with thousands of people
-Facilitation of out-reach activities

-Improve Science literacy
-Finding talented person earlier
-Individual Research

Citizen Scientist

Independent Researcher

Neo "Wild Researchers"

academist

Crowd/Cloud Funding by citizens and Rewards

Engagement as individual funder

2.Case trials utilizing Citizen Science (Open Science)

Multifaceted workshops to envision the future of open science with society

- ## The first workshop: 11 research experts 2016
  - in environmental sciences and informatics
  - the possibility that vague anxiety against unintended use might obstacle open research data.

- ## The second workshop: 37 participants 2017
  - from research communities, library, central and local governments, industries, and non-profit organizations

Sorting → **Group talk** → **Wrap-up**

- ## The third workshop: 11 research experts 2017
  - Core persons synthesized notions from previous 2 WS (to publish a report)

Y Kondo and K Hayashi. NISTEP Discussion Paper. No 163

Social Engagement

- Ideal but very time-consuming, need much adjustment cost
  - Must include cost of management
- Necessity to leave spontaneous activity by scientists and citizens as they are. (Market-oriented but needs catalyst)
- **Importance of the Bridging agent** as a person, as a team, and as an organization for paradigm-shifting
  - With various skills mainly of Communication
- We should enjoy multi-stakeholders' involvement with design thinking among actors (Participatory Innovation)
- ICT would help develop a kind of platform to mitigate gap between what we should do and what we could do.
- **These findings helped to develop Open Platform for foresight**

3. Open Public Platform for foresight as a potential solution

Vision of Open Platform for Foresight (OPF)

From ordinal foresight activity
To development of RD programs
Covering follow-up for comprehensive analysis of
I/O of RD

Stakeholder Involvement
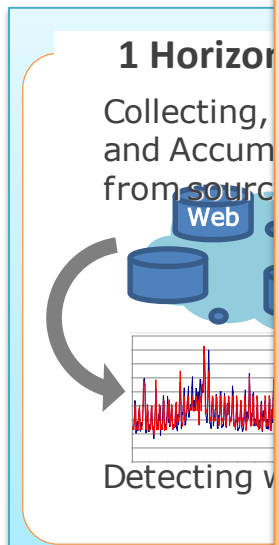
utilization

5 Validation and follow-up

4 Evidence based policy development and scenario writing

Visualization
With current policies

Information Analysis
Compress and Visualize

1 Horizon Scanning

Collecting, Structuring, and Accumulation from sources

Web

Detecting weak signals

2 Expert knowledge base

(* ST Expert Network)

topics

3 Tool for Trend analysis

Qualitative and quantitative analysis

Collecting

Range of OPF

Interactive

Publishing as knowledge
(web, print)

**From ordinal foresight activity
To development of RD programs
Covering follow-up for comprehensive analysis of
I/O of RD**

Stakeholder Involvement

utilization

4 Evidence based

1 Horizon

Collecting,
and Accum
from sourc

Web

Detecting

Information Analysis
Compress and Visualize

Collecting

Range of OPF

Publishing
as knowledge
(web, print)

Interactive

- **From temporal questionnaires or workshop to monitoring on regular basis**
- **On demand basis (quick, agile, flexible)**
- **Get stakeholders involved as much as possible from the beginning (or on the right timing)**

19

- Utilizing ICT as an information platform to provide evidence / clues for strategic R&D planning

- Use case: Integrating retrospective mapping of hot research areas through bibliometrics (Science Map) and prospective views on research strategies (responsive surveys for Experts Network of S&T Foresight Center : approx. 2,000 experts)

- Relevant information are being provided as a significant evidence for the process of setting strategic R&D areas by MEXT (to be realized by responsible funding agencies)
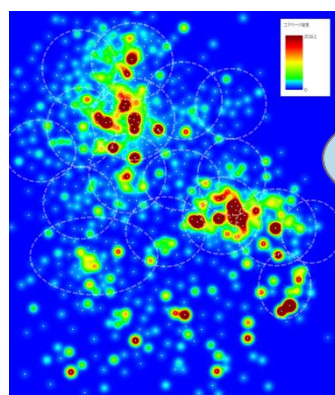
Retrospective (Bibliometrics) Approach

Science Map
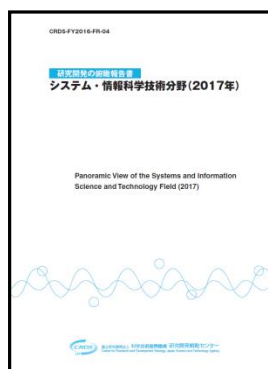
Panoramic View Reports etc. by JST / CRDS

Advanced R&D Programs for Medical Innovation

Provide materials to extract emerging research areas which seem to be led by, and promising for Japanese research teams

Provide bird-eye views on current R&D status in key areas and benchmarking with major countries

Contribute to the process of setting strategic goals and R&D goals for funding agencies

Collecting web-based views from Experts Network on highlights, core researchers and key words of research trends to be focused

- Classification of collected highlights based upon the proximity of contents, from trans-disciplinary viewpoints

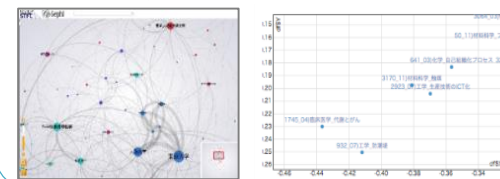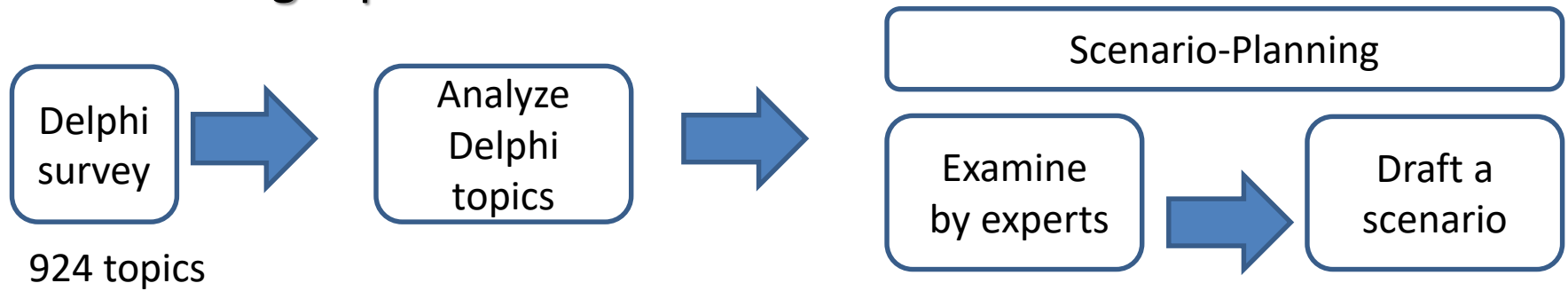- Establishing network charts by analyzing researchers involved and key words
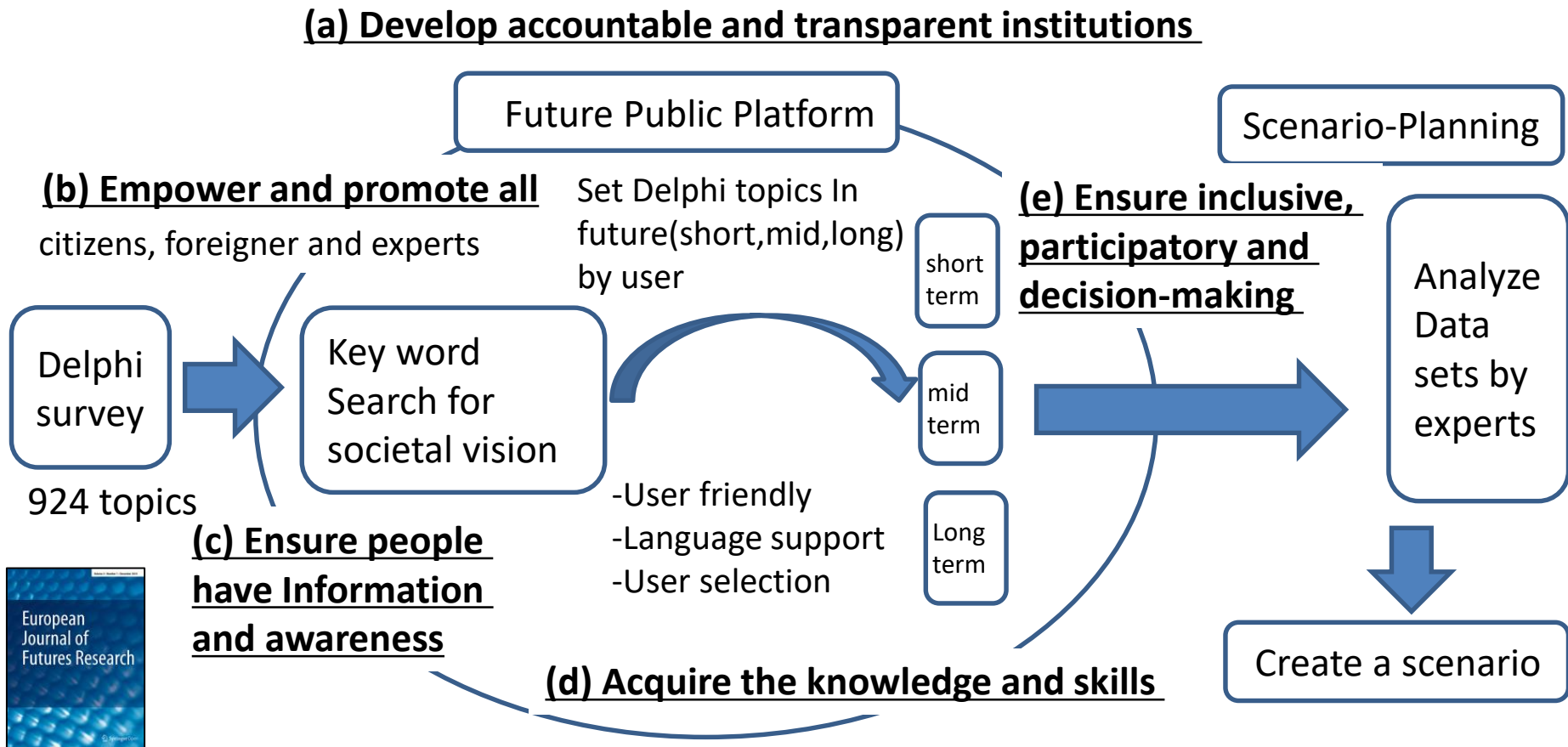
Visualizing various inter-relationships between the nodes, which are difficult to grasp through simply calculating frequency using Excel
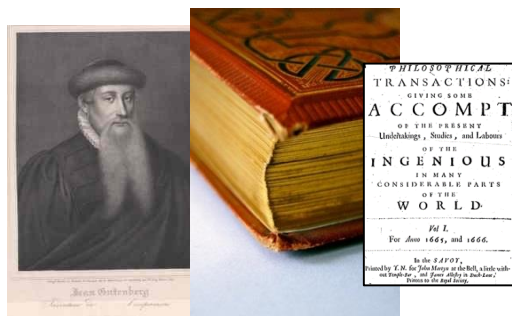
Prospective (Foresight) Approach

20

Last Foresight process

| Delphi survey | → | Analyze Delphi topics | → | **Scenario-Planning** |

924 topics

Scenario-Planning:
Examine by experts → Draft a scenario

Introduction of Future Public Platform

(a) Develop accountable and transparent institutions

Future Public Platform

Scenario-Planning

(b) Empower and promote all
citizens, foreigner and experts

Set Delphi topics In future(short,mid,long) by user

(e) Ensure inclusive, participatory and decision-making

Delphi survey → Key word Search for societal vision

short term

mid term

Long term

Analyze Data sets by experts

924 topics

(c) Ensure people have Information and awareness

-User friendly
-Language support
-User selection

Create a scenario

(d) Acquire the knowledge and skills

- ## Towards post-Gutenberg's worlds

Print based dissemination

Digital native dissemination

SCIENTIFIC DATA

slideshare

figshare
credit for all your research

PDF

ResearchGate

MENDELEY

?

Publish or Perish

Transition State

Share or Perish

Past Design

触媒なしの反応
触媒ありの反応

$E_a (X \rightarrow Y)$

$E_a (Y \rightarrow X)$

エネルギー

Y

ΔH

X

反応の進行

http://commons.wikimedia.org/wiki/File:Activation_energy_ja.svg

Future Design
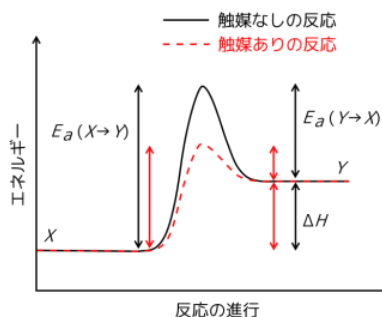
Reinvention of Scholarly activities

- ## Towards post-Gutenberg's worlds

Legacy Framework
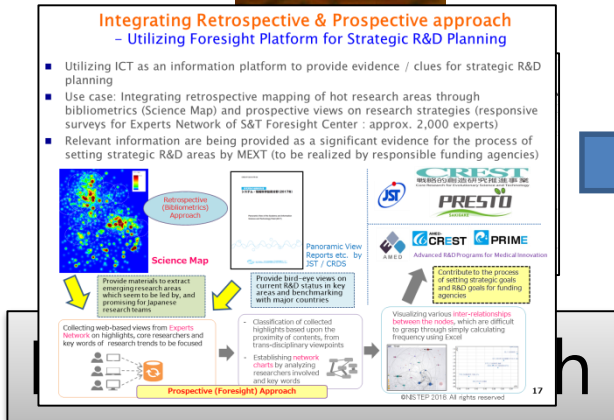
Digital native Framework
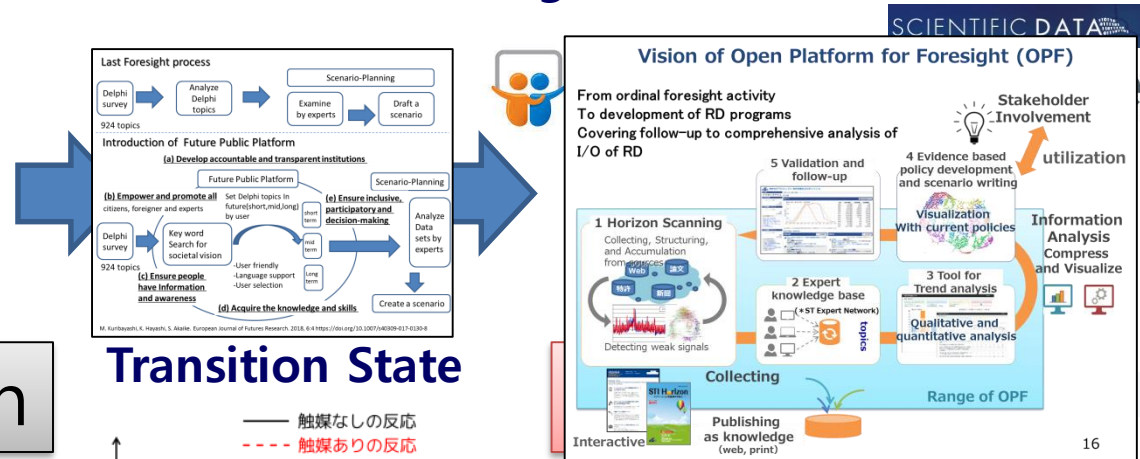
Transition State
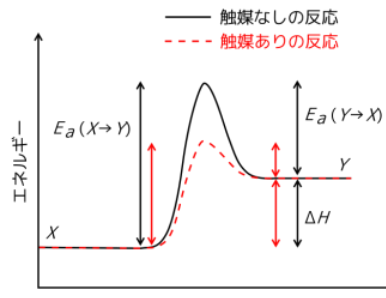
http://commons.wikimedia.org/wiki/File:Activation_energy_ja.svg

Past Design

Future Design
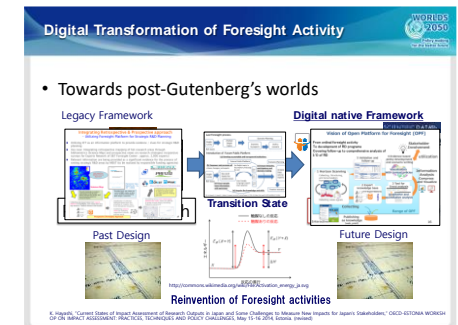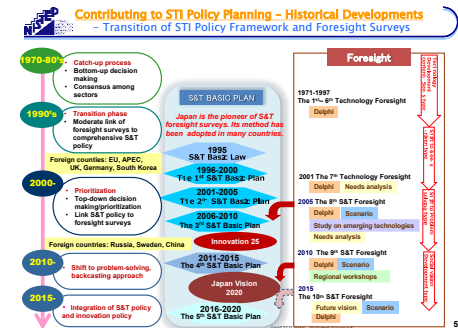
Reinvention of Foresight activities

I introduced (as a preliminary basis)

- Digital Transformation of Foresight Activity itself

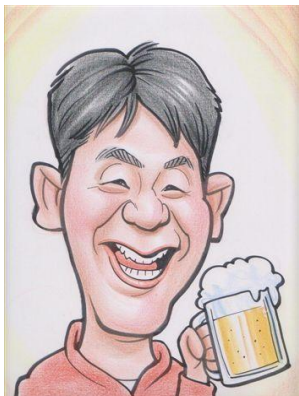 – Based on the long history of S&T Foresight Activity at NISTEP

  – Exploiting Open Science and its implementation as social engagement

  – Towards next paradigm, digital native society

For the better future development

Thank you for your attention

Twitter : hayashi_kaz

Facebook, LinkedIn, Mendeley

Kazuhiro Hayashi (with a picture)