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2013年AAAS年次大会CRDS主催シンポジウム報告書
Report on CRDS Symposium Session at 2013 AAAS Annual Meeting

Toward Bridging the Duality of Science: Seed-push, Issue-driven, or "Encounter" ?

Date: February 17, 2013
Time: 8:30 AM to 11:30 AM
Facility: Room 300 Hynes Convention Center
900 Boylston Street, Boston,
MA 02115, USA

CRDS JST
独立行政法人科学技術振興機構 研究開発戦略センター
Center for Research and Development Strategy Japan Science and Technology Agency

2013 AAAS Symposium Session

Toward Bridging the Duality of Science: Seed-push, Issue-driven, or "Encounter" ?

February 17 (SUN), 2013
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Contact:
Center for Research and Development Strategy (CRDS), Science and Technology Agency (JST)

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■ はじめに

米国科学振興協会（American Association of Advancement of Science: AAAS、トリプルエース）は、1848 年設立の世界最大級の学術団体であり、科学雑誌 Science の発行元としても知られている。その年次大会には、米国内外からから数千人の科学者、技術者、教育関係者、ジャーナリスト、政策担当者が参加し、科学研究や教育について、毎年掲げられるテーマの下に幅広い視点から約 160 のセッションが持たれ講演と議論が行われる。近年の年次大会のテーマは次のとおりとなっており、世界的に社会が変化する中での科学のあり方を問うものとなっている。

Bridging Science and Society（2010 年）
Science Without Boarders（2011 年）
Flattening the World: Building the 21st Century Global Knowledge Society 2012 年）
The Beauty and Benefits of Science（2012 年）

科学技術振興機構（JST）研究開発戦略センター（CRDS）では、2013 年のテーマである“The Beauty and Benefits of Science”が、CRDS における研究開発立案プロセスの基本方針である“邂逅”のコンセプトに通じるという理解の下、以下のタイトル及び内容にて企画シンポジウムを提案したところ、審査を経て受理された。

タイトル：Toward Bridging the Duality of Science: Seed-push, Issue-driven, or "Encounter"？
内容：自然界における法則性の発見などの真理の探究と、社会的課題や経済的利益といったアウトカムの実現への貢献という、ときに相反する科学の二つの側面（Duality）を両立させる研究開発システムをいかにして構築するか？この世界各国の共通の課題に取り組むため、各国では、既存の研究開発領域や技術シーズからスタートして社会的問題の解決へのパスを描くアプローチ、社会的課題を深くとらえる中で研究開発が必要な領域を明らかにしていくアプローチ、双方の視点を取り入れたアプローチ等、様々な取り組みを行っている。本セッションでは、各国の参加者がそれぞれの取り組みについて紹介するとともに、問題意識の共有と検討方法に関する情報交換を通じ、“社会の中の科学” を目指した研究開発システムのあり方への展望を議論する。

当シンポジウムでは、科学のフロンティア拡大と社会的問題の解決という２つ側面をどのように結び付けていくかについて、参加者からの問題意識の共有と方法論についての情報交換を行い、“社会の中の科学”を目指した研究システムのあり方への展望を議論した。本報告書は、これらの内容を紹介するものである。

Preface

The American Association of Advancement of Science(AAAS ; “Triple A-S”), founded in 1848, is one of the world’s largest academic organizations, which publishes the renowned journal *Science*. Thousands of leading scientists, engineers, educators, journalists, and policy-makers from the inside and outside of the United States participate in its Annual Meetings to discuss scientific research and education in a wide range of contexts. Approximately 160 sessions are held annuallyin relation with each year’s theme which recently tends to deal with the modality of science in the globalized world as below.

- Bridging Science and Society (2010)
- Science Without Boarders (2011)
- Flattening the World: Building the 21st Century Global Knowledge Society (2012)
- The Beauty and Benefits of Science (2013)

Center for Research and Development Strategy (CRDS), Japan Science and Technology Agency (JST) submitted the session proposal for the 2013 AAAS Annual Meeting because the 2013 theme fit the concept of “Encounter”, the basic principal of CRDS’s research and development (R&D) strategy building process. The following is the proposal from CRDS which was reviewed and accepted by the Program Committee.

Title: Toward Bridging the Duality of Science: Seed-push, Issue-driven, or "Encounter" ?

Synopsis: Science is exploring the truth in nature and discovering scientific laws while offering possible scientific solutions for social issues and bringing economic benefits. Though these two functions underline the duality inherent to the science, they do not always seem to go together. How can we enable the scientific enterprise to fulfill its potential in pursuing the scientific truth, as well as in bringing about the actual benefits? In order to reconcile this duality of science, a variety of approaches have been taken in building R&D strategy and agenda setting; for instance, drawing pathways from existing R&D areas and/or technical assets to future solution for social concerns (“seed-push”), or identifying specific scientific areas to be focused in R&D programs through the profound observation of social issues (“issue-driven”). In the meantime, a new challenge has also been launched, in which parallel efforts for promoting R&D and for identifying social issues (“encounter”) would be an another way to utilize both functions of science. In this session, academia, experts and practitioners from the US, Europe and Japan are invited to introduce their perspectives and propose possible solution on this theme. Sharing information on their own approaches and views on challenges they face, it is expected to seek the possibility of alternative ways to acknowledge and take further advantage of the both functions of science.

This report summarizes the presentations and discussions at the session held by the CRDS.

■ プログラム／Program

Moderator: Yuko Harayama

Professor, Department of Management Science and Technology, Graduate School of Engineering, Tohoku University

(10-minutes) Introduction - Aims, and the Structure of the Session : Yuko Harayama

(10-minutes) Background - Global Trends in Science, Technology and Innovation Policy:

Tateo Arimoto

Deputy Director, Professor, Science, Technology and Innovation Policy Program, National Graduate School for Policy Studies (GRIPS)

(30- minutes) Setting the tone - How We Can Direct and Link Scientific Research to Social Wishes

Nobuhide Kasagi

Principal Fellow, Center for Research and Development Strategy (CRDS)Japan Science and Technology Agency (JST) / Professor Emeritus, The University of Tokyo

Presentations from four speakers:

(15- minutes) A vision for excelling in mental health and wellbeing

Barbara J Sahakian

Professor, Department of Psychiatry and MRC/Wellcome Trust Behavioural and Clinical Neuroscience Institute, University of Cambridge

(15- minutes) Transformation of Foresight Activities toward ST&I Policy

Kumi Okuwada

Senior Fellow, Research Institute of Science and Technology for Society(RISTEX), Japan Science and Technology Agency(JST)

(15- minutes) Research and Development Response to Societal Needs in the Information Technology Area

Frans W. A. Brom

Head of Department, Technology Assessment Department,
Rathenau Instituut／Professor of Ethics of Technology Assessment,
Philosophy Department, Utrecht University

(15- minutes) Outputs are not Outcomes: Problems of measurement, complexity, and plausibility in R&D policy

Daniel Sarewitz

Co-Director, Consortium for Science, Policy & Outcomes
Professor of Science and Society, Arizona State University

(65- minutes) Clarification Questions and Discussion

(5- minutes) Closing

■ イントロダクション／Introduction

モデレータ：原山　優子　東北大学大学院工学研究科　教授

Moderator：Yuko Harayama (Professor, School of Engineering, Tohoku University)

ジュネーブ大学教育学博士課程及び経済学博士課程を修了後、ジュネーブ大学経済学部助教授、通商産業省通産研究所客員研究員などを経て 2002 年より東北大学大学院工学研究科教授。経済協力開発機構（OECD）科学技術産業局次長（2010 年 9 月～2012 年 11 月）。

Dr. Harayama holds a Ph.D. in education sciences and a Ph.D. in economics, both from the University of Geneva. She is Professor in the Management Science and Technology Department at the Graduate School of Engineering, and the former Deputy Director of the Directorate for Science, Technology and Industry, Organisation for Economic Co-operation and Development (OECD).

・科学のフロンティア拡大と社会的問題の解決という２つの側面をどのように結び付けていくか、またその中で科学者の関心やモチベーションをどう維持し、かつ社会的・経済的なインパクトも得ていくかについて、JST/CRDS による社会的期待と研究開発課題との“邂逅”の試みに基づいて議論するというシンポジウムの目的を説明。

・The primary objective of the symposium session is to discuss how to bridge the duality of science while keeping scientists incentivized and motivated, and obtaining socio-economic benefits at the same time, based on the attempt by the JST-CRDS to realize “encounter” between social wishes and Research and Development themes.

■ 背景説明／Background

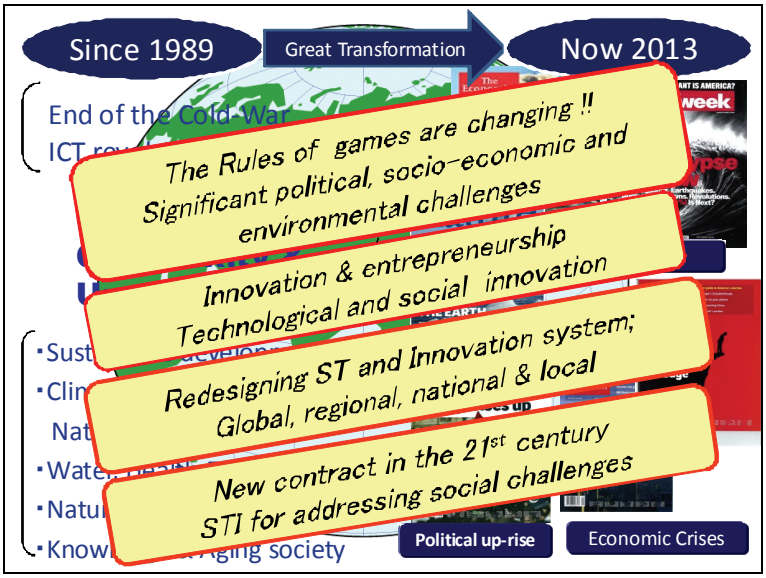
「科学技術イノベーション政策におけるグローバルなトレンド」
“Global Trends in Science, Technology and Innovation Policy”

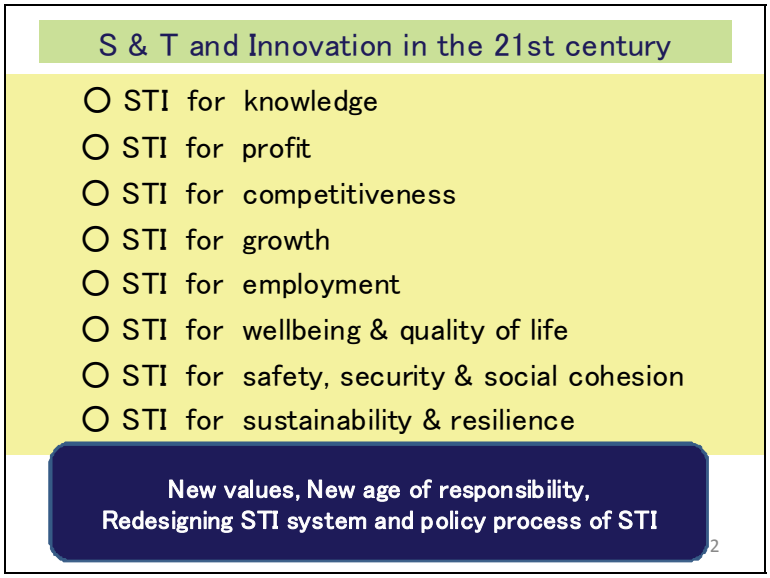
オーガナイザー：有本　建男　政策研究大学院大学　教授
Organizer: Tateo Arimoto (Professor, National Graduate Research Institute of Policy Studies(GRIPS))

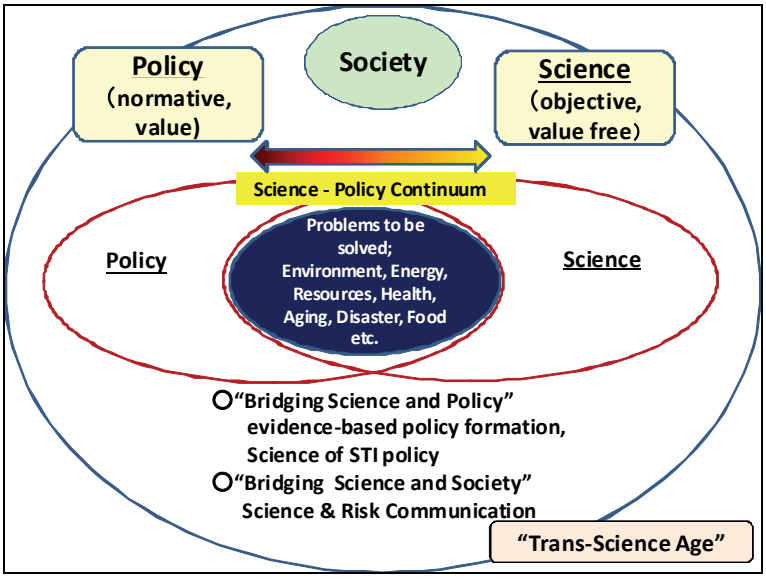
京都大学大学院理学研究科修士課程修了、科学技術庁入庁。同庁科学技術政策局政策課長、内閣府大臣官房審議官(科学技術政策担当)などを経て、2004 年文部科学省科学技術・学術政策長、2006 年より JST 社会技術研究開発センター長、2012 年より現職。

Tateo Arimoto is Program Director of Science, Technology and Innovation Policy in the GR IPS. He successively held important posts related to Japan’s science and technology policy, such as Director General of Science & Technology Policy Bureau, Ministry of Education and Science, and Deputy Director General for Science and Technology Policy, Cabinet Office.

・グローバル化が進み、世界規模でイノベーションか展開する時代にあって、従来のリニアモデルに代わる、”Issue-driven”な研究開発戦略が不可欠であり、科学技術イノベーション政策の新しいモデルの再構築が必要。
・科学研究も社会とのかかわり方をいっそう問われるようになっており、科学者は社会の課題を理解し、社会の中での科学者の役割を果たすことが求められている。
・As innovations are provoked internationally in the globalized world, we need to propose research and innovation strategies in an “Issue-driven” manner, based on a newly reconstructed model of science, technology and innovation policy.
・Scientific research is required to be involved with society better than before. Scientists should understand what societal challenges are, and play their roles to solve them.


Since 1989
Great Transformation
Now 2013
End of the Cold War
The Rules of games are changing !!
Significant political, socio-economic and environmental challenges
Innovation & entrepreneurship
Technological and social innovation
Redesigning ST and Innovation system;
Global, regional, national & local
New contract in the 21st century
STI for addressing social challenges
Political up-rise
Economic Crises


S & T and Innovation in the 21st century
○ STI for knowledge
○ STI for profit
○ STI for competitiveness
○ STI for growth
○ STI for employment
○ STI for wellbeing & quality of life
○ STI for safety, security & social cohesion
○ STI for sustainability & resilience
New values, New age of responsibility,
Redesigning STI system and policy process of STI


Policy
(normative, value)
Society
Science
(objective, value free)
Science - Policy Continuum
Policy
Problems to be solved;
Environment, Energy, Resources, Health, Aging, Disaster, Food etc.
Science
○"Bridging Science and Policy"
evidence-based policy formation,
Science of STI policy
○"Bridging Science and Society"
Science & Risk Communication
"Trans-Science Age"

■ 基調講演要旨／Setting the tone (Synopsis)

「いかに科学研究を社会的期待に結びつけるか」
“How We Can Direct and Link Scientific Research to Social Wishes”

笠木　伸英　JST/CRDS 上席フェロー、東京大学名誉教授
Nobuhide Kasagi (Principal Fellow, JST-CRDS; Professor Emeritus, The University of Tokyo)

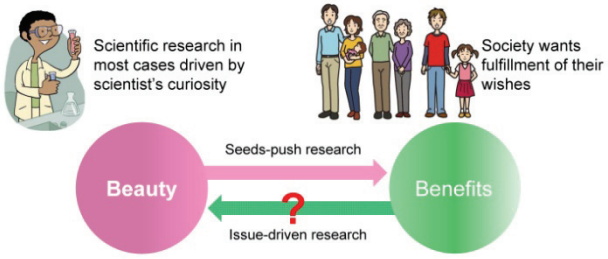
東京大学大学院修了、工学博士。東京大学講師、助教授、スタンフォード大学客員研究員を経て、1990 年より東京大学教授。現在、英国王立工学アカデミー国際フェロー、王立スウェーデン科学アカデミー会員。2009 年より JST/CRDS 上席フェロー。

Dr. Kasagi worked at the University of Tokyo for 36 years in research, education and administration. He joined the JST-CRDS in 2009. He has been a member of Science Council of Japan since 2005, and also is Fellow of The Royal Academy of Engineering and Japanese Government Delegate to the OECD Committee on Science and Technology Policy.

・科学研究を社会的期待に結びつけることが世界的にも必要とされているが、これを実現する研究開発戦略の策定は困難。
・戦略策定方法の一つとして、CRDS における社会的期待の検討と邂逅プロセスの試行内容及び今後の課題を紹介。
・戦略策定にあたっては、エビデンスに基づく客観的方法と担当者による判断に基づく主観的方法の双方を、明確に意識しつつ用いることが必要。

・Scientific research is expected to be linked to social wishes all around the world these days, whereas the type of R&D strategy planning to realize this is yet to be established.
・The JST-CRDS has attempted and examined a new R&D strategy planning methodology that makes social wishes “encountered” with scientific research themes, and extracted several challenges.
・In R&D strategy planning, it is important to employ subjective methods, which are dependent on decisions by the ones in charge, as well as objective methods, which are based on evidences, with awareness to their differences.

Seeds-push vs Issue-driven Research



- More effectively linking scientific achievement to social benefits, while keeping natural motive of scientist ?

Existing Problems in Designing R&D Proposals for Social Wish

- Many R&D proposals inclined to grasp social issues only from a viewpoint of individual scientific discipline and/or technological framework
- Ambiguity in extracting social wishes and lack of distinction between *objectivity* and *subjectivity* in designing R&D proposals
- R&D programs likely to contribute only partially to a specific aspect of the social issue, but not to total solution or satisfaction
- Fusion and collaboration of multiple scientific disciplines and technology fields not much encouraged

Need for Rational Strategic Methodology

- Need to develop genuine issue-driven R&D planning methodology
- Inherent difficulties in making logical, objective, evidence-based R&D policy options, but at least a fair and transparent process indispensable to build public trust in the national science and technology policy

■ 講演要旨／Synopsis of Presentations

■ 講演１：「メンタルヘルスと福利を向上させるためのビジョン」

“A Vision for Excelling in Mental Health and Wellbeing”

バーバラ・シャアーキアン　英国ケンブリッジ大学　教授
Barbara J Sahakian (Professor, Cambridge University)

ケンブリッジ大学にて実験心理学の PhD を取得。現在、ケンブリッジ大学 医学研究会議／ウェルカムトラスト行動臨床神経科学研究所及び精神医学部 臨床神経心理学 教授。

Dr. Sahakian completed a PhD in Experimental Psychology at the University of Cambridge .She is currently Professor at the Department of Psychiatry and MRC / Wellcome Trust Behavioural and Clinical Neuroscience Institute, University of Cambridge.

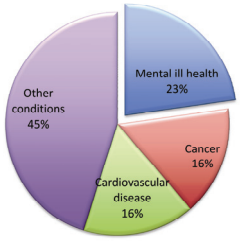
・メンタルヘルスが損なわれることによるコスト増大は社会の課題の一つ
・英国における Foresight Project の一つであるメンタルヘルスのプロジェクト（Mental Health and Well-being）では、遺伝的な要因の解明、バイオマーカの利用、早期発見の必要性等を提案
・当プロジェクトに脳神経科学の立場から参加し、認知症の早期発見につなげるツール CANTAB を開発

・Increasing cost for the care of mental patients is one of the societal challenges.
・ “Mental Capital and Well-being” was one of the Foresight Projects in the UK. This project highlights biomarkers, including cognitive and genetic measures, for use in the area of mental health. It also highlights the importance of early detection and early effective treatment.
・The speaker participated in the project as a neuroscientist. She is co-inventor of CANTAB. A recent new development is CANTABmobile (www.cantabmobile.com) which runs on portable devices, including iPad, and is for use in the early detection of Alzheimer’s disease.

Mental ill health is the single largest cause of disability in the UK

Wider economic costs of mental illness in England estimated at £105.2 billion each year

Estimated total annual costs including health service costs, lost earnings, lost productivity and human costs	
Depression	£20.2-23.8 billion
Anxiety	£8.9 billion
Schizophrenia	£13.3 billion
Dementia	£17 billion
Somatisation disorder	£17.6 billion



The wider costs of mental ill health include:
- direct costs of services
- lost productivity at work
- reduced quality of life

Department of Health (2011) No health without mental health: The economic case for improving efficiency and quality in mental health
http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_123993.pdf

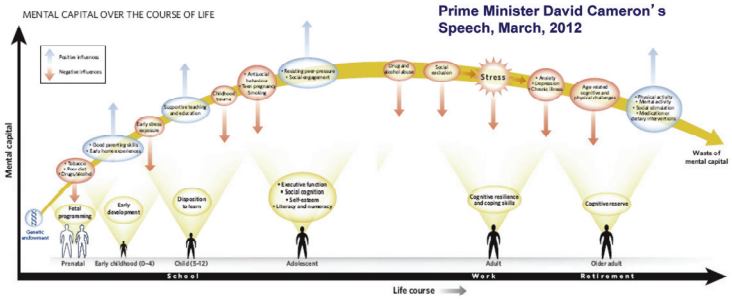
Foresight

Biomarkers for prevention, early detection and early effective treatment

Biomarkers include cognitive, genetic, neuroimaging and blood based measures

"Today only around 40 per cent of those with dementia know they have it"
"You can help people live independently for longer, even put the brakes on their decline"

Prime Minister David Cameron's Speech, March, 2012



Mental capital encompasses both cognitive and emotional resources, and resilience in the face of stress.

Beddington, Cooper, Field, Goswami, Huppert, Jenkins, Jones, Kirkwood, Sahakian & Thomas
"The mental wealth of nations" (2008), *Nature*, 455

CANTABmobile is a GP decision-making tool

- Improving access to cognitive assessment
- Empowering non-specialist clinicians to act
- Enabling early intervention for MCI and dementia

■ 講演２：「科学技術イノベーション政策に向けた予測活動の転換」

“Transformation of Foresight Activities toward ST&I Policy”

奥和田　久美　JST 社会技術研究開発センター　シニアフェロー
Kumi Okuwada (Senior Fellow, Research Institute of Science and Technology for Society, Japan Science and Technology Agency (JST-RISTEX))

民間企業にてエレクトロニクス材料等の研究活動に従事した後、2002 年より 科学技術政策研究所にて、科学技術予測や科学技術動向調査を担当。2007？年より科学技術動向研究センター長。2012 年より現職。

After serving to a private company as researcher for electronics, materials and processing engineering, Dr. Okuwada joined the Foresight project and S&T trend researches at NISTEP in 2002. In 2007, she started serving as Director of Science and Technology Foresight Center at the NISTEP. She joined the JST-RISTEX in 2012.

・日本における「バックキャスティング」の考え方の導入
・科学技術政策から科学技術イノベーション政策への転換
・日本の予測活動の変遷：技術の予測からイノベーション政策のための予測へ
・2000 年以降、科学技術による将来社会への貢献の予測が主目的に変化
・予測手法におけるシーズプッシュ型とニーズ探索型の統合
・現在のニーズ把握ではなく将来の課題を把握する困難さ、リニアモデルの終焉、
そして課題解決型の予測
・アウトカム見積もりの必要性

・Introduction of Backcasting concept in Japan
・Change from S&T policy to ST&I policy
・Transformation of foresight of Japan into “ for innovation policy”
・Target of foresight in 2000s : Contribution of science and technology to future society
・Trials in methodology : Integration of Seed-push type and Needs-search type
・Difficulties in recognizing future issues (not current issues),
in non-linear innovation model and in issue-driven type foresight
・Necessity in “estimation of outcome”

The situation surrounding scientists and engineers in advanced countries is steadily going forward the same direction.

- From S&T policy to ST&I policy
  (or S&T under Innovation policy)
- Increase in expectation for social benefit
- Long trend forward aging societies

In Japan, the current secondary Abe Cabinet has placed economical recovery as the prioritized strategy.
The industrial competitiveness meeting of the Abe Cabinet will determines new targeting policies this spring, which are going to the main pillars of the growth strategy.
Of course, they are making to the new targeting policies with backcasting approach.

Foresight Activities in Japan

Foresight activities on science and technology have been continued in Japan for 40 years.

Three main approaches in foresight programs in 2000s

Seeds-push type : Delphi survey (continued for 40 years)
Needs search : Summarize of public needs in society (or regional)
Scenario writing : Route forward future, Roadmap

Summarization and integration
(Mega-trend and accelerating measure)

Reports in the past AAAS annual meetings

2005 "The Evolutionary Foresight Process and Its Application to Agenda-Setting for S&T Policy"
2009 "Sustainable Development Through Scientific and Technological Innovation"
2011 "A New Foresight Breaking Up The Borders
The 9th Science and Technology Foresight in Japan
- Contribution of Science and Technology to Future Society -

Difficulties in foresight activities (3)

Difficulties in "Issue-driven type of foresight"

- **Scenarios** — without drawing sufficient conditions
- **Roadmap** — too incremental on the fixed concept
- **Solution** — higher barrier in institution than in R&D
- **Evidence** — lack of the view of balance to the investment
- **Evaluation** — without requiring outcome beyond outputs
- **Collaboration** — without clear objectives, without necessary interdiscipline

"Backasting" should lead showing "Alternative".
What is more demanded is "Options with estimation of outcome".

■ 講演３：情報技術分野において社会ニーズに応える研究開発とは

“Research and Development Response to Societal Needs in the Information Technology Area”

フラン・ブロム　ラテナウ研究所技術アセスメント部部長
Frans W. A. Brom (Head of Department, Technology Assessment Department, Rathenau Instituut / Professor of Ethics of Technology Assessment, Philosophy Department, Utrecht University)

ユトレヒト大学にて PhD を取得（1997 年）。2007 年より現職を務めるほか、2010 年よりユトレヒト大学 哲学倫理学部教授（技術アセスメント倫理）、2013 年よりワーゲニンゲン大学科学者行動規範外部委員会議長などを兼任。

Dr. Brom gained his doctorate from Utrecht University. His research has examined the societal significance of scientific and technological advances, with a particular focus on the interaction between Technology Assessment, ethics and political philosophy.

・科学技術の社会へのインパクトも、社会の求めるものも多様である。社会は Society ではなく、複数形の Societies である。
・イノベーションにつなげるには、現場での共創（co-creation）とマーケットのダイナミクスの双方が必要
・規制にはイノベーションの阻害と促進の双方の側面がある
・邂逅で得られた研究開発課題はイノベーションに使われるだろうか

・There are various societal impacts from science and technology as well as various expectations to science and technology from society. We should take society as plural: societies.
・Both “co-creation” among science, technology and society in site, and market dynamics are required to provoke innovations.
・Regulation sometimes facilitates and sometimes hampers innovation.
・It would be questionable whether R&D themes obtained from the “encounter” process are actually utilized for innovation.

Reframing the problem

- R&D helping to cope with societal issues:
  - Needs a proper research strategy
- Setting the strategy based on strengths:
  - Is that the R&D that is needed?
- Setting the strategy based on needs:
  - Is that the R&D that is possible?
- Building a strategy on interaction and encounter:
  - Is that the R&D that will be used in innovation?

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Programme: some steps forward

Learning from interactions technology assessment

1. Social impact of ST&I: plurality and Interactivity
2. Society? Societies!
3. R&D ➔ Innovation: co-creation
4. R&D ➔ Innovation: market & entrepreneurial spirit
5. Double face of regulation

Summing up the challenges for the R&D strategy directed at responsible innovation

Rathenau Instituut

Frans W.A. Brom | 2 | Innovation Lessons from TA

Challenges for the science agenda

1. Plurality and interactivity of social impact
2. Diverse and contested societal needs
3. Fostering co-creation
4. Market dynamics of innovation
5. Regulatory framework for responsible innovation

Frans W.A. Brom | 3 | Innovation Lessons from TA

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■ 講演４：アウトプットはアウトカムではない：研究開発政策における計量の問題、複雑さ及び妥当性

"Outputs are not Outcomes: Problems of measurement, complexity, and plausibility in R&D policy"

ダニエル・サラビッツ　アリゾナ州立大学 科学と社会 教授
Daniel Sarewitz (Co-Director, Consortium for Science, Policy & Outcomes / Professor of Science and Society, Arizona State University)

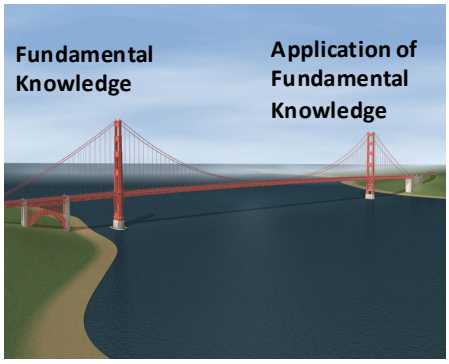
コーネル大学にて地質科学で PhD を取得（1986 年）。1989 年~1993 年に米国議会下院で研究開発政策に関するスタッフとして勤務。1999 年より現職を務めるほか、アリゾナ州立大学　科学・政策・アウトカム コンソーシアム 共同ディレクターを兼任。
Dr. Sarewitz received a doctorate in geological sciences from Cornell University in 1986. From 1989 to 1993, he worked on R&D policy issues as a staff member in the U.S. House of Representatives. He now directs Consortium for Science, Policy & Outcomes (CSPO) at Arizona State University, and focuses his efforts on a range of activities to federal science and technology policy processes.

・研究成果を応用に結びつけることは容易ではなく、また研究のアウトプットをエビデンスとして把握するのは困難。エビデンスとなる項目について、我々は「何を」、「どこで」計測しているのかを明確にする必要。
・アウトプットとアウトカムの違い。課題の因果関係の複雑さ（例：肥満）
・Public Value Mapping という非経済的な価値を対象とした分析方法を検討中。
・CRDS の試みはトップダウン的な手法に見える

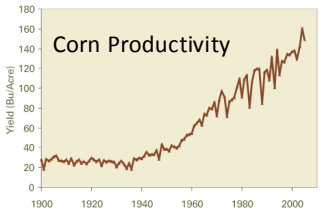
・It is not easy to link research outputs to their applications, and outputs measurements may provide little evidence of the public value of those outputs. Other types of evidence are necessary.
・We need to be aware of the gap between outputs and outcomes, as well as the complexity of causal relations surrounding societal issues. (eg. obesity)
・The CSPO is currently examining Public Value Mapping, an analytical tool to measure non-economic values.
・The attempt at the CRDS seems rather a top-down approach.

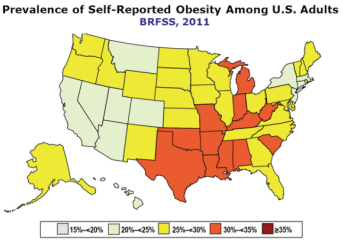
What We Measure . . . .

R&D budget
Citations
Network analysis
STEM workforce
Patents
Nobel prizes
Publications
STEM salaries
Science maps
Citation impact
Patent citations
H-factor
Collaboration metrics
% of GDP invested in R&D
Social rate of return on R&D
Co-word analysis



Outputs are not outcomes





Output

Outcome?

A Method: Public Value Mapping

Traditional Science Policy Logic Model

Research Activities, Institutions, and Translation

Policy Analysis using Standard Market-based Assessment or Output Assessment Approach

"And then a miracle occurs"

Societal Impact

Enhanced Science Policy Logic Model
Adds PVM to Avoid Public Values Failure

Assertions of Public Value Priorities and Societal Benefits, Risk, and Impacts

Public Value Mapping
(Non-Economic Analysis)

Case Study Approach

- Summarize case background and identify stakeholders
- Secure stakeholder documents including policy statements, plans, memos, web pages
- Public value statement scan
- Value chain analysis (links and hierarchies)
- Assessment of institutional capacities

Retrospective or Prospective Analysis of Capacities to Achieve Stipulated Public Values

■ 議論の概要

モデレータ原山教授の司会により、科学の２つの側面を結び付けるという方法による研究開発戦略の策定をめぐって、次の点で意見交換が行われた。

社会的期待から研究開発課題を導出することの現実性

- 社会が望んでいるものから、ニーズに対応できるような技術が開発できる研究開発課題を導出するということが、現実としてできるのだろうか。例えば、我々は看護ロボットがほしいのではなく、看護に必要な技術的支援はなにかを考える必要があるのではないか。（Brom）
- どのような未来を描くかによって社会が必要する技術も異なってくる。一つの技術もでも様々な使い方が考えられる。未来像（ビジョン）と現状とのギャップを埋めようとする方法を用いることによって、社会が必要とする技術を明らかにすることが可能と考えている。（笠木）
- 福島の原子力事故では、必要とされるロボット技術についての科学者/技術者の認識が弱かったという点が明らかになった。これは、社会が何を必要としているがについて認識する重要性が学べた事例といえる。（奥和田）

社会のニーズはボトムアップのアプローチによって把握されるのではないか

- 科学の二面性の結び付け（邂逅）には、ミクロレベルでのボトムアップのアプローチが効果的なのではないか。例えば盲目の人は、健常者が考えるほどには読むことに対する技術的支援を必要とせず、むしろ人の顔認識を必要としていることが分かったケースがある。（Sarewits）
- CRDS の取り組みは、ナショナル・レベルのファンディングを想定している点は伝えておきたい。科学者/技術者には社会ニーズに対応したい意識はあるが、ニーズを理解しきれない。またニーズの充足には、あまりにも様々なファクターが絡む。両者を結びつける触媒のような仕組みが必要。（笠木）
- Brom 教授が紹介した Co-creation の手法は、研究者と社会（具体的な現場）の共通認識を可能にする。これに対し、CRDS による方法はトップダウン的なのではないか。（原山）
- 万能な手法はないが、Co-creation によって技術者は、現場で何が必要とされているかを知ることになる。科学者が自身の関心から研究に取り組むことも重要であるが、それだけでなく、社会もしくは現場の他のステークホルダーともっと協力するようにすべきである。（Brom）
- CANTAB の開発ではツール自体の開発以上に、実際に利用してもらった反応を聞くことが重要だった。ケンブリッジの学生は基礎研究の成果の応用にも関心を持っている。アントレプレナーとしてのスキルを身につけることにも熱心である。（Sahakian）

■ Key Points of Discussions

Moderated by Professor Yuko Harayama, the methodology for R&D strategy making by linking beauty and benefit s of science was discussed.

Feasibility to identify R&D themes from social wishes

- The CRDS methodology seems to have difficulties in identifying R&D themes from abstract social wishes and deriving technologies really adaptable for practical needs. For example, if we need to seek for technologies which help us to do our nursing works better, we do not necessarily need robotic nurses. (Brom)
- The types of technologies we would need are dependent upon how we draw the future society. And there are many possible ways to utilize single technology for different purposes. We could clarify the technologies required in our society by trying to fill the gap between our future vision and the present state. (Kasagi)
- The Fukushima nuclear power plant accident revealed that robotic researchers in Japan did not really recognize what kind of robots are needed in society (any robots were not adequate to be mobilized for operations in the radioactive contaminated areas). This was one good example for us to remember the importance to recognize the needs in society. (Okuwada)

Can societal needs only be recognized though bottom-up approaches?

- For linking societal needs and technologies, it seems that bottom-up approaches in micro level targets are effective. There is an example discovered by ubiquitous computing researchers; what blind people want most are not automatic readers but something to recognize other people's faces. (Sarewitz)
- The methodology tried by the CRDS focuses on R&D investment strategies at the national level. Nowadays many researchers intend to respond to societal needs, but unfortunately they are not able to know enough about them. In addition, there are so many factors in the process to meet the societal needs. Broad-mind catalysts to link both sides are required. (Kasagi)
- The methodology of Co-creation presented by Dr. Brom enables engineers and society to have common understandings on technologies. On the other hand, the methodology tried by the CRDS looks more like a top-down approach. (Harayama)
- Through co-creation, engineers will be able to know what are really required in the fields where technologies are used. Researches based on curiosities are important, and moreover, researchers have to cooperate with stakeholders in the fields. (Brom)
- CANTAB was a research development within the University of Cambridge and was then spun out to Cambridge Cognition Limited (www.camcog.com). In Cambridge University, students are becoming interested not only in basic research but also in the application of research. Students of the Business School are eager to acquire skills as entrepreneurs. to start up new companies from research developments.（Sahakian）

■ 議論の概要（つづき）

邂逅を促進する方法はあるか

- ◆ 邂逅を促進するような方法はないのだろうか（原山）
- ◆ 若い科学者にステークホルダーとのかかわり方等を学ぶことを義務付けるのは負荷がかかりすぎるが、科学が課題の解決にどのように役に立つかついてや、協力関係の必要性等について考える訓練は、早い段階から必要である。（Sarewits）
- ◆ 戦略性の高いプログラムに科学を導入しようとする傾向にあり、科学は課題解決に寄与しうるが、必ず役立つとは限らない。（Brom）
- ◆ 一般の人（Public）に向けて keep opening door である必要がある。これは納税者に対する義務である。また一般の人に対する説明の際には表現を工夫する（Change languagses）必要がある（Sahakian）

■ シンポジウムの成果

- ◆ 社会が期待するものやニーズを研究開発に結びつける際の両者のギャップの大きさが、特にナショナル・レベルの政策において特に大きいことが再認識された。また、両者のギャップを乗り越えるための、人材育成を含む様々な試みや、アウトプット/アウトカムを把握する必要性等について、参加者との意見交換ができた。
- ◆ 「科学者と社会」についての議論を、科学者の社会ニーズに対する理解という視点から行うことができた。
- ◆ 海外からの参加者を含め、「今回の議論を次回につなげていく」という共通認識が得られたこと

■ Key Points of Discussions（Continued）

Accelerating "Encounter"

- Is it possible to accelerate or push "Encounter"？ (Harayama)
- Although we have already put a lot of burdens on young scientists in their training, scientists would also need to discuss societal problems with stakeholders and try to understand social contexts surrounding technologies from the beginning of their training.（Sarewitz）
- One of the major problems is that we tend to deliver science in very strategic programs. But science is always context dependent, and does not necessary produce goods.（Brom）
- It is important to keep engaging the public in discussions about science. We are responsible for accounting for science to the taxpayers who contribute most of our research funds. It is important to speak clearly, without the use of jargon or highly technical terms when we talk to the public.（Sahakian）

■ Findings

- It was reconfirmed that there is a large gap between social wishes/needs and R&D themes especially at the national policy-making level. The necessity of various efforts to overcome the gap with human resource development and assessment of research output/outcome was discussed and shared among the participants.
- "Scientists and society" was discussed from a view point of researchers' understanding on societal needs.
- The participants of the session have agreed to continue the discussion on how to link scientific researches to social wishes.

■ 参考資料／Appendix

(Slide of Setting the tone by Dr. Kasagi)

Center for Research and Development Strategy
Japan Science and Technology Agency

2013 AAAS Symposium
Boston February 17, 2013

Symposium on Toward Bridging the Duality of Science: Seed-push, Issue-driven, or "Encounter" ?

"How We Can Direct and Link Scientific Research to Social Wishes"

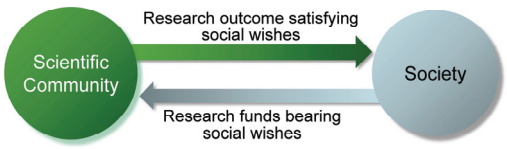
Nobuhide Kasagi FREng
Principal Fellow
Professor Emeritus, The University of Tokyo

Chikako Maeda, Fellow
Ryoji Nakamura, Fellow
Mariko Shoji, Fellow
Junichi Toyouchi, Fellow
Hideo Mori, Fellow
Shinya Nakamoto, Fellow
Tsuyoshi Motegi, Fellow
Shushi Ueta, Deputy Director General
Hiroyuki Yoshikawa, Director General

- Why we need to link scientific research to social wishes
- A trial for "Encounter" at CRDS
- What we have learned and future perspective

Science in Society and Science for Society

- *Declaration on Science and the Use of Scientific Knowledge* adopted by the World Conference on Science, Budapest, 1 July 1999
  1. Science for knowledge; knowledge for progress
  2. Science for peace
  3. Science for development
  4. Science in society and science for society
- *Social Contract for Science* proposed by J. Lubchenco (Science, 1998):



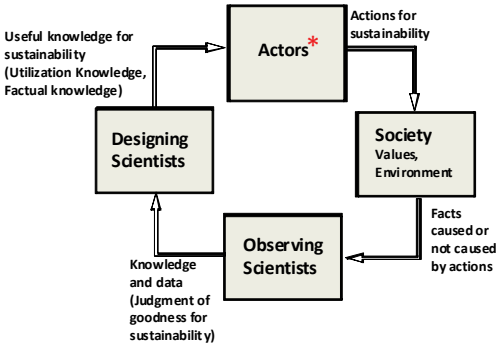
Role of Science and Scientists

A. Creation of scientific knowledge as a social asset and its transfer to the next generation

- Linking science to innovation, economic growth and social welfare
  - Science as a low-cost engine for innovation under increasing pressure of austerity
  - Innovation process from conventional linear to more complex and interactive

B. Responsibility of scientists as advisor to the public and the policy

Role of Scientists for Society: Our View



*Actors in Society are:
statesmen,
policymakers,
business humans,
administrators,
engineers,
educators,
writers,
artists,
journalists,
etc..

who move society.

C. S. Peirce: Abduction, F. Saussure: Evolutionary Loop, K. Popper: Piecemeal Technology

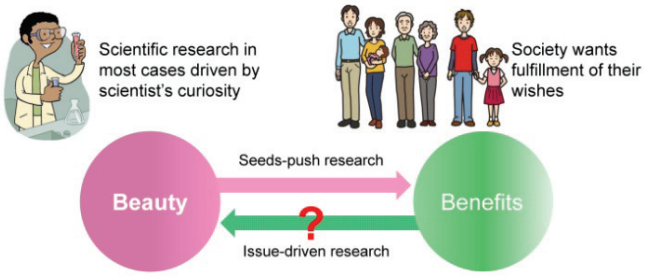
(H. Yoshikawa, 2010)

Current Issues in Japan

- Urgent major problems such as recovery and rebuilding, future energy plan, deindustrialization, aging with declining population, sovereign debt, economic crisis …….. after 2011 Great East Japan Disaster

- Japan's 4th Basic Science and Technology Plan (2011)
  - Restoration and reconstruction
  - Green innovation
  - Life innovation
  - ……..
  - S&T budget for FY2013 ~ 4.6T Yen (49B $) (+25%)

Seeds-push vs Issue-driven Research



- More effectively linking scientific achievement to social benefits, while keeping natural motive of scientist ?

Existing Problems in Designing R&D Proposals for Social Wish

- Many R&D proposals inclined to grasp social issues only from a viewpoint of individual scientific discipline and/or technological framework
- Ambiguity in extracting social wishes and lack of distinction between *objectivity* and *subjectivity* in designing R&D proposals
- R&D programs likely to contribute only partially to a specific aspect of the social issue, but not to total solution or satisfaction
- Fusion and collaboration of multiple scientific disciplines and technology fields not much encouraged

Need for Rational Strategic Methodology

- Need to develop genuine issue-driven R&D planning methodology
- Inherent difficulties in making logical, objective, evidence-based R&D policy options, but at least a fair and transparent process indispensable to build public trust in the national science and technology policy

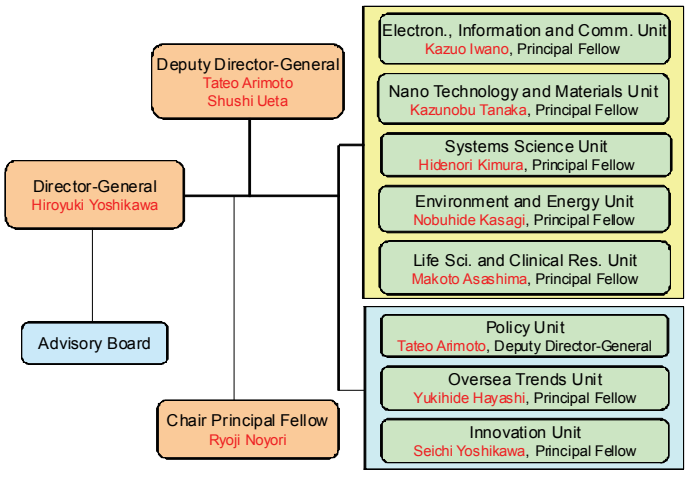
Previous Work

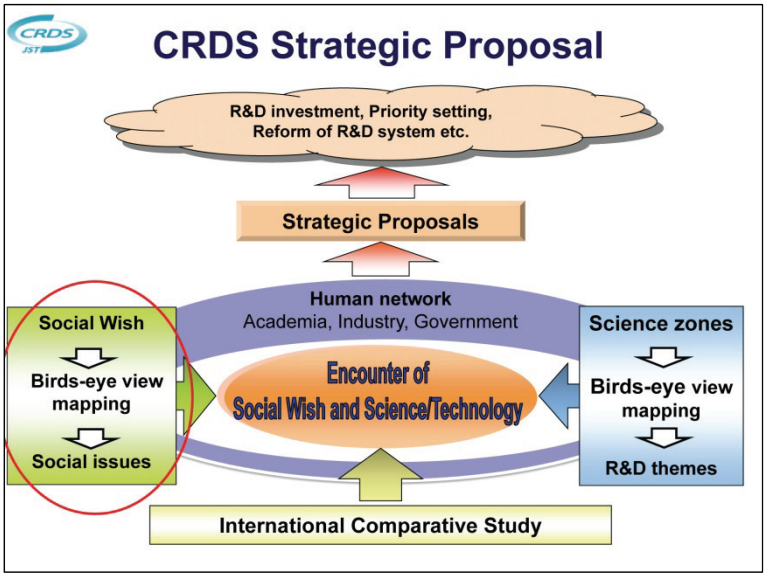
- Technology forecasting and roadmaps
  - OSTP (US), NISTEP (Japan), METI (Japan), UNIDO
  - Guide how R&D of a new technology should be funded with prediction of when it will be introduced to the market
  - Mostly concentrate on technological aspects of each of the target technologies, but without much attention to competitive technologies and changing social needs
- Trials of identifying social issues to be resolved by science and technology, while drawing a future vision
  - OECD, EU, NISTEP (Japan), RISTEX (Japan), Futur (Germany), Foresight Projects (UK), UNIDO
  - Few trials of largely extracting social issues from a bird-eye viewpoint and connecting them to well-qualified R&D themes

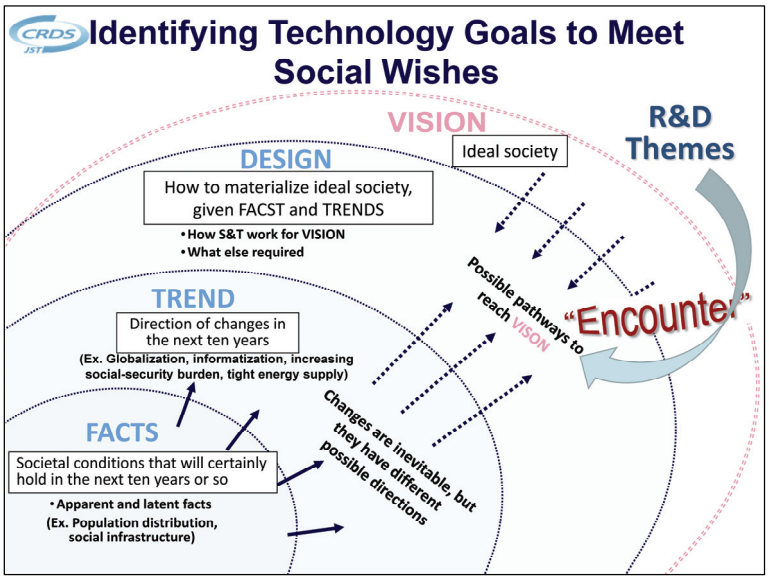
- Why we need to link scientific research to social wishes
- A trial for “Encounter” at CRDS
- What we have learned and future perspective

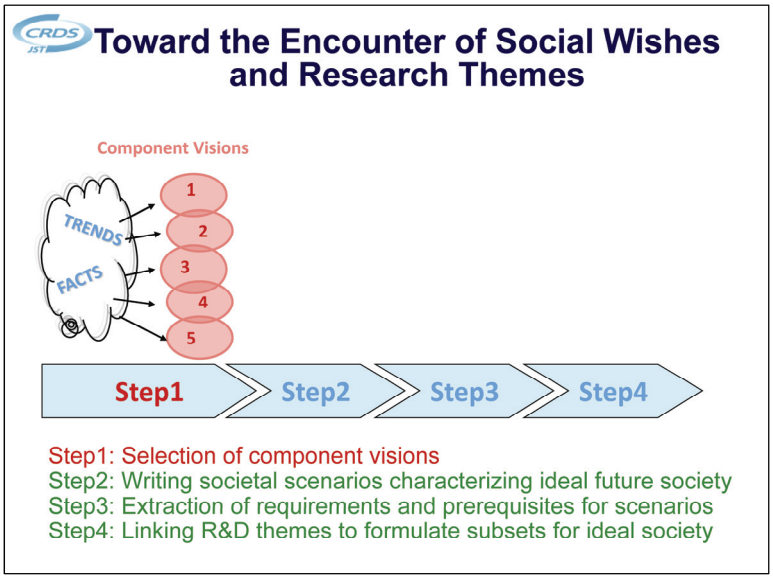
Organization of CRDS

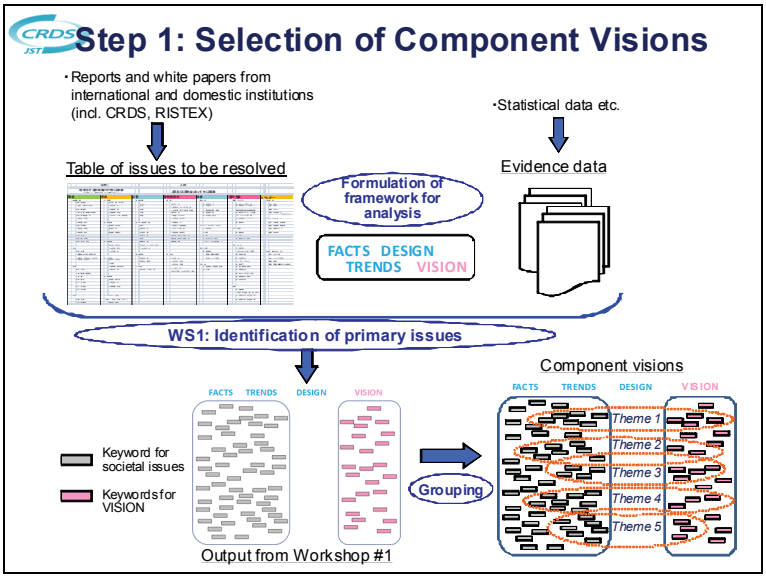
(Composed of 54 members)




CRDS Strategic Proposal
R&D investment, Priority setting,
Reform of R&D system etc.
Strategic Proposals
Human network
Academia, Industry, Government
Social Wish
Birds-eye view mapping
Social issues
Encounter of
Social Wish and Science/Technology
Science zones
Birds-eye view mapping
R&D themes
International Comparative Study


Identifying Technology Goals to Meet Social Wishes
VISION
Ideal society
R&D Themes
DESIGN
How to materialize ideal society, given FACST and TRENDS
• How S&T work for VISION
• What else required
TREND
Direction of changes in the next ten years
(Ex. Globalization, informatization, increasing social-security burden, tight energy supply)
FACTS
Societal conditions that will certainly hold in the next ten years or so
• Apparent and latent facts
(Ex. Population distribution, social infrastructure)
Possible pathways to reach VISION
"Encounter"
Changes are inevitable, but they have different possible directions

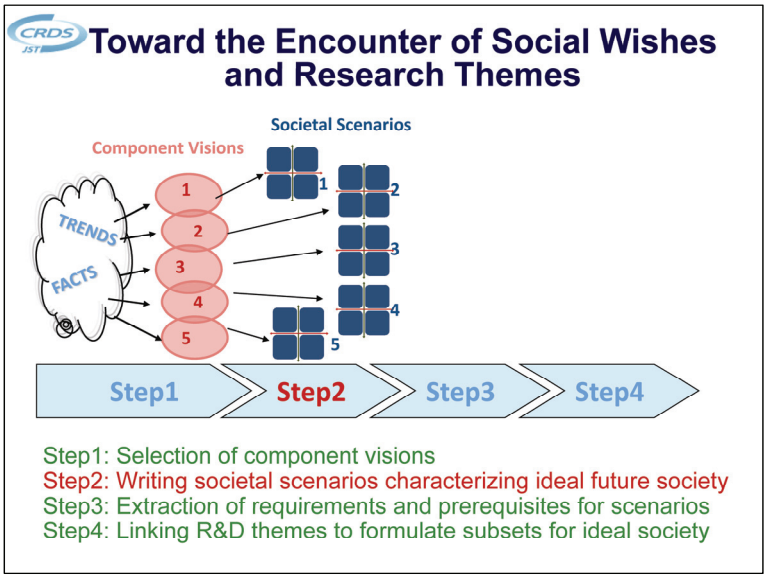

Toward the Encounter of Social Wishes and Research Themes
Component Visions
TRENDS
FACTS
1
2
3
4
5
Step1
Step2
Step3
Step4
Step1: Selection of component visions
Step2: Writing societal scenarios characterizing ideal future society
Step3: Extraction of requirements and prerequisites for scenarios
Step4: Linking R&D themes to formulate subsets for ideal society

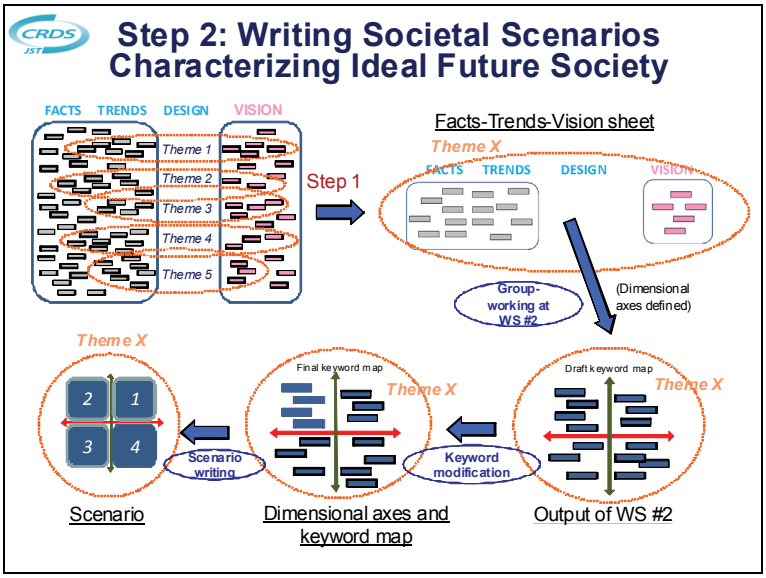


Selected Themes

- Country in borderless world
  - Theme 1: Society promoting international cooperation and collaboration
- Components in the framework of states

  (particularly relevant to Japan, but also in many developed countries)
  - Theme 2: Society overcoming energy, environment and economy (3E) issues
  - Theme 3: Society prepared for reservation, restoration and construction of social infrastructure
  - Theme 4: Society of mental and physical health expectancy (resilient to population aging with a low birth rate)
- For individuals
  - Theme 5: Society in which each individual can cultivate own capacities for self-fulfillment





Formulation of Scenarios with Dimensional Axes

Theme 1: Society promoting international cooperation and collaboration
- Strong / weak national strategy
- External / internal-minded (international / domestic-oriented) people and organizations

Theme 2: Society overcoming energy, environment and economy (3E) issues
- Large or small economy
- National (state) or civil initiatives

Theme 3: Society prepared for reservation, restoration and construction of social infrastructure
- Strengthening stocks / enforcing operation
- Uniformity / diversity

Theme 4: Society of mental and physical health expectancy (resilient to population aging with a low birth rate)
- Adaptive / preventive medicine

Theme 5: Society in which each individual can cultivate capacities for self-fulfillment
- Competitive / harmonized relationship of individuals and organizations
- Fixed / flexible relationship of individuals and organizations

Theme 2: Society Overcoming Energy, Environment and Economy (3E) Issues

2nd Q. Civil initiative & Large economy

In order to keep and improve status as an economically leading country, the Japanese government aims at higher economic growth as well as the simultaneous 3E solution. The government encourages private sectors with policy such as deregulation and decentralization, and keeps its intervention to market minimum. .....

1st Q. State initiative & Large economy

In order to keep and improve status as an economically leading country, the Japanese government aims at a higher economic growth as well as the simultaneous 3E solution. The policy prioritizes stable and abundant energy supply for industry and induce various new business activities. The government encourages offshore businesses by domestic companies. .....

changing: e.g. non-traditional fossil fuels and renewable energy

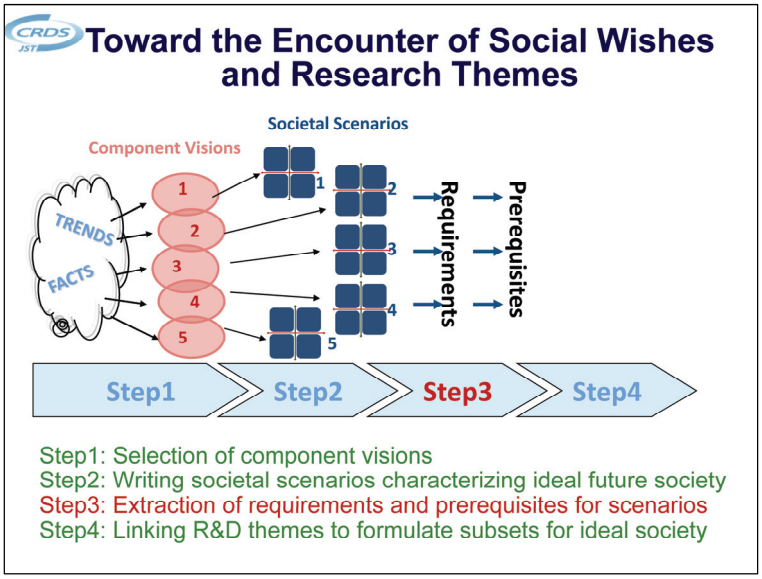
3rd Q. Civil initiative & Small economy

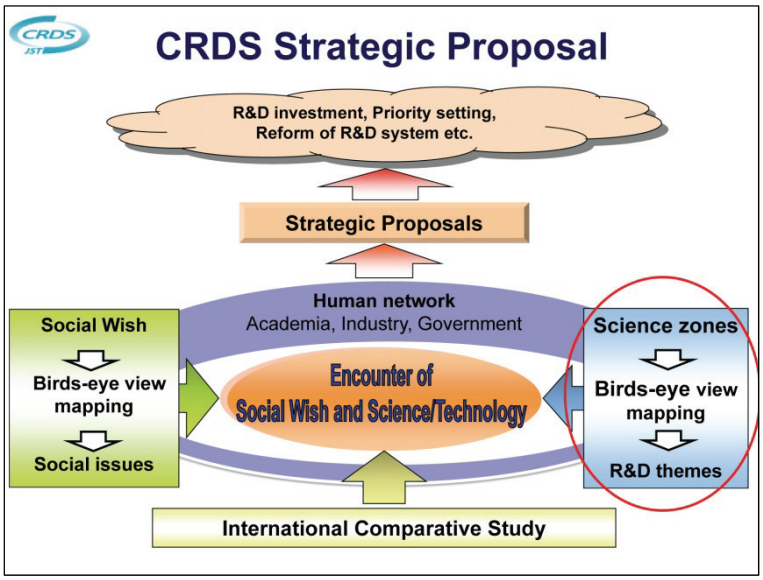
With the population declining and the society aging, Japan aiming at the simultaneous 3E solution does not prioritize the strong economic growth as in the past. The government encourages private sectors with policy such as deregulation and decentralization, and keeps its intervention to market minimum. .....

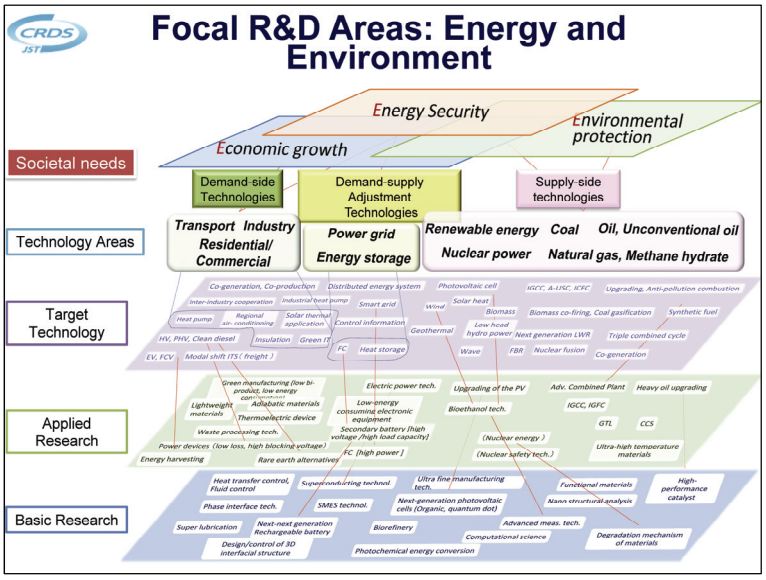
4th Q. State initiative & Small economy

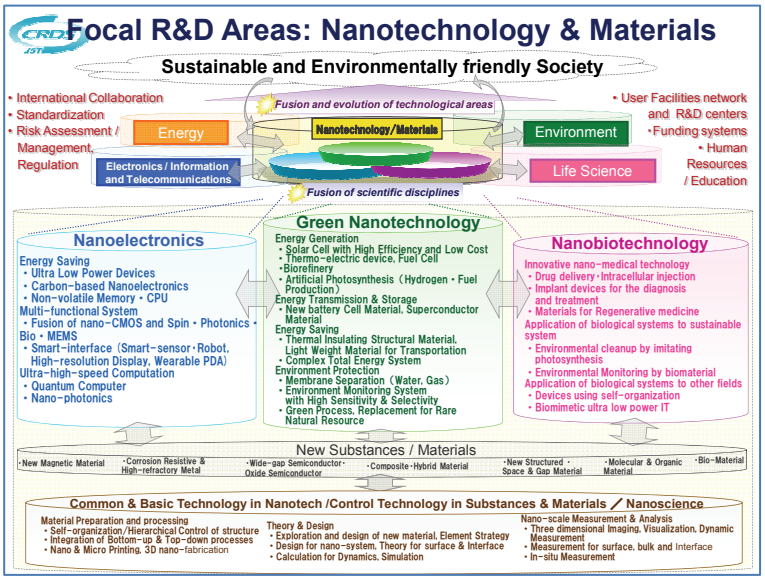
With the population declining and the society aging, Japan aiming at the 3E achievement does not prioritize the strong economic growth as in the past. Demand for primary energy supply is lower than before. The government implements a policy mix for the massive introduction of renewable energy in Japan. .....

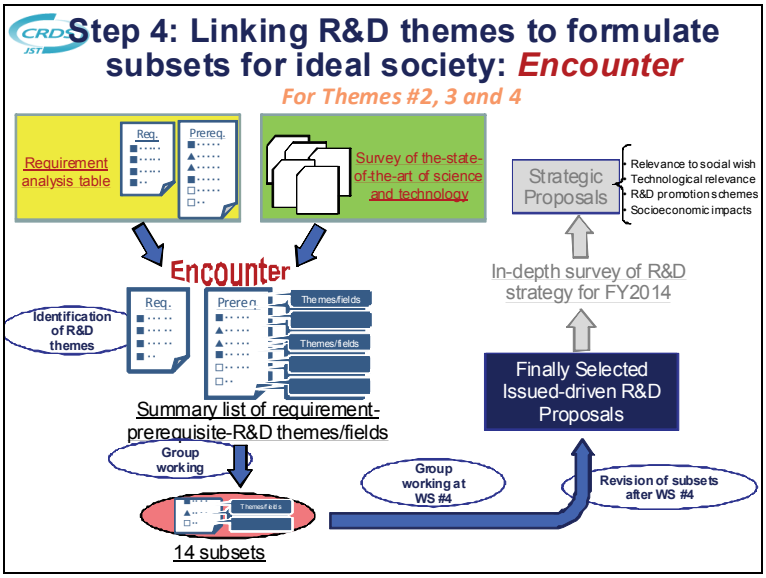
from overseas companies

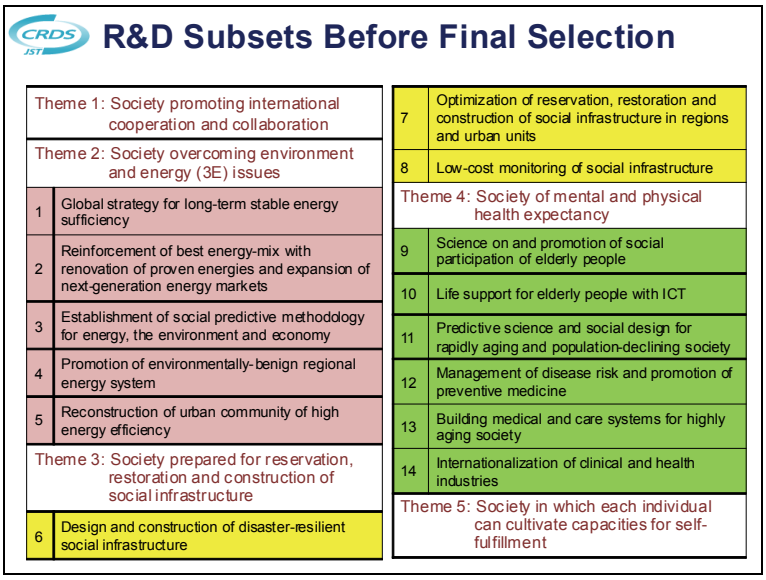

Toward the Encounter of Social Wishes and Research Themes
Societal Scenarios
Component Visions
TRENDS
FACTS
1
2
3
4
5
Requirements
Prerequisites
Step1
Step2
Step3
Step4
Step1: Selection of component visions
Step2: Writing societal scenarios characterizing ideal future society
Step3: Extraction of requirements and prerequisites for scenarios
Step4: Linking R&D themes to formulate subsets for ideal society


CRDS Strategic Proposal
R&D investment, Priority setting,
Reform of R&D system etc.
Strategic Proposals
Human network
Academia, Industry, Government
Social Wish
Birds-eye view mapping
Social issues
Encounter of
Social Wish and Science/Technology
Science zones
Birds-eye view mapping
R&D themes
International Comparative Study


Focal R&D Areas: Energy and Environment
Energy Security
Environmental protection
Economic growth
Societal needs
Demand-side Technologies
Demand-supply Adjustment Technologies
Supply-side technologies
Technology Areas
Transport Industry Residential/ Commercial
Power grid
Energy storage
Renewable energy
Coal
Oil, Unconventional oil
Nuclear power
Natural gas, Methane hydrate
Target Technology
Applied Research
Basic Research


Focal R&D Areas: Nanotechnology & Materials
Sustainable and Environmentally friendly Society
• International Collaboration
• Standardization
• Risk Assessment / Management, Regulation
Energy
Electronics / Information and Telecommunications
Fusion and evolution of technological areas
Nanotechnology/Materials
Environment
Life Science
Fusion of scientific disciplines
• User Facilities network and R&D centers
• Funding systems
• Human Resources / Education
Nanoelectronics
Energy Saving
• Ultra Low Power Devices
• Carbon-based Nanoelectronics
• Non-volatile Memory • CPU
Multi-functional System
• Fusion of nano-CMOS and Spin • Photonics
Bio • MEMS
• Smart-interface (Smart-sensor・Robot, High-resolution Display, Wearable PDA)
Ultra-high-speed Computation
• Quantum Computer
• Nano-photonics
Green Nanotechnology
Energy Generation
• Solar Cell with High Efficiency and Low Cost
• Thermo-electric device, Fuel Cell
・Biorefinery
• Artificial Photosynthesis (Hydrogen・Fuel Production)
Energy Transmission & Storage
• New battery Cell Material, Superconductor Material
Energy Saving
• Thermal Insulating Structural Material, Light Weight Material for Transportation
• Complex Total Energy System
Environment Protection
• Membrane Separation (Water, Gas)
• Environment Monitoring System with High Sensitivity & Selectivity
• Green Process, Replacement for Rare Natural Resource
Nanobiotechnology
Innovative nano-medical technology
• Drug delivery・Intracellular injection
• Implant devices for the diagnosis and treatment
• Materials for Regenerative medicine
Application of biological systems to sustainable system
• Environmental cleanup by imitating photosynthesis
• Environmental Monitoring by biomaterial
Application of biological systems to other fields
• Devices using self-organization
• Biomimetic ultra low power IT
New Substances / Materials
・New Magnetic Material
・Corrosion Resistive & High-refractory Metal
・Wide-gap Semiconductor・Oxide Semiconductor
・Composite・Hybrid Material
・New Structured・Space & Gap Material
・Molecular & Organic Material
・Bio-Material
Common & Basic Technology in Nanotech /Control Technology in Substances & Materials / Nanoscience
Material Preparation and processing
• Self-organization/Hierarchical Control of structure
• Integration of Bottom-up & Top-down processes
• Nano & Micro Printing, 3D nano-fabrication
Theory & Design
• Exploration and design of new material, Element Strategy
• Design for nano-system, Theory for surface & Interface
• Calculation for Dynamics, Simulation
Nano-scale Measurement & Analysis
• Three dimensional Imaging, Visualization, Dynamic Measurement
• Measurement for surface, bulk and Interface
• In-situ Measurement


Step 4: Linking R&D themes to formulate subsets for ideal society: Encounter
For Themes #2, 3 and 4
Requirement analysis table
Req.
Prereq.
Survey of the-state-of-the-art of science and technology
Strategic Proposals
• Relevance to social wish
• Technological relevance
• R&D promotion schemes
• Socioeconomic impacts
In-depth survey of R&D strategy for FY2014
Encounter
Identification of R&D themes
Req.
Prereq.
Themes/fields
Themes/fields
Summary list of requirement-prerequisite-R&D themes/fields
Finally Selected Issued-driven R&D Proposals
Group working
Group working at WS #4
Revision of subsets after WS #4
14 subsets


R&D Subsets Before Final Selection
Theme 1: Society promoting international cooperation and collaboration
Theme 2: Society overcoming environment and energy (3E) issues
1 Global strategy for long-term stable energy sufficiency
2 Reinforcement of best energy-mix with renovation of proven energies and expansion of next-generation energy markets
3 Establishment of social predictive methodology for energy, the environment and economy
4 Promotion of environmentally-benign regional energy system
5 Reconstruction of urban community of high energy efficiency
Theme 3: Society prepared for reservation, restoration and construction of social infrastructure
6 Design and construction of disaster-resilient social infrastructure
7 Optimization of reservation, restoration and construction of social infrastructure in regions and urban units
8 Low-cost monitoring of social infrastructure
Theme 4: Society of mental and physical health expectancy
9 Science on and promotion of social participation of elderly people
10 Life support for elderly people with ICT
11 Predictive science and social design for rapidly aging and population-declining society
12 Management of disease risk and promotion of preventive medicine
13 Building medical and care systems for highly aging society
14 Internationalization of clinical and health industries
Theme 5: Society in which each individual can cultivate capacities for self-fulfillment

- Why we need to link scientific research to social wishes
- A trial for "Encounter" at CRDS
- What we have learned and future perspective

What We Have Learned

- A new design method based on systematic and logical thinking is proposed for "*encounter*" between social wish and R&D themes as:

1. Extracting anticipated future societal changes and issues from *facts* and *trends*, and specifying the social wish as concrete issues and associated functional requirements and prerequisites by verbally drawing a *vision*.
2. Identifying focal scientific elements and R&D movement in a specific field by making the state-of-the-art review of science and technology from a bird's-eye view
3. Guiding the two preceding processes to an encounter, where social issue-oriented R&D themes are formulated (*design*) with enforced integration and collaboration of multiple scientific disciplines

What We Have Learned (Cont.)

- The present methodology is well justified by the trial of CRDS involving experts of various disciplines.
- It offers a realistic process of making a strategic R&D proposals possibly better in terms of social foresight as well as methodological legitimacy in identifying R&D themes.
- The well-documented process with distinction between objectivity and subjectivity would be more convincing to the policy makers and the public.

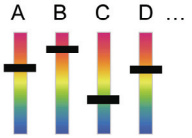
Future Perspective

- Every process has been made as objective as possible, although subjective views might have also been included partially. Such views should not necessarily be excluded unless they are too much biased; essentially important is the separation of objectivity and subjectivity that is clear to every stakeholder.
- Further study is needed to clarify how much the requirements and prerequisites should be detailed since it certainly affects the success of encounter.
- All subsets presently formulated will be screened and elaborated for final strategic proposals through scientific (objective) assessment and political (subjective) evaluation.

Objectivity and Subjectivity in Decision Making

Objective assessment of policy options

Subjective judgment



- Clear distinction between evidence-based assessment and political judgment
- Public trust in consensus building under democracy

Thank you very much for your attention!

■ 2013 年 AAAS 年次大会 CRDS 主催シンポジウム報告書 作成担当■

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CRDS-FY2013-XR-02

独立行政法人科学技術振興機構研究開発戦略センター

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Report on CRDS Symposium Session at 2013 AAAS Annual Meeting

Toward Bridging the Duality of Science:Seed-push, Issue-driven, or "Encounter" ?

平成 25 年 7 月　July 2013

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