

第 8 回予測国際会議「未来の戦略構築に貢献するための予測」開催報告

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シンポジウムプログラム

日時： 2017 年 11 月 29 日 (水) 10:00～17:45

場所： 政策研究大学院大学 1F 想海樓ホール

主催： 文部科学省科学技術・学術政策研究所、政策研究大学院大学

開催趣旨：

近年、政治・経済情勢の複雑化や新しい科学技術の登場により社会変化が加速され、社会全体での不確実性が一層高まっています。こうした環境の中で、国や企業は、国内外の潮流をいち早く見定め、未来の産業創造や社会の変革に対応した先見性のある戦略的な活動展開が不可欠となっています。

こうした中、不確実性を織り込んで将来の社会像を描き、戦略立案を行う有用なツールとして予測活動(フォーサイト)があります。予測活動では、将来の社会像と実現の方向性についてのビジョン共有が重要となります。このため、合意形成の観点からは、多様なステークホルダーの参画が鍵になります。

一方、不確実性に迅速に対応する観点からは、情報技術の発展に伴い人工知能等を活用した分析など、新たな手法の導入やデータ基盤の整備に対しても関心が高まっています。このため、ビッグデータから社会変化や有望な科学技術の進展の兆候を抽出する分析手法の開発など、予測活動に関連する様々な取組が世界各所で進められています。

本会議では、こうした世界各国の状況についての事例紹介をもとに、これからの国や企業の戦略立案に資する予測活動のあり方について、国内外の専門家とともに議論を行います。

プログラム：

10:00 開会・基調講演

開会挨拶 文部科学大臣政務官 新妻 秀規

基調講演1「予測の未来を予測する？」

内閣府総合科学技術・イノベーション会議 議員 原山優子

基調講演2「日本の政策決定プロセスと科学技術予測」

政策研究大学院大学科学技術イノベーション政策研究センター
センター長 白石隆

11:00 セッション1「未来に向けた戦略と予測」

国や企業の戦略策定のために用いる予測の在り方や、予測の活用方策について、国内外の産・学・官の有識者による講演

「民間企業における戦略と予測」

株式会社日立製作所 武田晴夫

「ロシアにおけるスマートな科学技術イノベーション政策に向けた予測」
ロシア国立高等経済学院統計・知識経済研究所 (HSE/ISSEK)
Alexander Chulok

「カナダ政府における予測システムの構築」
カナダ政府ポリシーホライズンズカナダ (PHC) Peter Padbury

12:30 休憩

14:00 セッション 2「予測活動の新たな展開:ステークホルダーの参画と合意形成」

ステークホルダーの参画のもと合意形成を目指す予測活動など、国・国際機関レベルの新たな予測活動の方向性について、予測活動の専門家による講演

「日本の科学技術イノベーション政策における予測活動の新たな展開」
文部科学省科学技術・学術政策研究所 赤池伸一

「予測とコミュニティ参画」
フィンランド技術庁(Tekes) Pirjo Kyläkoski

「EU における未来予測調査:イノベーション政策を支える予測活動」
オーストリア技術研究所(AIT) Karl Matthias Weber

15:30 休憩

15:45 セッション 3「デジタル化時代の予測活動:各機関の事例紹介」

将来社会や科学技術の変化の「兆し」を捉え、予測活動の基礎となる活動として、人工知能等のデータ分析や予測・評価など、機関レベルの取組事例を紹介

「科学技術予測・ホライズン・スキヤニングにおける情報技術の利用:科学技術予測センターにおける予測オープンプラットフォーム/KIDSASHI 等のシステム開発」

文部科学省科学技術・学術政策研究所 小柴等

「国の研究開発政策のための革新的なアイデア創出の促進と継承」
韓国科学技術政策研究院(STEPI) Seongwon Park

「公的研究助成における新たに投資すべき研究領域発見のための予測と評価:米国立科学財団(NSF)における評価基盤構築」

米国 NSF Anand Desai

「多様な将来社会像と政策調整:OECD と各国政府における経験から」
経済協力開発機構(OECD) Joshua Polchar

17:30 閉会挨拶 科学技術・学術政策研究所 所長 加藤重治

(敬称略)

Foreseeing the Future of Foresight?

Yuko Harayama
Executive Member
Council for Science, Technology and
Innovation (CSTI)



Predictions by Robert Boyle (350 years ago!)

- The Prolongation of Life
- The Recovery of Youth, or at least some of the Marks of it, as new Teeth, new Hair colour'd as in youth
- The Art of Flying
- The Art of Continuing long under water, and exercising functions freely there
- The Cure of Wounds at a Distance
- The Cure of Diseases at a distance or at least by Transplantation
- The Attaining Gigantick Dimensions
- The Emulating of Fish without Engines by Custome and Education only
- The Acceleration of the Production of things out of Seed
- The Transmutation of Metals
- The makeing of Glass Malleable
- The Transmutation of Species in Mineralls, Animals, and Vegetables
- The Liquid Alkaest and Other dissolving Menstruums
- The making of Parabolical and Hyperbolical Glasses
- The making Armor light and extremely hard
- The practicable and certain way of finding Longitudes
- The use of Pendulums at Sea and in Journeys, and the Application of it to watches
- Potent Druggs to alter or Exalt Imagination, Waking, Memory, and other functions, and appease pain, procure innocent sleep, harmless dreams, etc.
- A Ship to saile with All Winds, and A Ship not to be Sunk
- Freedom from Necessity of much Sleeping exemplify'd by the Operations of Tea and what happens in Mad-Men
- Pleasing Dreams and physical Exercises exemplify'd by the Egyptian Electuary and by the Fungus mentioned by the French Author
- Great Strength and Agility of Body exemplify'd by that of Frantick Epileptick and Hysterick persons
- A perpetuall Light
- Varnishes perfumable by Rubbing

From the Royal Society Archive

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29/11/2017

Time of accelerated changes!

- **2015**

- Preparing the 5th Science & Technology Basic Plan (2016-2020)
 - Planning: Business As Usual (BAU)?
 - Our hypothesis: **Time of accelerated changes**
- ⇒ Enhancing **preparedness** for the **unforeseeable future**
- ⇒ Identifying our **core values**!

Society 5.0

- **2016**

- Unexpected becoming reality (including geo-politics) ⇒ Uncertainty↑
 - Hype in Artificial Intelligence (AI)
 - UN Sustainable Development Goals (SDGs) ⇒ Shared values

- **2017**

- Uncertainty surrounding security issues

3

29/11/2017

Policy formulation based on ...

- Looking back
 - Data gathering & Analysis
 - Ex-post policy evaluation ⇒ Lessons to be learned
- Looking at the present
 - Data gathering & Analysis
 - Assessment ⇒ Framing the future
- **Looking forward**
 - Delphi
 - Road mapping
 - Horizon scanning
 - Scenario planning
 - ...
- Deep dive toward “Evidence-based (informed) policy making”

Forecasting the future?
Predicting the future?
Modeling the future?
Planning the future?
**Enhancing preparedness
for the future?**

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29/11/2017

On the ground

- Many tools tested and improved
 - Combined (e.g. Delphi & Scenario)
- Sharing practices
- Data gathering
- Mutual learning



- Among experts and what about **other stakeholders**?
- Tips for **users**?
- **Digital transformation** affecting the practice?

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29/11/2017

Today's
menu!

Practice @ the OECD

- Background
 - Going Digital: Making the Transformation Work for Growth and Well-being
 - Pillar 1. Horizontal activities
 - Collaborative projects: **Strategic Foresight**, Policy Design, & Digital Security
 - ➔ Going Digital Expert Advisory Group
- **Going Digital Scenarios**
 - Strategic foresight ➔ Preparing government for the unexpected
 - Provide a sense of the broader range of future possibilities (Plausible extremes!) ➔ To develop & test more robust & agile policies (resilience % potential direction, pace and scale of changes)

@ Session 3

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29/11/2017

Discussion @ the OECD

- Strategic foresight as an invitation to think about our future
- Revisiting the “path dependency”?
 - Actions today will frame our future
- All of us, in particular the governments, we have a part of responsibility for our future
- Value in the process
 - Practice of horizontality
- Tool for engaging a continuing dialogue



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29/11/2017

The future of foresight?

Foresight empowered by
new approaches & new tools!

Not only for “**better policies**”,
but for “**better lives**”!

Looking forward for a fruitful
discussion!



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29/11/2017



Outline

- **HSE and ISSEK:**
a few key facts
- **S&T Foresight studies:**
global outlook for changing environment
- **Russian S&T Foresight:**
methodology and examples of key results
- **Creating S&T Foresight System in Russia:**
tasks, typical 'lessons' and key steps forward

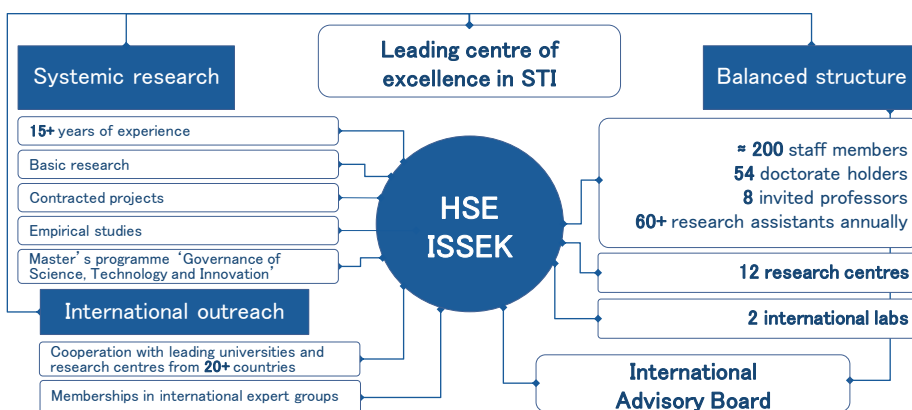


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HSE ISSEK as a centre for advanced studies in STI



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Facts and figures



- **150+ articles in leading scientific journals** (including *Nature*, *Applied Energy*, *Energy Policy*, *Technovation*, *Technological Forecasting and Social Change*, *Scientometrics*, *Futures*, *Foresight*, *Journal of Knowledge Economy*, etc.)

- **90% of articles in Q1-Q2 journals**

- **50+ international book chapters**

- **70+ working papers indexed in SSRN** (Series: Science, Technology and Innovation)



- **20 young scholars (below 39 y.o.) have published papers in journals indexed in Scopus & Web of Science**

- **60+ students annually** participate in HSE ISSEK research projects



- **Journal *Foresight and STI Governance***

- **Indexed in Scopus (Q2)**, EBSCO, SSRN, RePEc, ProQuest, New Jour, Academic Search Premier, RSCI WoS



- **Participation in editorial boards of 10 international journals**



- **Springer book series on STI studies**
- **> 30,000 paid downloads total**

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Major research areas



STI measurement

- Statistics and indicators of STI, Information Society, digital economy, education, employment
- Business tendency surveys
- Methodological studies and survey design
- Data analysis and international comparisons

STI policy

- Institutional design of institutions (research and policy evaluation)
- Economic mechanisms (funding, tax incentives, performance-based compensations, etc.)
- Regional and cluster STI policies (Russian Cluster Observatory)
- Innovation strategies of large companies

Foresight and long-term forecasting

- Global technology trends
- Foresight methodologies
- Long term foresight, forecasting and strategic planning at national, sectoral, regional and corporate levels

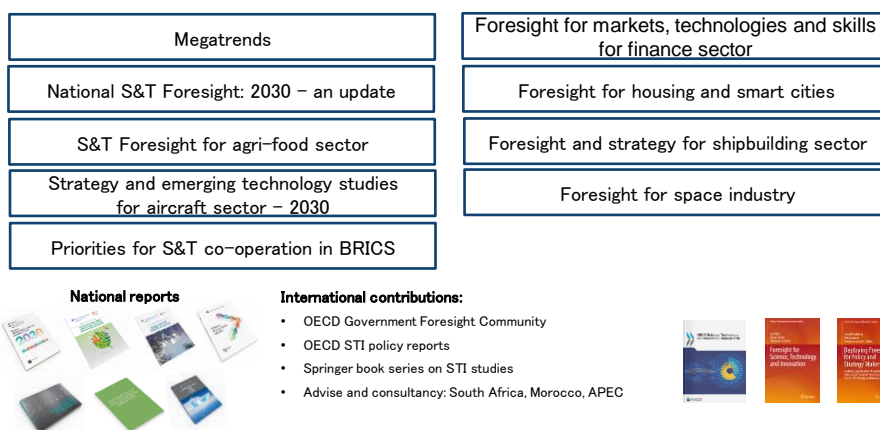
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STI policy studies: new projects



7

Foresight: recent and ongoing projects

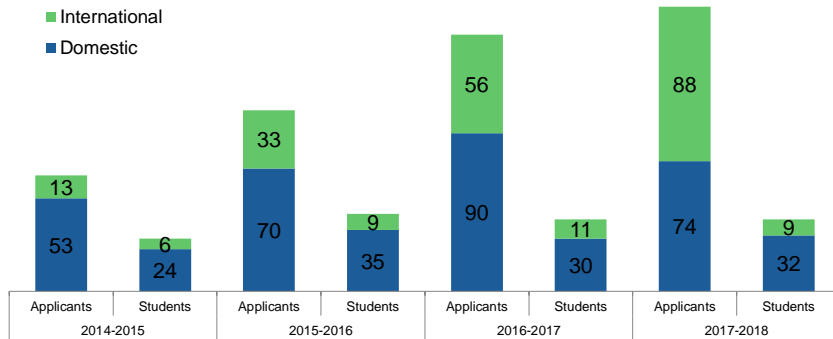


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Master's programme



- Launched in September 2014



- **Teaching staff:** leading ISSEK and international scholars
- **Double degree programmes:** *Technische Universität Berlin, Maastricht University, Seoul National University*
- **Student exchange programmes:** *University of Bremen, Tokyo University*
- **International internships:** *OECD, ZSI, etc.*

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S&T Policy: current challenges

External Challenges*

- Selectivity (which fields we support?)
- Concentration (which institution or research team we support?)
- Sustainability (do we spent enough resources to reach the goal?)

S&T Policy →
S&T FORESIGHT

- Institutional framework (IPR, transparency, business climate, agile ecosystem, etc.)
- Providing mobility and substitution of resources
- Smart governance (bargain between "hard and soft" modes)

Expectations

Evidence-based analysis →
"proofs" and transparency
"What if " questions → scenarios
and modelling
Weak signals of emerging
disruptive trends → intelligence
Prioritizing → detailed data
Integration to policy → "smart"
decisions

Possibilities

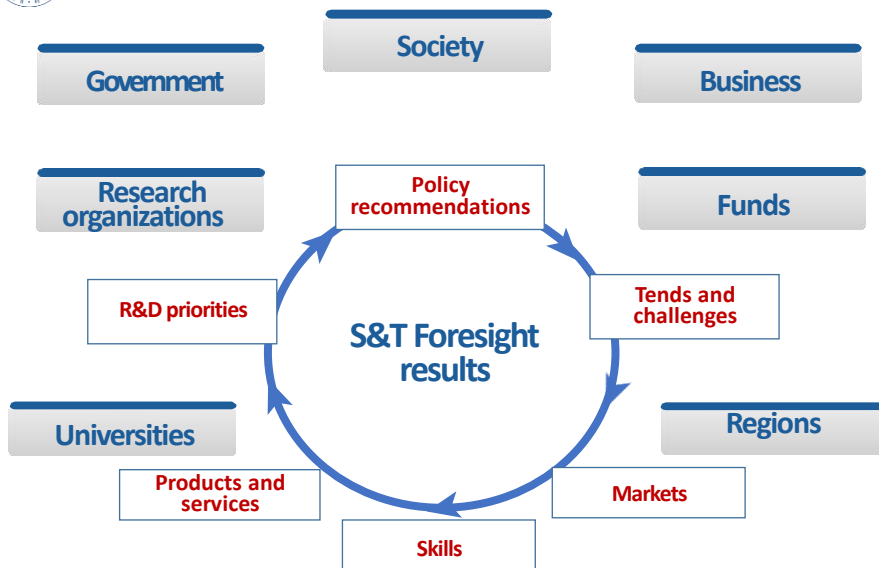
Multidisciplinary and multicultural
research
Integration of quantitative and
qualitative methods
Big Data analytics
Stakeholders engagement
Communication and networking

* Adapted from L.Giorgiou

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S&T Foresight Results: key beneficiaries



COULD FORESIGHT MEET THIS GROWING DEMAND ?

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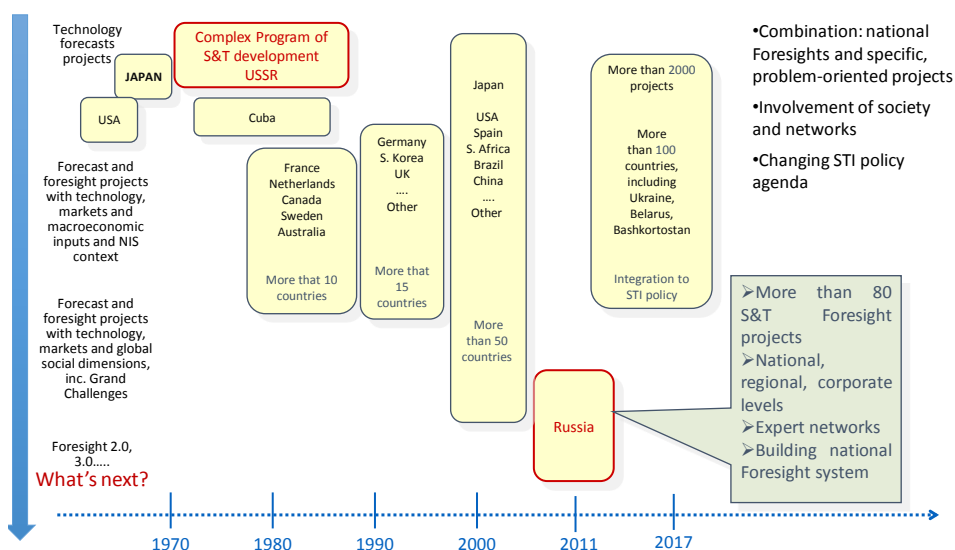
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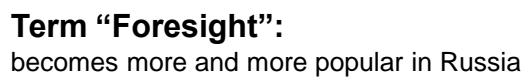
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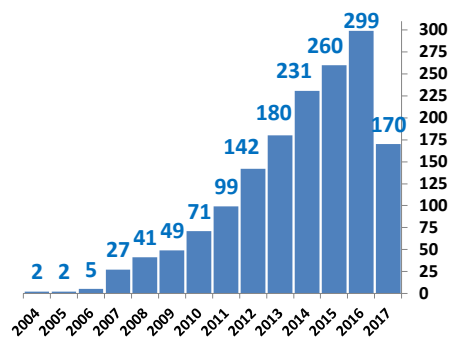
Foresight generations: Russia and foreign countries



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Number of publications on Foresight in Russian Science Citation Index database



Search was run for the Russian word "Форсайт" (Foresight) and all its word-forms in keywords-title-abstract of publications in Russian Science Citation Index (РИЦ www.elibrary.ru) database for all types of documents.

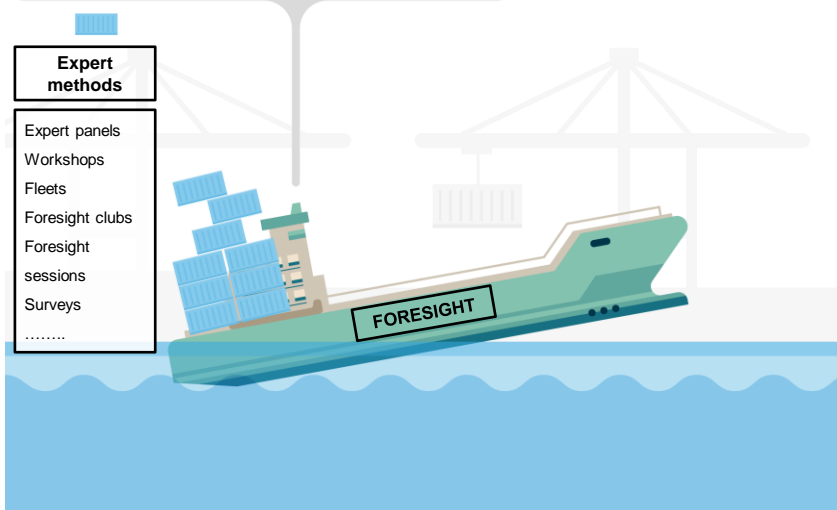
Semantic agenda of high level STI policy papers



We have “critical mass” for national S&T Foresight system

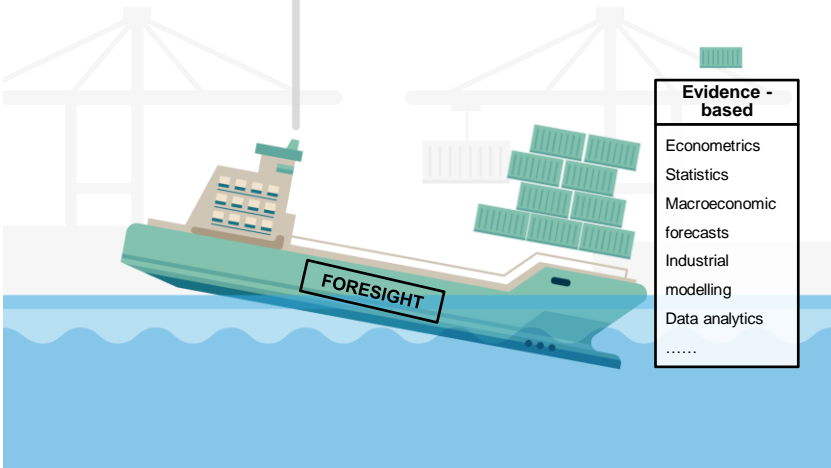
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S&T Foresight Results: Shortcomings of methodology



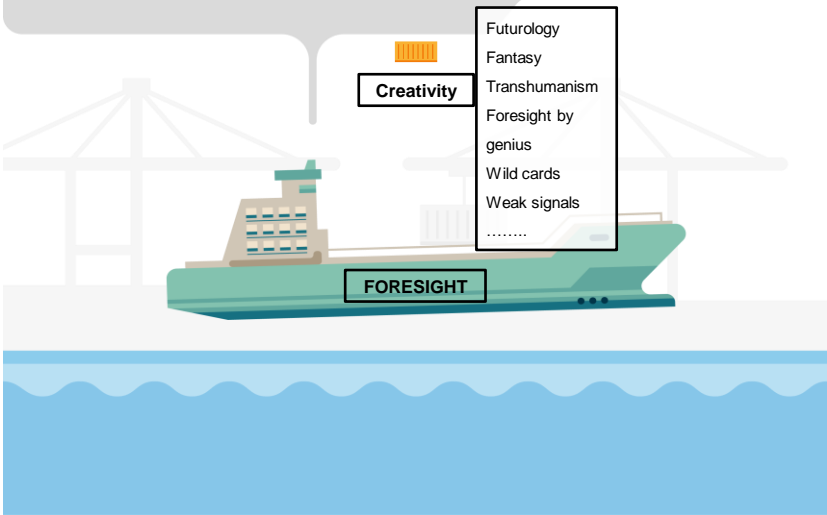
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S&T Foresight Results:
Shortcomings of methodology



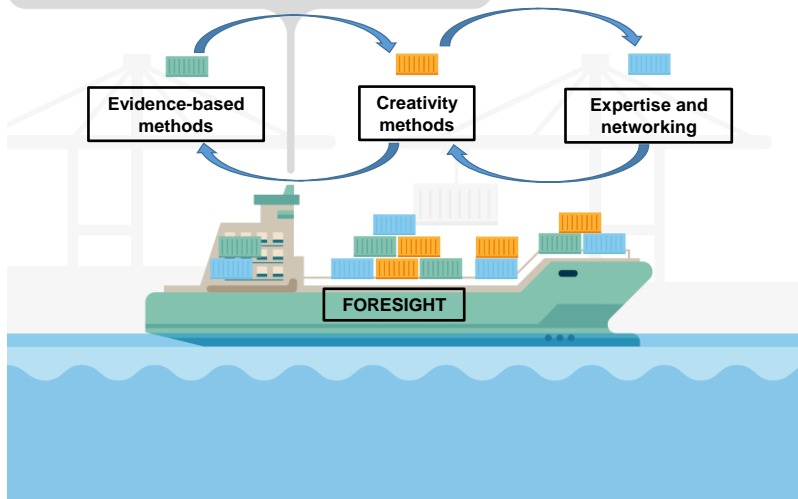
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S&T Foresight Results:
Shortcomings of methodology



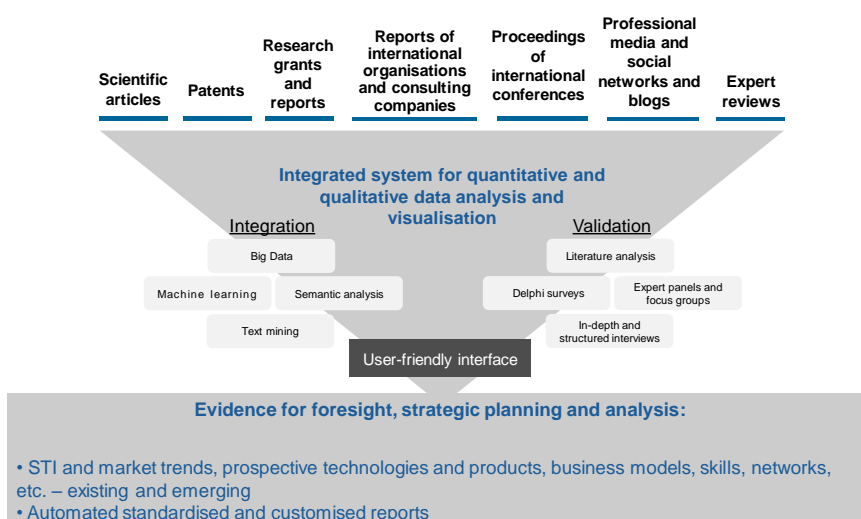
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S&T Foresight Results: Shortcomings of methodology



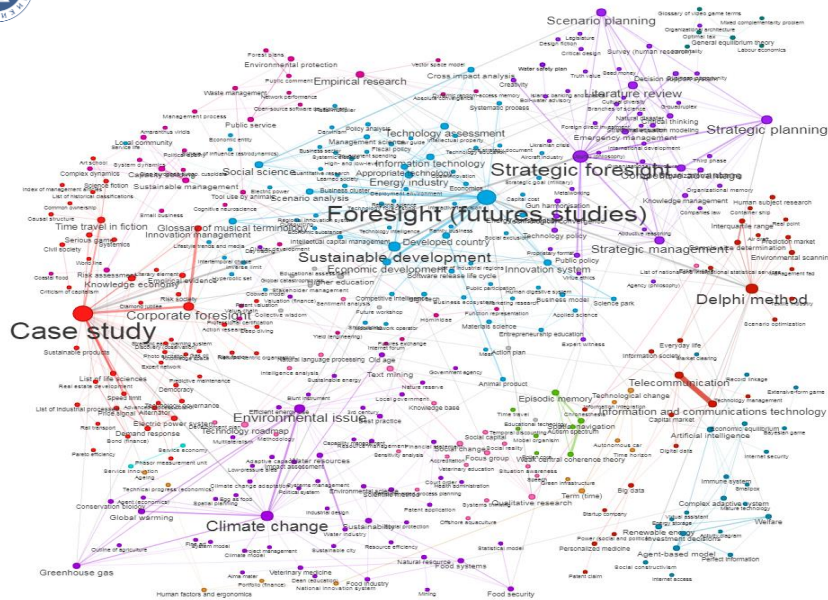
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intelligent Foresight Analytics (iFORA): a new frontier



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Foresight studies: insights from world semantic map

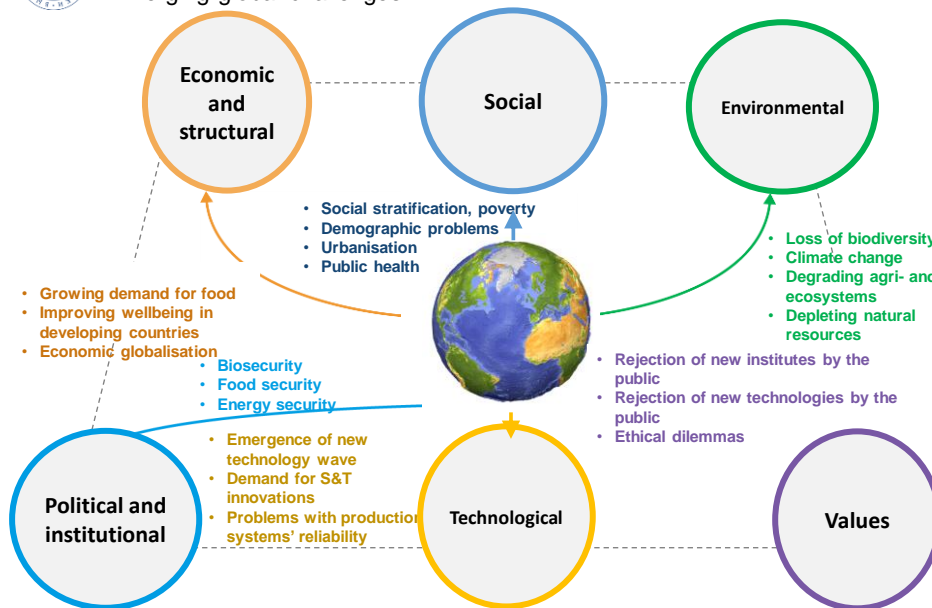


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S&T Foresight Results:

Emerging global challenges

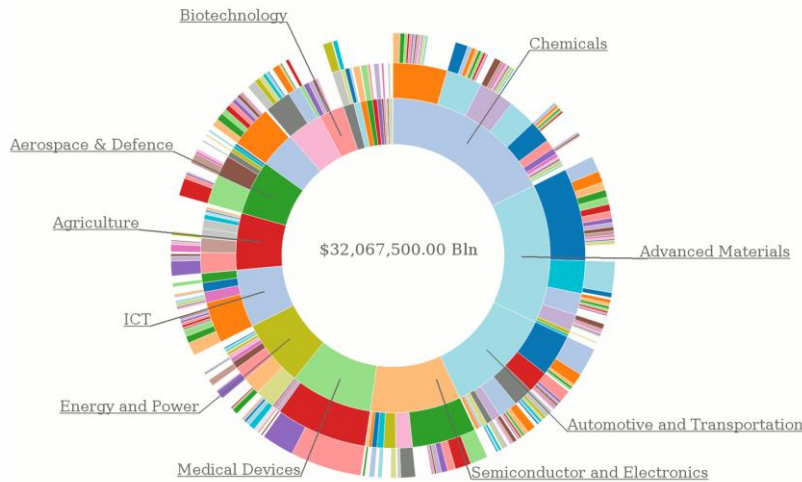


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Could Bid Data help us? → Features of iFORA: classification of more than 2000 world markets

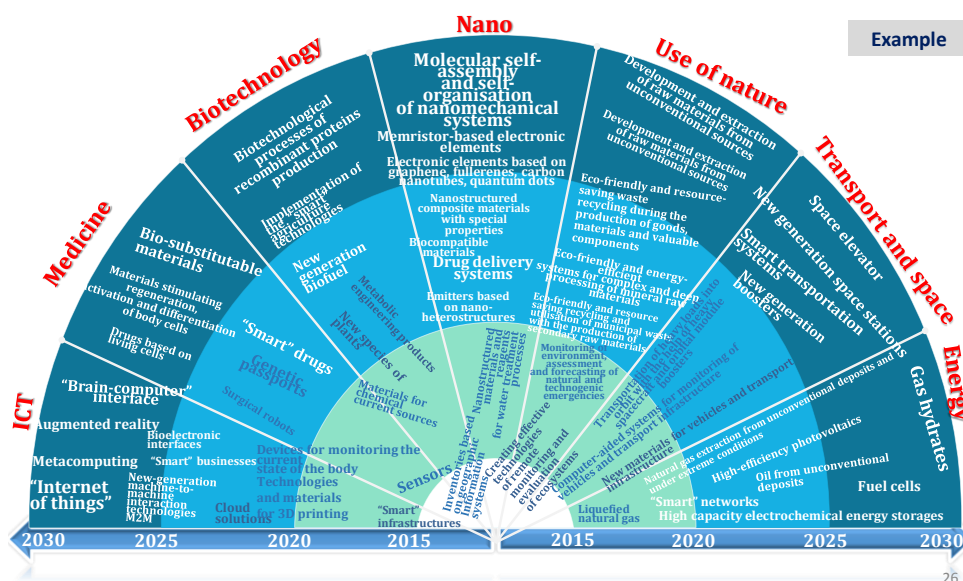


Confidential

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Radical products and services: R&D outcomes

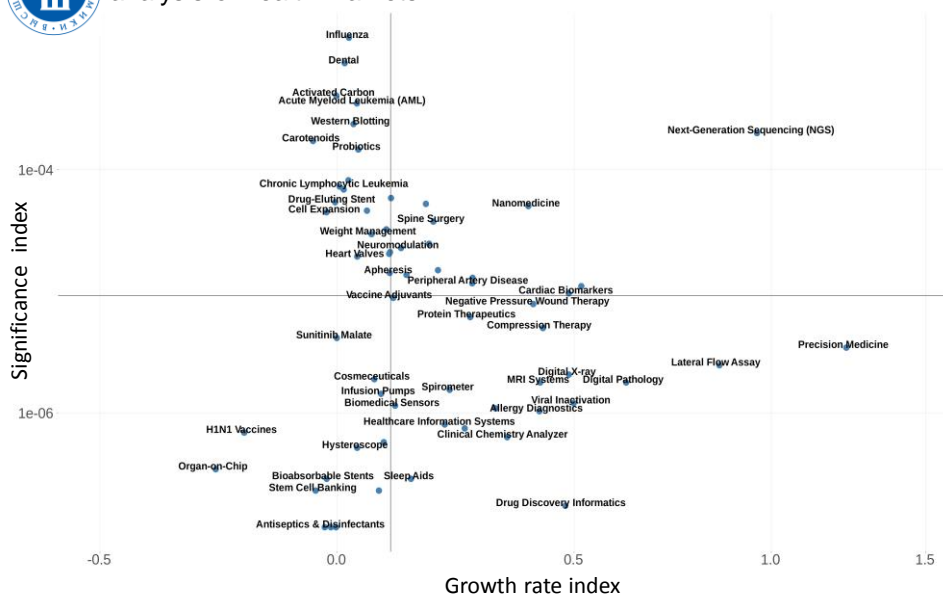


Example

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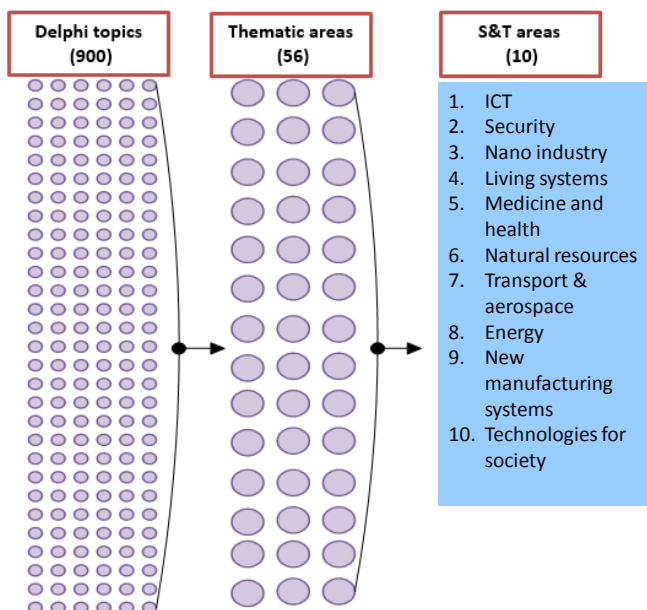
Russia S&T Foresight Results: analysis of health markets



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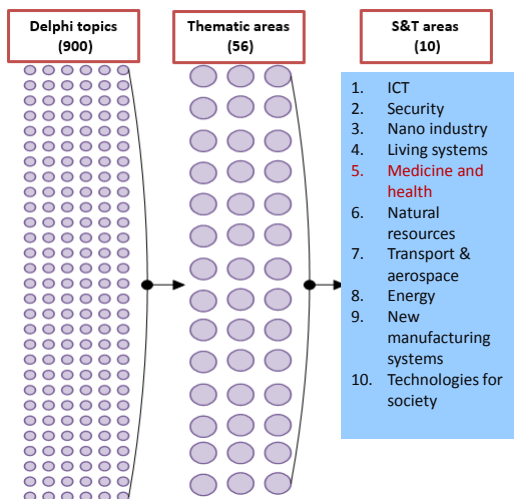
Foresight 2025 (2006-2008): systemic approach



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Foresight 2025 (2006-2008): high level of accuracy



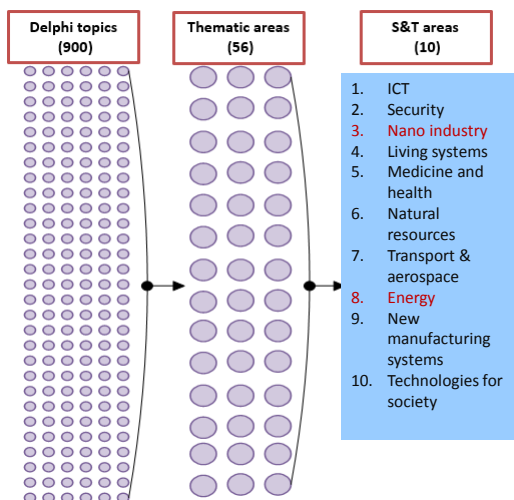
Medicine and Health

- ✓ DNA microchip technologies for detecting clinically significant pathogens and diagnosing diseases
- ✓ Automatic devices for detecting pathogens, and assessing their drug sensitivity and resistance within 1h
- ✓ Genetic and protein markers for early miscarriage and pregnancy diagnostics
- ✓ Devices for non-invasive determination of blood glucose
- ✓ Quantum dot technology for diagnostics of diseases
- ✓ Technology for storing, growing, and transplanting autogenous tissues
- ✓ Artificial blood, eye, bones
- ✓ Robots for caring for people with physical and mental disabilities
- ✓ Nanostructured fabrics for making bioactive clothes
- ✓ Corrosion-resistant materials and coatings for exploitation in extreme environments
- ✓ Sensory elements for next-generation nano-size biochips

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Foresight 2025 (2006-2008): high level of accuracy



Nano industry

- ✓ Nanostructured fabrics for bioactive clothes
- ✓ Corrosion-resistant materials and coatings for exploitation in extreme environments
- ✓ Sensory elements for next-generation nano-size biochips

Energy

- ✓ Power installations for generating electricity, heat, and cold at the same time
- ✓ Adaptive learning energy saving systems for buildings (smart homes)
- ✓ Efficient energy storage supercondenser-based systems
- ✓ Efficient technologies for production of synthetic liquid fuels for application as motor fuels
- ✓ Technologies for designing and constructing energy efficient buildings with 2.5-3 times lower power intensity
- ✓ Technologies for CO2 capture and storage during organic fuels burning
- ✓ Fast neutron reactor technologies with heavy and light liquid-metal coolants

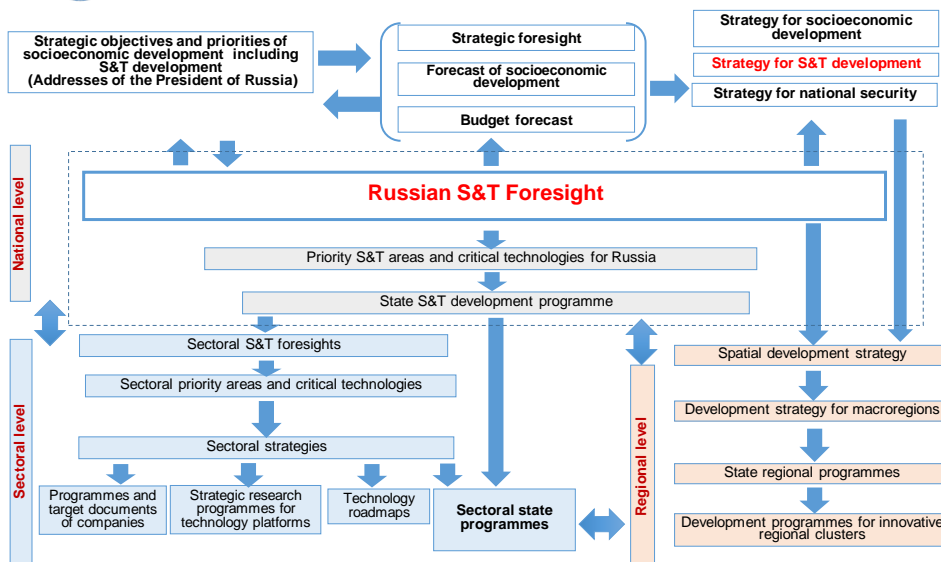
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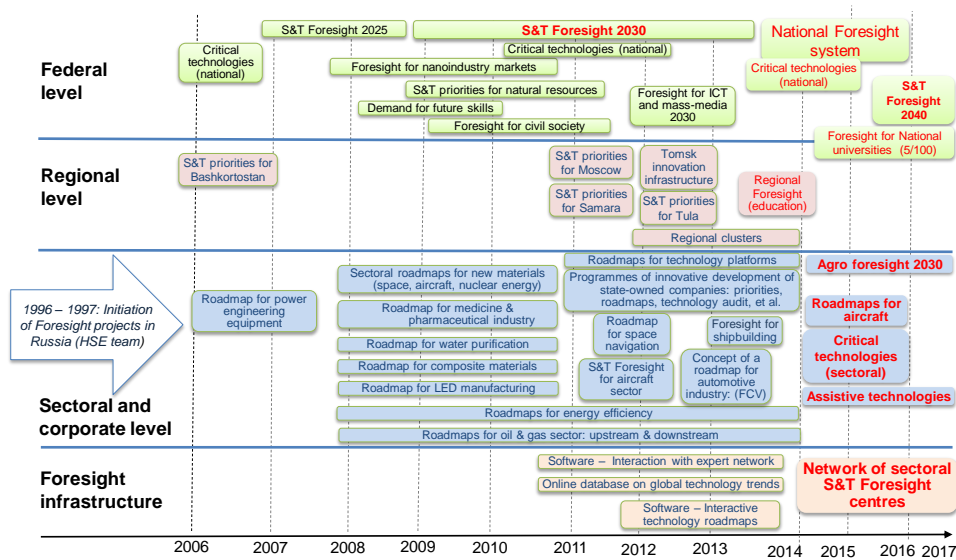
National System of S&T Foresight: position in the system of strategic planning



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Russian S&T Foresight: rapid growth and emergence of national S&T Foresight system



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National S&T Foresight: basic hypothesis and key questions



Moving to new production paradigm → accelerated, avalanche-like application of advanced production technologies and new materials, total customization and personalisation



Transformation of global value chains → emergence of new ones, "elimination" of certain traditional segments, redistribution of profit margins between participants



Moving to "action" economy → growing roles of "system integrators" - companies which provide turn-key solutions by quickly assembling them from the best available technologies adjusted to match specific demand



Changes in the employment structure → triggered by the move towards the new production paradigm



New education model → building "skills portfolios" based on expected demand by companies

1. WHEN, NOT WHAT

Portfolios of technological leadership have been completed: who will implement the first?

2. WHY, NOT HOW

Technocratic approach with KPI vs socio-humanist and mission oriented values of next generation of leaders

3. WHO: GEEKS VS ROUTINES

Growing social differentiation promoted by AI: one genius or millions of low qualified workers

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S&T Foresight: Basic requirements

Obligatory

- ✓Time horizon: at least 10 years
- ✓Participatory: Involvement of all categories of stakeholders (representation of each side has to be not less than 10%)
- ✓Criteria for experts:
 - publications in peer-reviewed international journals, the citation index is not below the world average level
 - patents on the relevant technological areas
 - co-nomination by at least three other experts
- ✓Number of involved experts: not less than 100 for national projects and at least 50 for sectoral / problem-oriented projects
- ✓Methodology:
 - combination of evidence-based, creative, interactive and expert methods
 - wide evidence base (Russian and foreign Foresight projects)
- ✓Decision making support:
 - presence of practical recommendations for the use of the results in the political decision making process

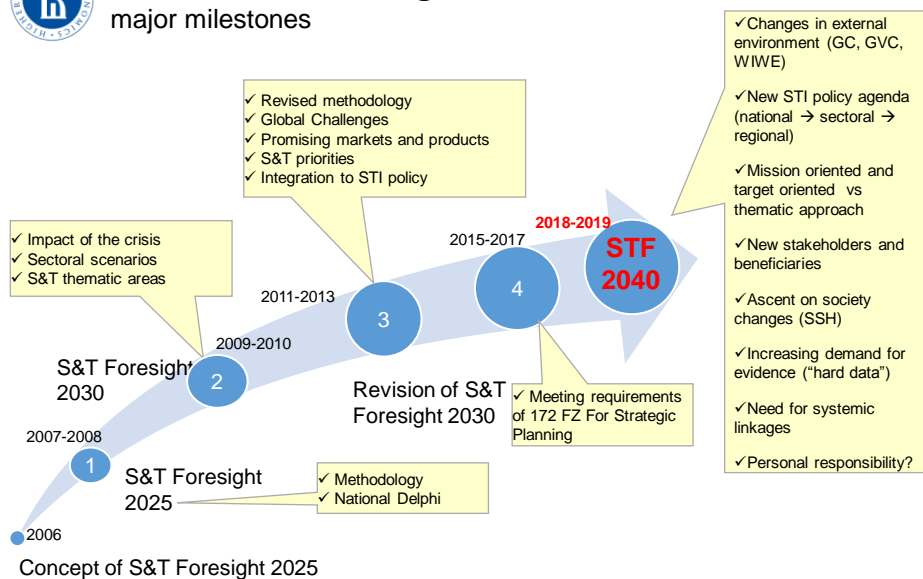
Additional

- ✓High competence of the project team in the field of Foresight, certified by leading international Foresight centers and reviews of previous customers of Foresight projects
- ✓The verification of the methodology and results with international experts selected by the following criteria:
 - the number of publications on Foresight in peer-reviewed journals is at least 10 in the last 5 years
 - citation index is not less than the average for the field of Foresight
- ✓The linkages between the logic of the project and global challenges, risks and threats
- ✓Inclusion of key national and regional strategic documents into the information database
- ✓Dissemination of results through publications, presentations, information materials, etc.

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National S&T Foresight: major milestones



37



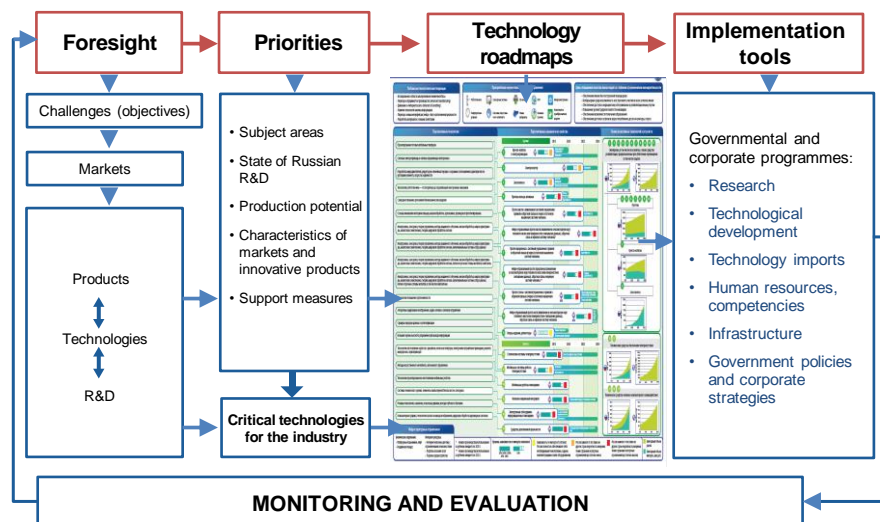
Russian S&T Foresight studies: some key aspects

- Revolution VS Evolution → are we ready for rapid growth of productivity in our multilevel sectors?
- Emphasis on breakthrough and VIP projects VS long and routine work with details
- Forecasts of "genius" VS in-depth evidence-based research results
- Underestimation of "path dependence" – sunk costs pulls down
- Low level of foresight culture: readiness for innovations by society, transition for new resources of competitiveness by business, new governance routines
- Conservatism of matures VS hyper optimism of newcomers
- Low level of institutional memory: "new manager – all new"
- Straightforward, linear logic VS complexities and scenario approach
- Underestimation of the role of intuitions, including skills and low

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Technology roadmaps for S&T Foresight: translating into projects and investments



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Thank you for your attention!

achulok@hse.ru



Building a foresight system in government Canada

Lessons learned at Policy Horizons Canada

8th International Conference on Foresight
NISTEP and GRIPS, Tokyo, Japan

Peter Padbury
Chief Futurist
Policy Horizons Canada
29 November 2017



Canada

WHO ARE WE

Policy Horizons Canada is a federal scanning and foresight organization that is:

- focused on the medium- to long-term policy horizon
- matrix organization with 30 staff
- governed by a steering committee of DMs who represent the DM Policy Committees and several government-wide functions



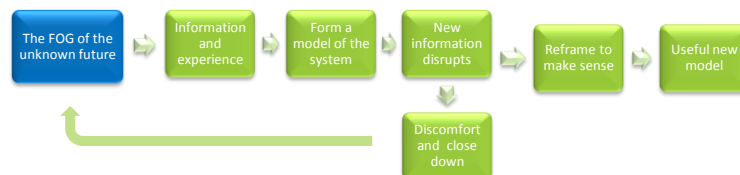
WHAT IS FORESIGHT?

- Foresight is a discipline that uses inputs from scanning in a systematic process to understand how an issue could evolve and the challenges and opportunities that may emerge
- The objective of foresight is **not** to predict the future, but to explore the range of futures that may plausibly emerge and then develop policies and strategies that are robust across that range of futures and that deliver desired outcomes
- Rigorous foresight helps us understand the emerging policy landscape and provides the best foundation for pragmatic vision-building.



THE CENTRAL ROLE OF MENTAL MODELS

- Humans have an amazing capacity to visualize the future. It allows us to consider a problem, explore options, weigh pros and cons and in so doing develop mental models even run “movies” of possible strategies and desired outcomes.
- Foresight tools help people share, explore and test their mental models about how the world is changing and what it could mean for their organization.
- Foresight is a learning process and a way of thinking

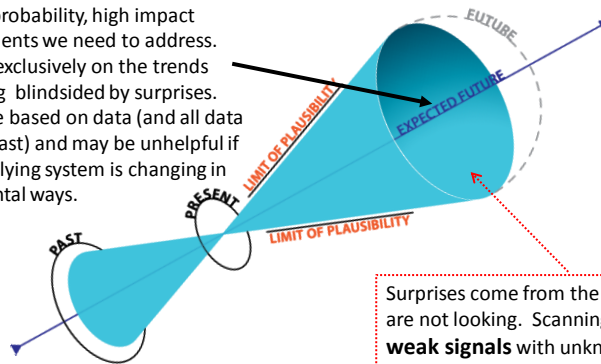


- The Horizons Foresight Method helps people surface, examine, build and test mental models by focusing on the information that helps build useful models about the future



SCANNING FOR WEAK SIGNALS IS THE FOUNDATION FOR USEFUL FORESIGHT

Trends describe the expected future, the high probability, high impact developments we need to address. Focusing exclusively on the trends risks being blindsided by surprises. Trends are based on data (and all data is in the past) and may be unhelpful if the underlying system is changing in fundamental ways.



Surprises come from the places people are not looking. Scanning identifies **weak signals** with unknown probability but potentially significant impact that are often ignored. Foresight explores how they may interact with the system to create surprises.



FORECASTING vs FORESIGHT

APPROACH	TOOLS	IMPLICIT ASSUMPTIONS	PRODUCT
Forecasting	<ul style="list-style-type: none"> Scanning for trends Data analysis Trend extrapolation Trend impact assessment 	The future is an extension of the present. Surprises come from changes in the value of the known variables	An understanding of the expected future
Strategic Foresight	<ul style="list-style-type: none"> Scanning for weak signals of change Driver analysis Influence maps Cross impact analysis System analysis Scenarios Assumption testing 	The underlying system is evolving. Surprises come from changes that disrupt the system	An understanding of the range of plausible futures and the potential surprises that current policies and institutions are not ready to address
Applied Foresight	<ul style="list-style-type: none"> Builds on strategic foresight Stakeholder analysis Design thinking Strategy and vision building 	By understanding how the system could evolve and the surprises that could emerge, we can develop more robust policies, strategies and visions	Policies, strategies and visions that are robust across the range of plausible futures

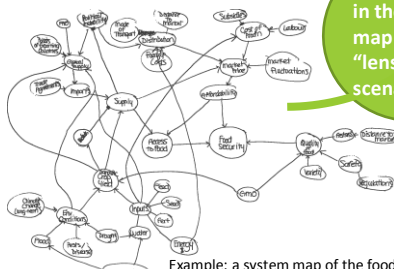


Horizons Strategic Foresight Method



SYSTEM-BASED SCENARIOS ARE POWERFUL

System-based scenarios allows users to "see" what the system looks like in the future given different conditions. They provide a rigorous analysis of how the landscape could evolve. The end state or structural scenarios are an analytically solid foundation for developmental or narrative scenarios.



Example: a system map of the food production system to explore the issue of food security

The elements in the system map become "lens" in the scenarios

Scenario logic	Provides boundaries for each scenario
Driver 1	Deduce what "value" each driver takes under this scenario logic
Driver 2	
System element 1	Deduce how the above context shapes SE1
Scenario element 2	Deduce how the above context shapes SE2
Policy challenges	Identify the challenges current policy is not ready to address
Test assumptions	Test the robustness of current assumptions



Example of scenario logic

	Muddling Through	Slow Decline	Gradual Progress	Transformation
Logic	Incremental approach. No major decline or improvement	Period of instability. Things are not getting better	Growing prosperity and security	Crisis catalyzes change (drought > food shortage)
Geopolitics	Declining US and EU influence, while China and others grow in influence	Shifting coalitions led by US, China and others compete for influence	US, EU, China and others cooperate to promote prosperity	Recognition of shared values and mutual interests in addressing global issues
Economy	West is fiscally constrained, but 'rise of the rest' slowly continues	Recession Growing debt Growth hubs in parts of Asia	Growing value chains. Growing transparency and accountability	Well-being redefines progress. Both long and short (resilient) value chains.
Political	Shifting consensus Patching-up old systems	Mini-lateralism: coalitions of like-minded Competing norms	Multilateralism is working and becoming networked.	Experimenting with co-creation, empowerment of self-organizing networks to produce global public goods

HOW FORESIGHT SUPPORTS THE POLICY PROCESS

MAIN OUTCOMES:

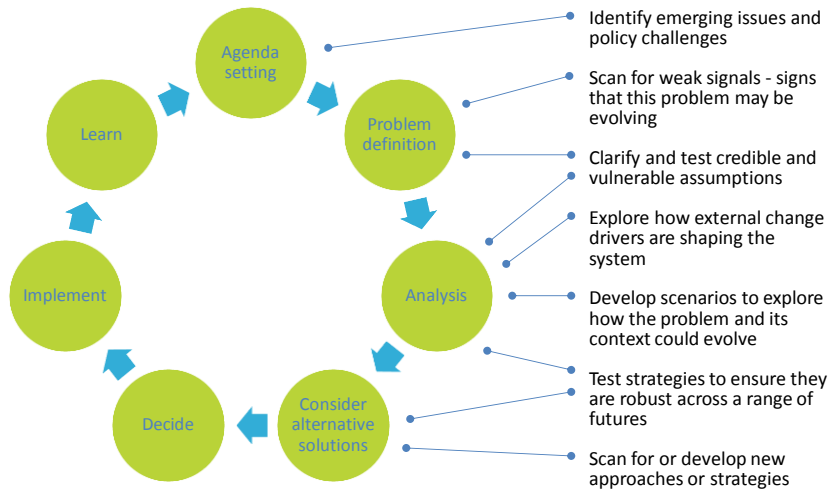
- Clarify planning assumptions
 - validate credible assumptions
 - identify vulnerable assumptions in need of further research
 - Identify and rewrite mistaken assumptions
- Identify emerging challenges and opportunities

BENEFITS:

- Enhance mental models of participants
- Focus attention and dialogue on strategic issues
- Develop more robust policy, strategy and programs
- Rehearse for change

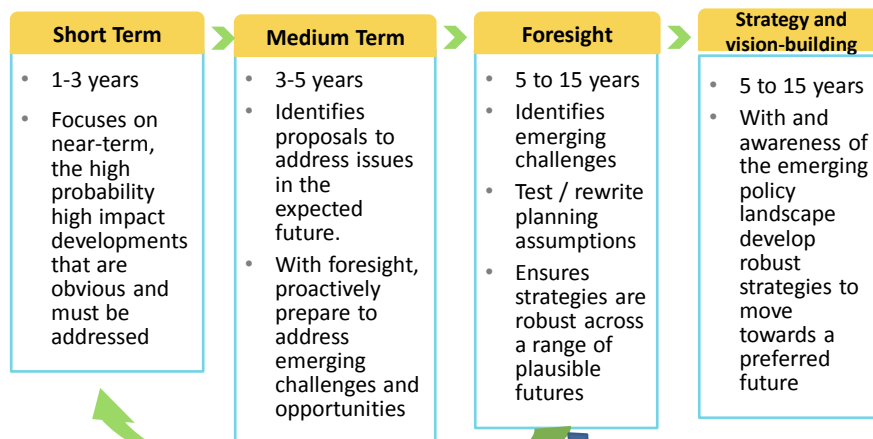


POTENTIAL CONTRIBUTIONS OF FORESIGHT TO THE POLICY PROCESS



11

HOW FORESIGHT IMPROVES PLANNING AND VISION-BUILDING

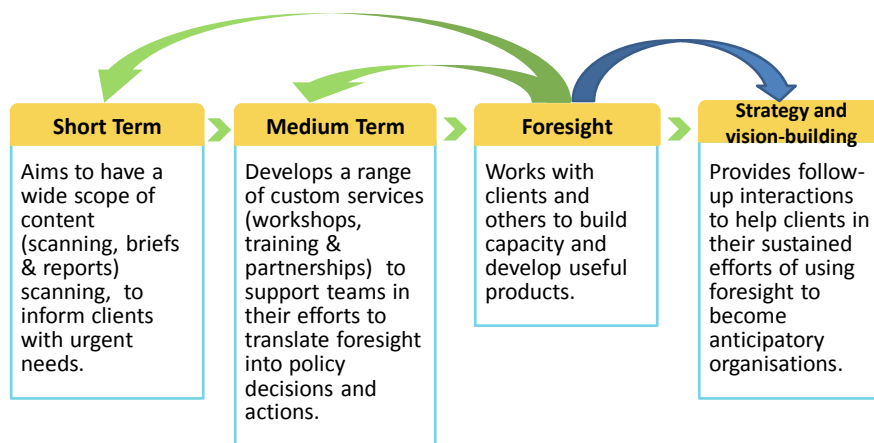


Foresight provides context, a sense of the evolving policy landscape, to improve near and medium term planning and vision-building



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HORIZONS FUNCTIONAL RELATIONSHIP WITH CLIENTS



Applying Design Thinking, Horizons keeps its user experience in mind when planning collaborations over short and long time spans.



UNIQUE FEATURES OF THE HORIZONS METHOD

- Engages knowledgeable people to share their mental models of the system and explore how the system may evolve
- Uses our capacity to visualize the future through our mental models and “movies”
- Visual tools provide “scaffolding” at every step of the process to help participants to share their models and facilitate dialogue
- Systems thinking is the analytical foundation
- System-based scenarios ensures the findings are provocative yet plausible and strategically useful



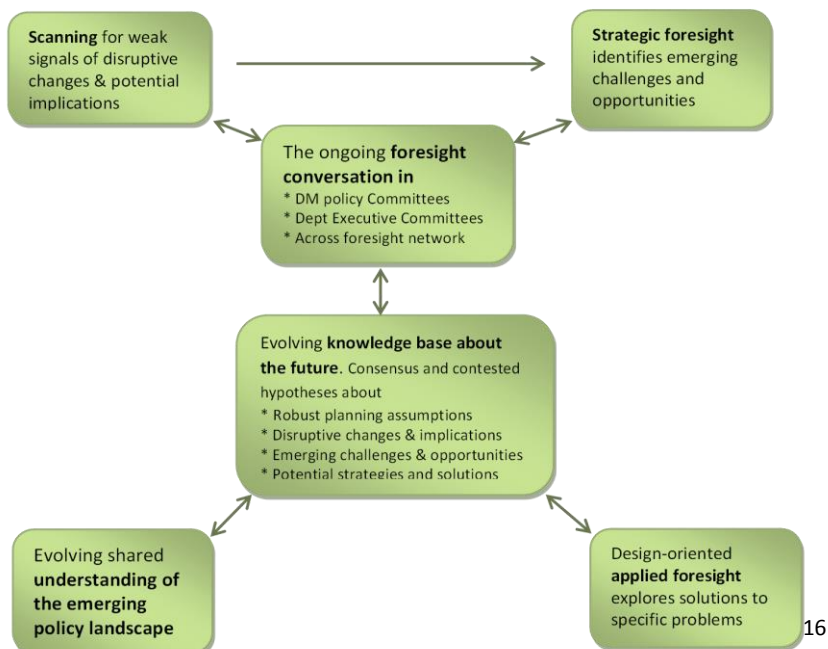
LESSONS LEARNED FROM FORESIGHT UNITS IN OTHER COUNTRIES

Horizons has looked at foresight practices in Singapore, UK, Finland, Germany, France and South Korea. The following generalizations are possible:

1. In countries that take foresight seriously, the senior public servants are active in an **ongoing foresight conversation**.
2. In Singapore, UK and Finland **sophisticated scanning processes** familiarize leaders with the early signs of potentially disruptive change on the horizon.
3. Several countries use **strategic foresight** to explore how large systems and complex public policy problems could evolve and the surprises that could emerge.
4. Singapore and Horizons also use **applied foresight**, which draws on design thinking to help groups develop solutions to specific problems.
5. Several countries are attempting to **curate “building blocks” from the foresight conversation** so the next conversation or project does not start at the beginning.



ELEMENTS IN A GOVERNMENT-WIDE FORESIGHT SYSTEM



A SHARED VOCABULARY HELPS

Scanning identifies weak signals that are early signs of changes in the domestic and international environments that could have a significant impact on the issue or system we are studying.

Foresight explores how these changes may evolve and interact to create a range of futures as well as new policy challenges and opportunities. Insightful scanning is the foundation for great foresight.

Forecasting relies on trend data from the past to extrapolate, estimate or simulate the baseline or expected future. Its value is limited at a time when the underlying systems are changing.

Assumptions are the foundation on which we build our understanding of an issue or system. They are a very efficient and strategic way to test and communicate the findings of a foresight study.

Expected future is how most people typically see the future. The expected future looks a lot like today. This, often unconscious, image shapes the decisions we make. It is visible as assumptions, in our conversations, decisions and buried in public policy documents.

Alternative plausible futures are futures that could realistically come about that are substantially different from the expected future. The identification of alternative plausible futures helps one to be better prepared for the disruptive changes that have not been factored into the expected future.



For further information:

For an overview of the Horizons Foresight Method and the inner game of foresight:

http://www.horizons.gc.ca/sites/default/files/uploaded_media/2016-271-overview-eng_1.pdf

A detailed training manual can be found on our website:

<http://www.horizons.gc.ca/en/content/foresight-training-manual-module-1-introduction-foresight>

Thank you!

Policy Horizons Canada

www.horizons.gc.ca





Foresight for Science, Technology and Innovation Policy in Japan: Past, Present and Future

Dr. Shinichi AKAIKE

Director, S&T Foresight Center

National Institute of Science and Technology Policy

Ministry of Education, Culture, Sports, Science and Technology

0



Brief History & Outline of NISTEP

History

1988: National Institute of Science and Technology Policy established (restructured from the National Institute of Resources)

2001: Ministry of Education, Culture, Sports, Science and Technology (MEXT) formed due to administrative reform. NISTEP became an affiliated research institute under MEXT. The Science and Technology Foresight Center was founded as a part of NISTEP.

2013: Reorganized the structure of NISTEP (Japanese organization name)

2016: Reorganized the structure of NISTEP (Group restructured)

Major Research Activities

○ Analysis of Science and Technology and Academic Activities

○ Analysis of the Innovation Process

○ Science of Science, Technology and Innovation Policy

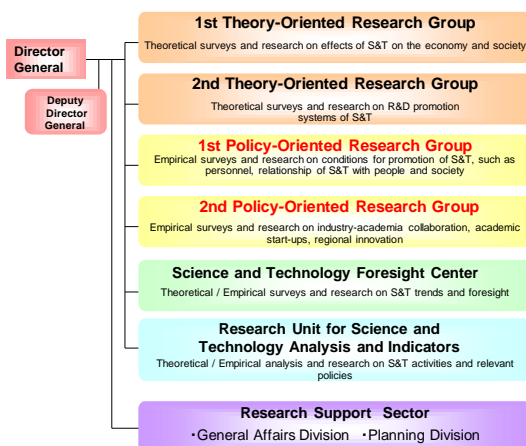
○ Science and Technology Foresight, and Science and Technology Trends

Budget

Approx. 8 Hundred Million Yen (~ 6M Euro)

Organization and Personnel

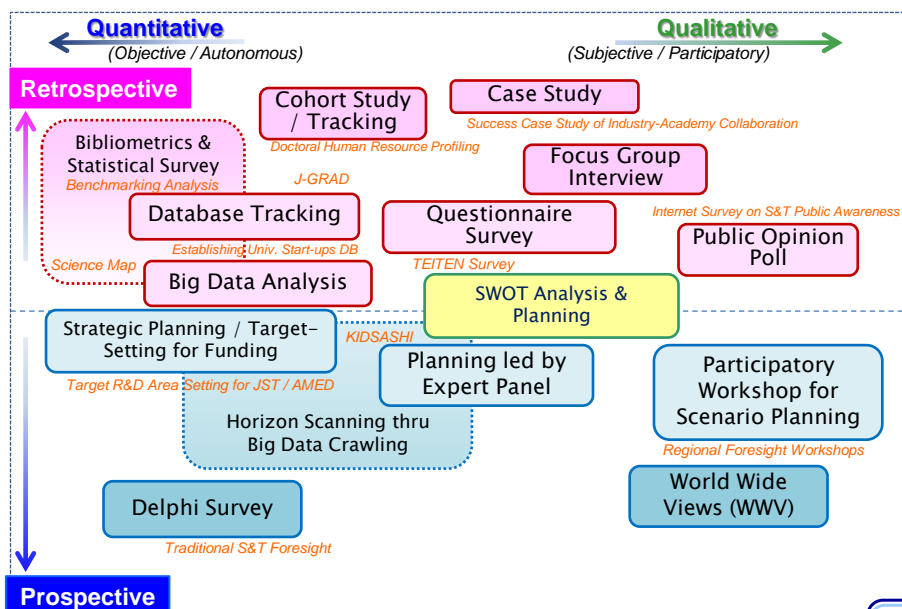
Staff: 45+ (about 35 Research Staff incl. Visiting Researcher)
[*As of FY 2017]



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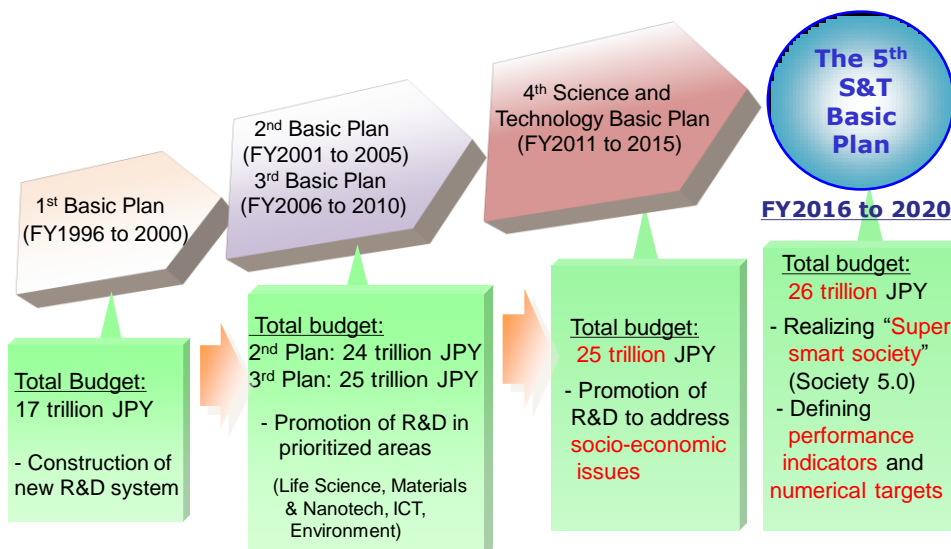
Integrating Retrospective & Prospective Approach – Direction and Methodologies of Policy Analysis



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2

S&T Basic Plans : Historical development



(Source) Cabinet Office, Revised by NISTEP

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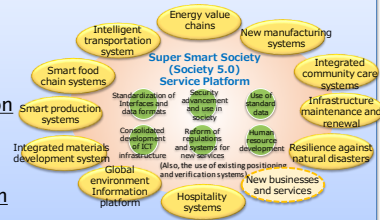
3

Outline of the 5th S&T Basic Plan

- The Science and Technology Basic Plan is a comprehensive plan decided by the Japanese Cabinet in accordance with the Science and Technology Basic Law, in order to promote science and technology in Japan over a five-year term, based on a 10-year forward outlook.
- The 5th Basic Plan (FY2016 to FY2020), **the first plan formulated by the Council for Science, Technology and Innovation (CSTI)**, is focused on enhancing “science and technology innovation (STI) measures”.
- Executing this Basic Plan will require a wide spectrum of parties—including the government, academia, industry, and citizens—to work together and lead to transform Japan into “the world’s most innovation-friendly country.”

<Outline of the 5th S&T Basic Plan>

- Chapter 1: Basic Concepts
- Chapter 2: Acting to create new value for the development of future industry and social transformation
- Chapter 3: Addressing economic and social challenges
- Chapter 4: Reinforcing the “fundamentals” for STI
- Chapter 5: Establishing a systemic virtuous cycle of human resources, knowledge and capital for innovation
- Chapter 6: Deepening the relationship between STI and society
- Chapter 7: Enhancing functions for promoting STI



(Source) Cabinet Office, Revised by NISTEP

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4

Toward Aiming at Following-up Process of S&T Basic Plan

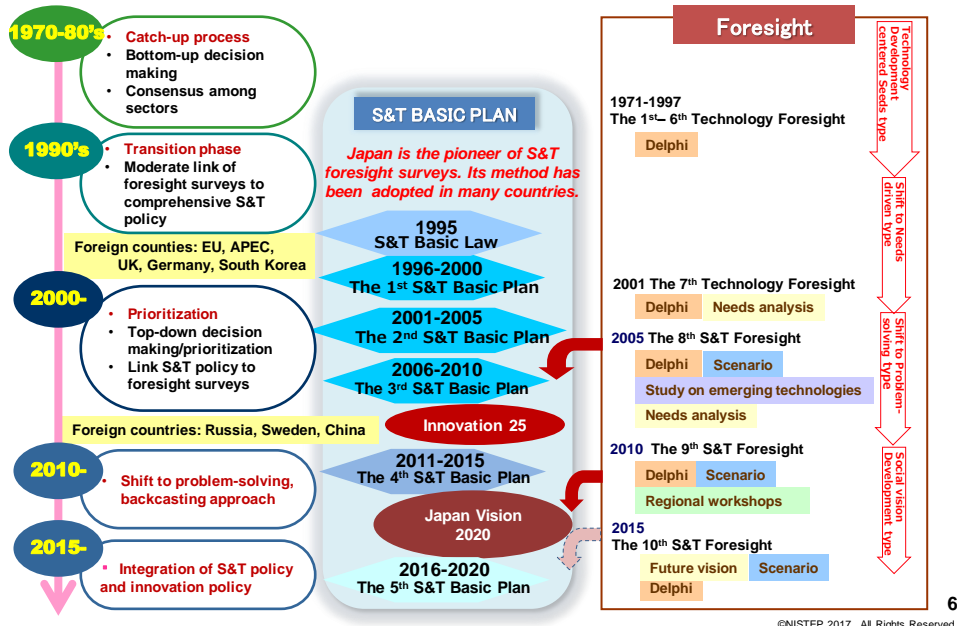
Decision of 5th S&T Basic Plan by the Cabinet (Jan. 2016)

- Council for Science, Technology and Innovation (CSTI) recently submitted a recommendation on the Fifth Science and Technology Basic Plan to Prime Minister's Cabinet Office, and then, Cabinet has decided the 5th S&T Basic Plan, along the line with the recommendation by CSTI in January 2016, describing future directions of Japan's S&T and innovation policy for next 5 years starting in FY2016.
- The Special Committee within MEXT's Council for Science and Technology, as well as Experts Committee of CSTI, has proceeded with discussions on this topic using survey and research data provided by **NISTEP**, such as **TEITEN Survey** and **S&T Foresight**.
- Topics discussed by CSTI included “the building of a super-smart society,” “integrated reform of competitive funds with universities,” “promotion of ‘open science’ and ‘open innovation,’” and “creation of SMEs and venture companies, challenging for new business.”
- NISTEP is trying to follow up progresses of S&T Basic Plan, including promotion of S&T Foresight and establishing the Ph. D Database, both of which were explicitly stated in the 5th Plan.

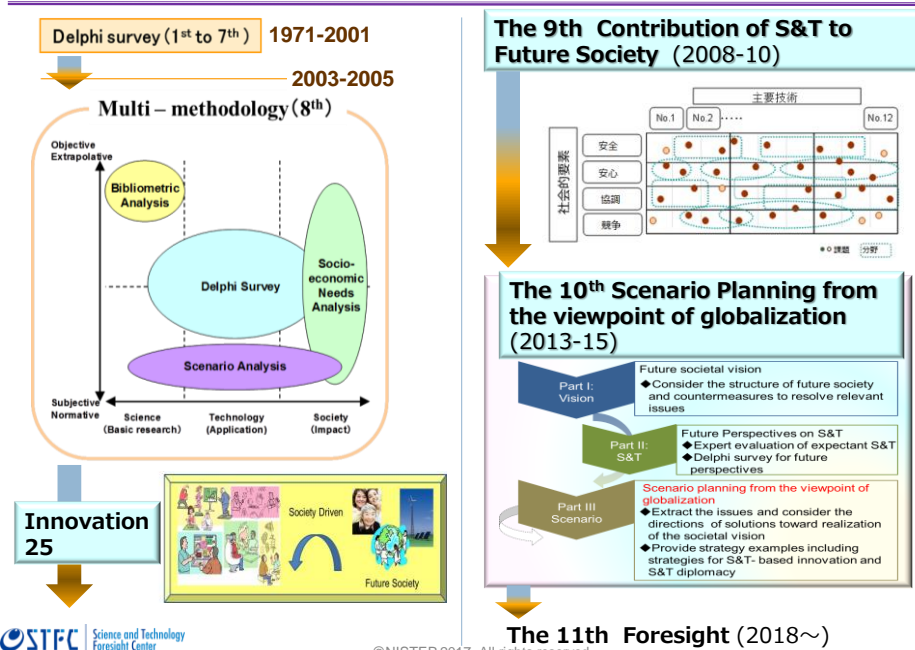


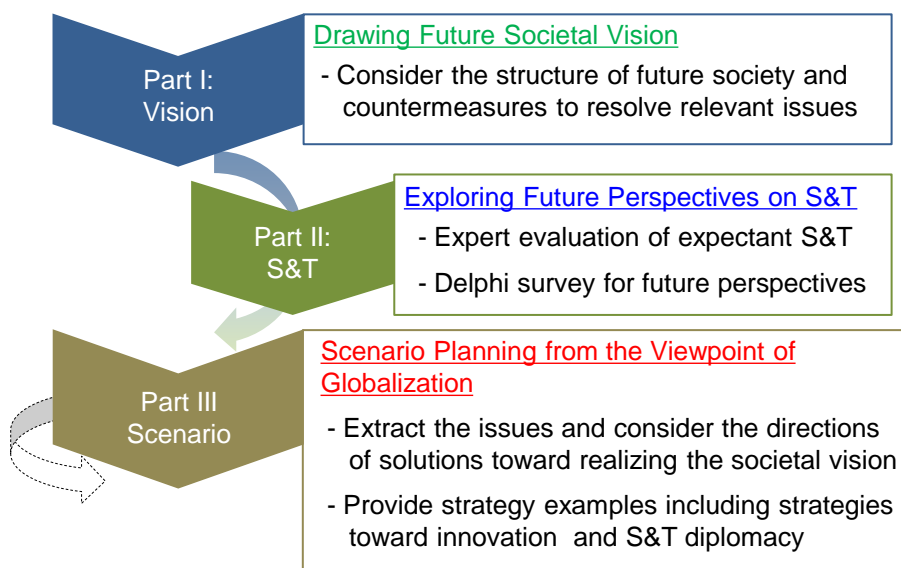
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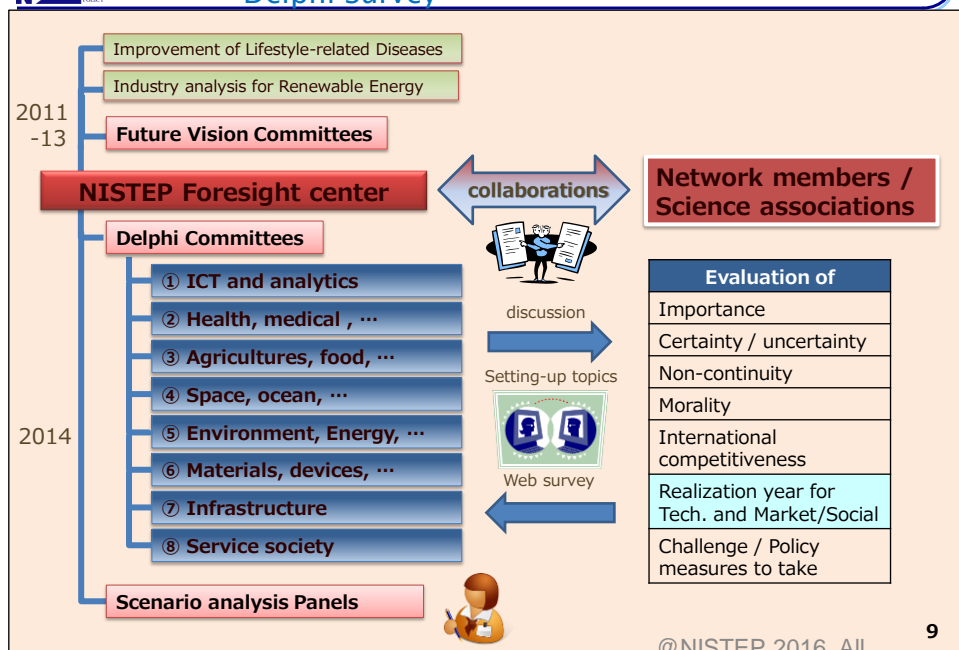
Changing the future design

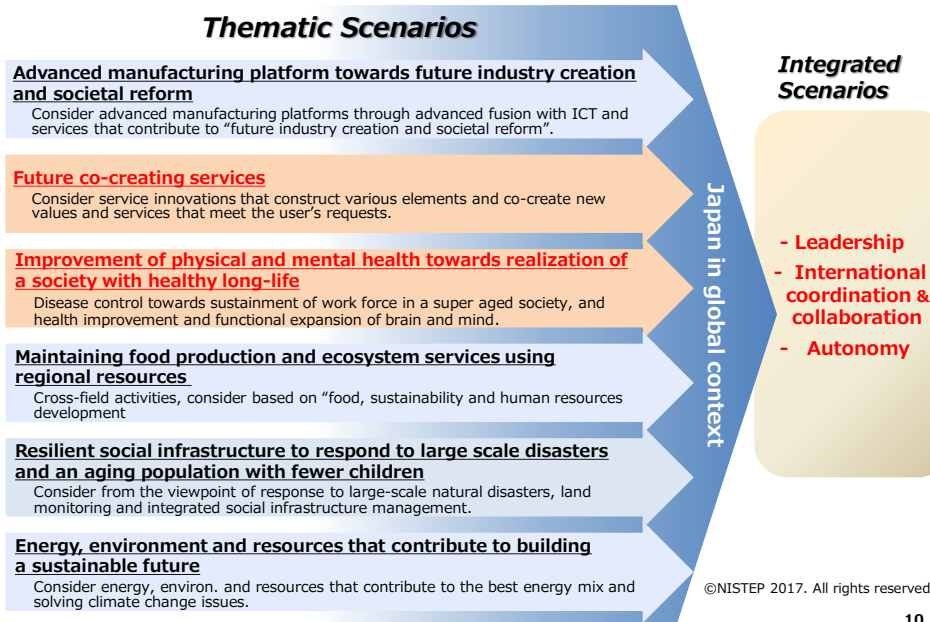




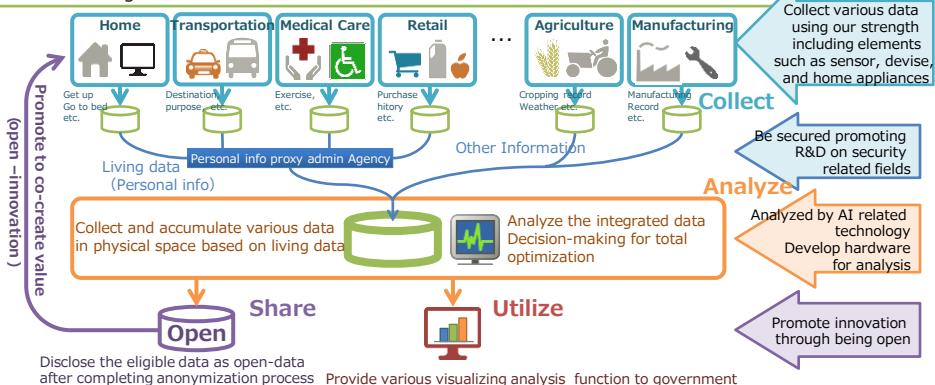
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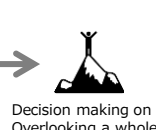




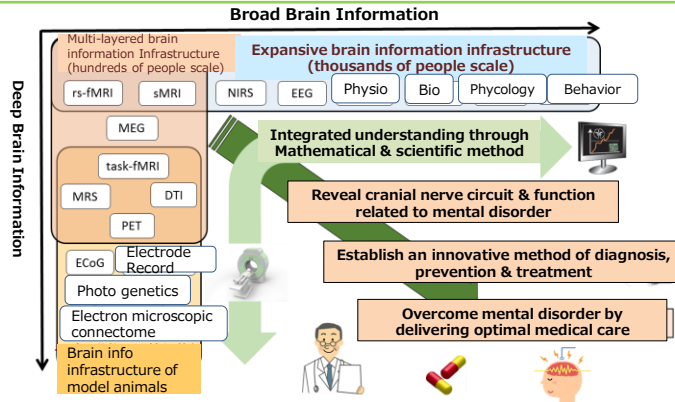
- Consider the technology development for IoT/IoE that Japan had strength and the progress on social challenge resulting from declining workforce
- Lead advanced information society by centralized collecting and analyzing various data such as "living data"



Aim&Effect



- Quantify the qualitative diagnosis and establish a new method of treatment by turning not only behavior and psychological states but also information related to brain diagnosis into big data
- Improve health of labor force and secure QoL in a time of declining population and autonomously maintain our nation's vitality

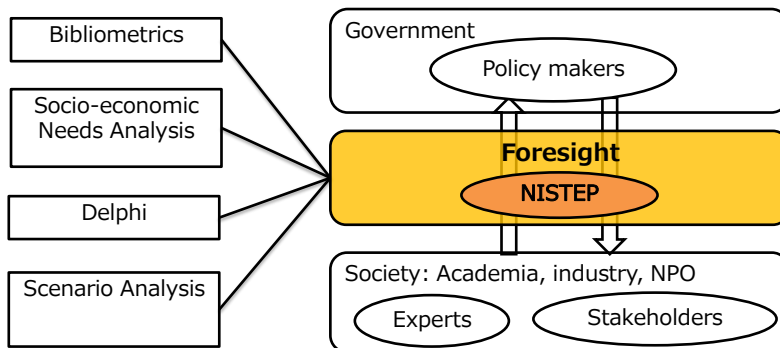


As the absolute number of working age population (ages 16-64) is decreasing in 2030 while the society is aging further, the labor productivity per person is required to increase. Although the impact of disease on employment could be an issue, the impact of mental disorders including depression is greater than that of cancers among working age population. Patients with depression account for 6-7%. Overcoming depression is to secure workforce but also is very important to improve the person's QoL, which is thought to be **most required to realize prosperous society. The society needs not only economical benefits but also spiritual benefits and a feeling of happiness.**

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Stakeholder involvement

Foresight and engagement in key stakeholders



The 5th S&T Basic Plan refers to the importance of engagement in key stakeholders and policy makers.

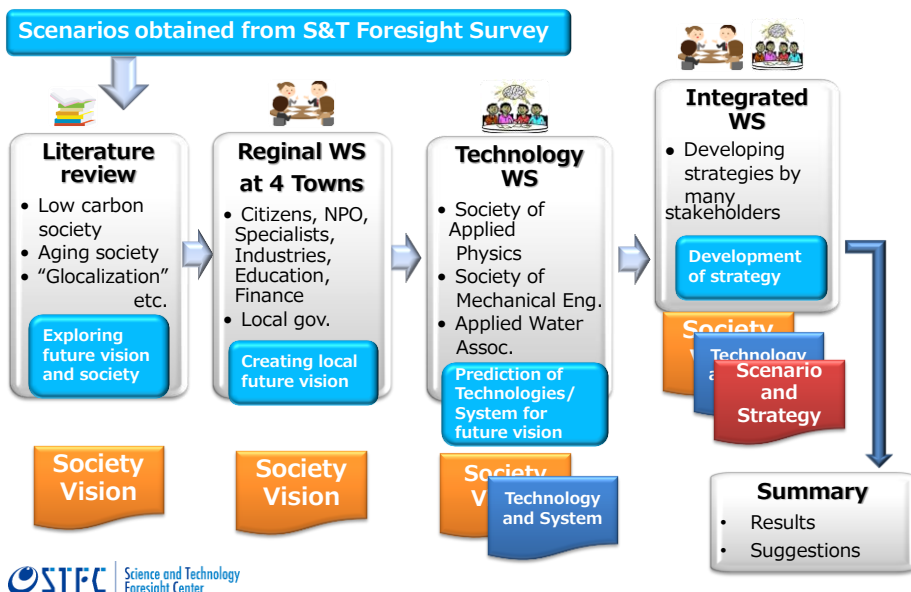
Stage	Stage2: Regional WS	Stage3:Technology WS	Stage4:Integrated WS
Aim	Examining an ideal regional society in the future	Examining S&T to contribute to the future society	Examining strategy and relevant S&T to contribute to the future society
Identification of the relation between S&T and a societal vision	<ul style="list-style-type: none"> Conducting processes (vision→S&T→strategy) as a package, in order to retain an integrated view on the relation between S&T and society 		
Response to complex societal issues	<ul style="list-style-type: none"> Examining coexistence for 'Aging society' and 'Low-carbon society' as major societal issues to be resolved 		
Participation of multi-stakeholders	<ul style="list-style-type: none"> Collaborating with local authorities Selecting suitable participants and promoting participation of person in charge in associated divisions 	<ul style="list-style-type: none"> Collaborating with academic societies Adding potentials for the future society from S&T viewpoint 	<ul style="list-style-type: none"> Collaborating with relevant organizations Discussing with experts in other local authority, industry and academia

[Source: 'A Study of the desirable future society based on regional characteristics for establishment of "Aging Society x low carbon society" in 2035', NISTEP Research Material No.259, June 2017 (in printing)]

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Regional Workshop – Participatory Approach for Stakeholders involvement



Regional WS Location

Kitakyushu City, Fukuoka Pref.
Population 976,800. Cabinet designated city. It faces the Kanmon Strait and is located at the northernmost tip of Kyushu Island.

Kaminoyama City, Yamagata Pref.
Population 31,500. It is a castle town and enhancing of "Quaort".
Quaort: German meaning "recuperation area".

Yaotsu Town, Gifu Pref.
Population 10,190. A village located between two rivers, houses and farmland spread along river terraces of about 120 m above sea level.

Okinawa Pref. KUMEJIMA TOWN 久米島町
Population 8,228. The administrative area is 63.50 km and consists of five islands in addition to Kumejima main island.

Science and Technology Foresight Center

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Regional Workshop – Procedure and Methods

- **Step1:**
Examining an ideal regional life style among participants
- **Step2:**
Consolidation of opinions and prioritization
- **Step3:**
Examining a strategy in which **stakeholder** can realize the desired theme
- **Step4:**
Drawing pictures about an ideal regional life **in 2035**



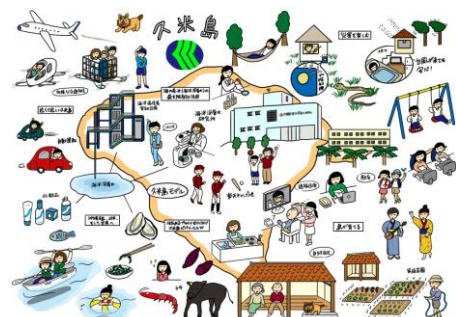
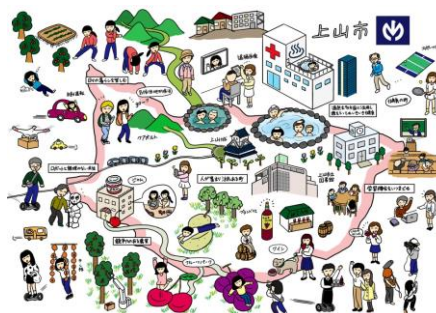
[Source: 'A Study of the desirable future society based on regional characteristics for establishment of "Aging Society x low carbon society" in 2035', NISTEP Research Material No.259, June 2017 (in printing)]

Results

Ex. Science and technology related to realization of social image in 2050

Health · Living
 ~ Sicken society + Senior citizens' society, improvement of human ability ~

- AI diagnosis, home medical care, biometric information sensor
- Ultra compact, wearable robot
- Cyborg technology
- Wearable Any sensor / actuator
- Emotion understanding monitoring device
- Robot parent (appearance, texture, voice, etc.)



International community
 ~ Slow life My Life+My Job~

- Wearable auxiliary equipment
- Society's clearance with high-speed railway
- Enhancement of VR
- Wearable instant translator
- Enjoying diverse values and coexisting social systems

“The Form of Future Society Utilizing Regional Resources” (Output Summary)

- ◆ Key factors of integrated solutions for **aging society**, **low-carbon society** and **regional vitalization**: **regional community roles, branding of regional resources, creating balanced lifestyle, a richer society and exporting regional resources**
- ◆ Effective strategies to realize these factors

Compacting residential area

Promoting the effective and autonomous community formation through realizing compact residential area, and providing common platform/opportunities.

Mobility management

Realize transportation types by utilizing various tools. Promoting relationships in motion. Expanding mobility radius providing a more fulfilling life.

Local energy and food production for local consumption

Exporting excessive products to other regions. Agriculture for self-sustaining to realize a fruitful life.

Diverse ways of working and learning

Seeking opportunities proactively and flexibly, responding to individual preference and demands of society.

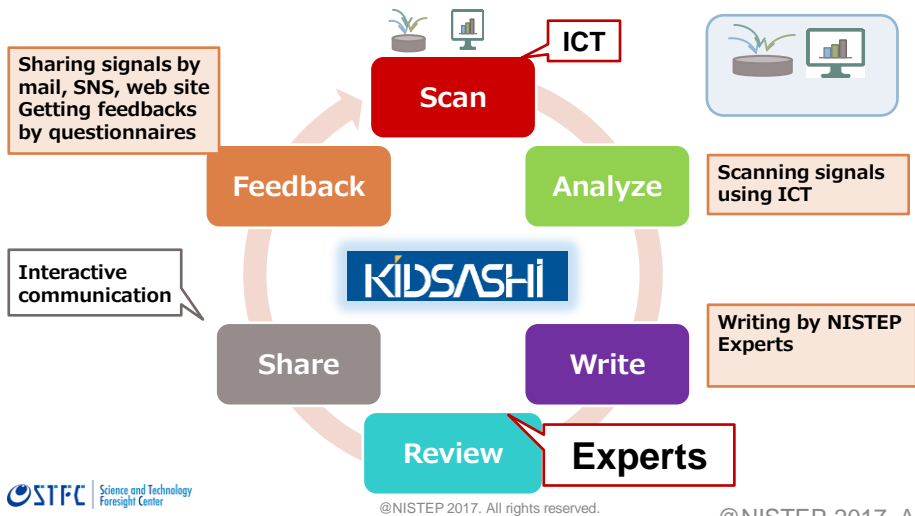
Health and medical care network

Mutual aid of community, self-sustaining and highly satisfactory life through supporting technology such as robots, while utilizing geographical conditions of the region and traditional food.

[Source: ‘A Study of the desirable future society based on regional characteristics for establishment of “Aging Society x low carbon society” in 2035’, NISTEP Research Material No.259, June 2017]

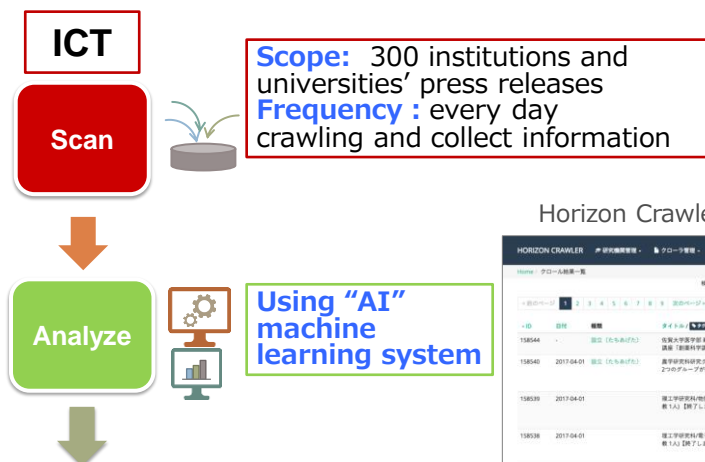
Original Horizon Scanning

KIDSASHI (Japanese: きざし、insight, weak signal)
Knowledge **I**ntegration through **D**etecting **S**ignals by
Assessing/**S**canning the **H**orizon for **I**nnovation



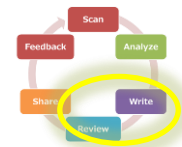
20

Original Horizon Scanning – Scan and Analyze



Horizon Crawler (screen capture)

Original Horizon Scanning – Write and Review



Experts

Write

↓

Review

↓

KIDSASHI (English) What is KIDSASHI Login

KIDSASHI : (ENGLISH)
Knowledge Integration through Detecting Signals by Assessing/Scanning the Horizon for Innovation

(JAPANESE ARTICLES? CLICK HERE)

Freshness of vegetables being kept by 1-minute near infrared radiation
Shikoku Research Institute Inc. in Tottori... technology which keeps freshness of vegetables... after harvest, very short time... devices to decrease moisture loss... and rotting. The new technology might show... and contribute to exports promotion.

Dawn of centers for genome edition in Japan
The genome edition is a technology that enables to change the targeted genome sequence intentionally using the enzymes which cut the designated position of the DNA double helix. The technology does not leave any trace of edition comparing to the traditional genome recombination. Recently simple and effective genome edition methodologies have established, studies are applied to various biological species over the world. Japan in these days, research centers for the genome editions have been operated in the...

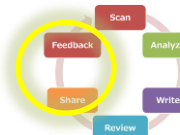
STI Horizon
— エスティーアイ ホライズン —

Another NISTEP media is also prepared

Scanned signals are written as articles

Web Communication

Feed back from experts though



Questionnaires

- ✓ New insight
- ✓ Weak signal
- ✓ Most interested entry



Answer (feed back)

- Regenerative medicine
- DNA editing
- Environmental DNA
- Space development

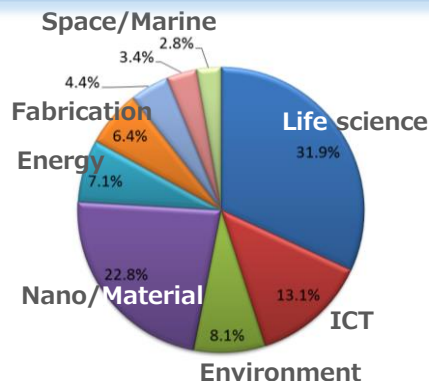


Fig. The percentage of registered 2000 Science experts in NISTEP network since 2001

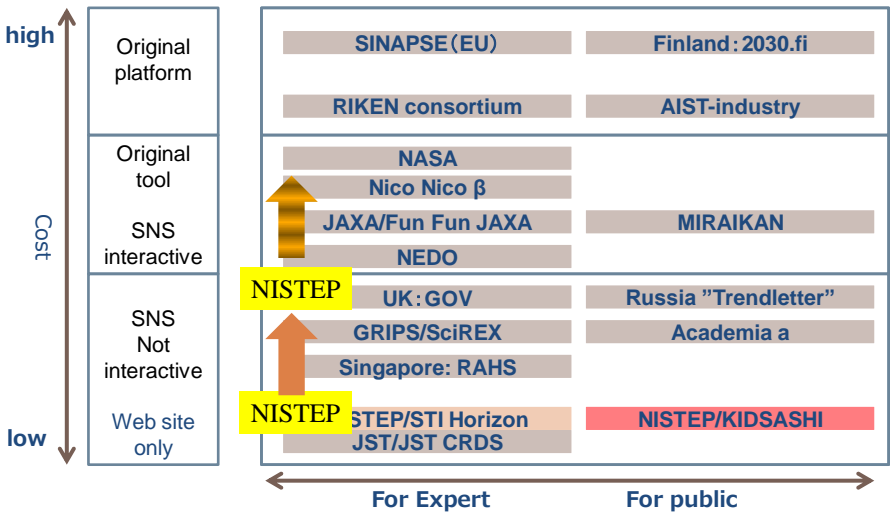
Web Communication

Case studies of other organizations

	Category	Name	SNS rules	Face book	book
1	Government	UK	—	—	—
		Finland	—	—	—
		Russia	—	—	634
		Singapore	—	—	—
2	Institute Think tank	NEDO	○	—	337
		JST/JST CRDS	△	—	—
		GRIPS/SciREX	△	—	439
3	Institute Museum Agency	MIRAikan	○	—	24,310
		JAXA	○	—	40,523
		NASA	○	—	18,883,715
4	Media	Nico Nico β	—	—	1,736
5	Organization	SINAPSE (EU)	—	—	32,951
		AIST-industry	—	—	—
		RIKEN consortium	—	—	—
6	Academia	A University	—	—	396
		B society	—	—	891
7	Industries	A Industry	○	—	20,282
		B Industry	○	—	26,336

Web Communication

Cost and target ranking



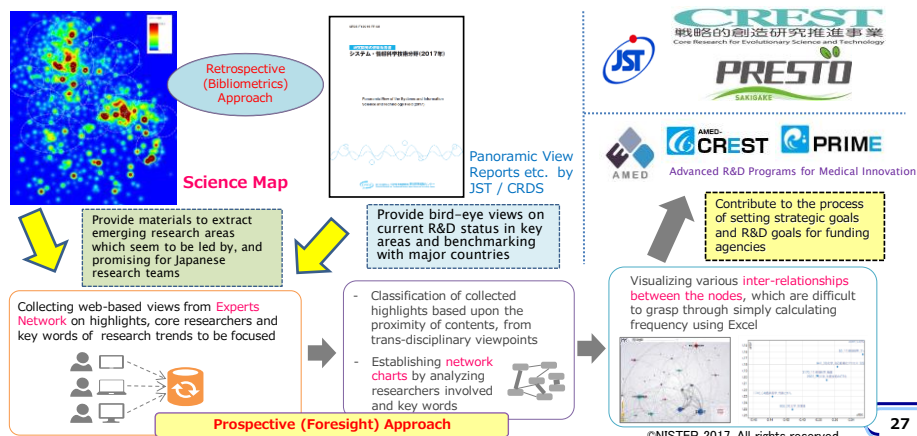
Web Communication

Shared by SNS



Integrating Retrospective & Prospective approach – Utilizing Foresight Platform for Strategic R&D Planning

- 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)



50

➤ Stakeholder involvement

Academia, private firms, local communities and so on.

➤ Integration of qualitative and quantitative methodologies

Delphi Survey, Web crawling, bibliometrics, patent analysis,
econometrics, regional workshops, interviews, scenario-planning

➤ Close communication with policy makers

Seminar, workshops and other formal and informal contacts



Linkage between foresight and strategic planning

Thank you so much for your attention!

Please visit our Website:

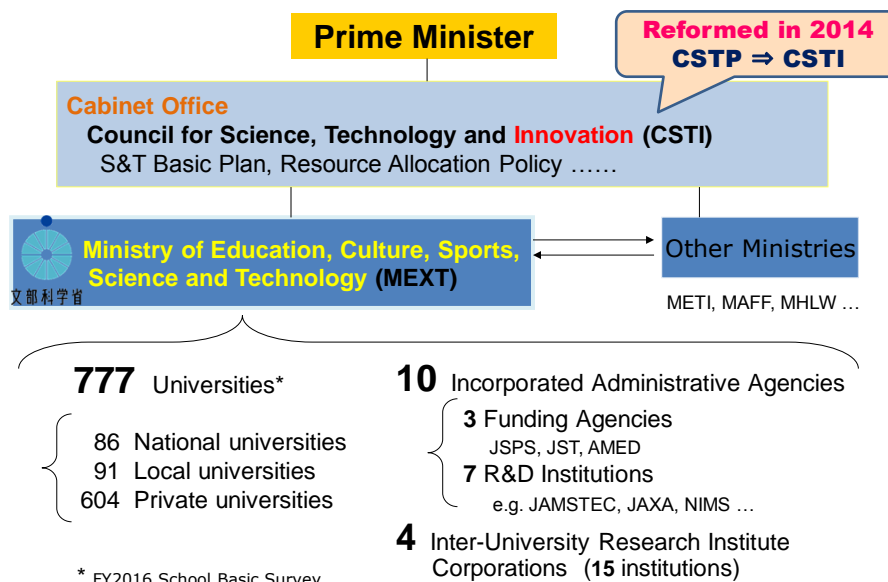
<http://www.nistep.go.jp/en/>

KIDSASHI Website:

<https://stfc.nistep.go.jp/horizon2030/index.php/en>

(Reference)

Japanese Administrative Structure to Promote STI



(Source) MEXT

32



(Reference)

Public Research Institutes & Funding Agencies for STI

HMY: Hundred Million Yen (2016FY)

- **RIKEN - The Institute of Physical and Chemical Research (908HMY, 3,470staffs)**
- **NIMS - National Institute for Materials Science (181HMY, 1,535staffs)**
- **QST - National Institutes for Quantum and Radiological Science and Technology (539HMY, 1,220staffs)**
- **JAMSTEC - Japan Agency for Marine-Earth Science and Technology (339HMY, 1,062staffs)**
- **JAEA - Japan Atomic Energy Agency (1,547HMY, 3,700staffs)**
- **JAXA - Japan Aerospace Exploration Agency (1,929HMY, 1,534staffs)**
- **NIED - National Research Institute for Earth Science and Disaster Prevention (95HMY, 229staffs)**

(Funding Agencies)

- **AMED - Japan Agency for Medical Research and Development (1,264HMY, 300staffs)**
- **JSPS - Japan Society for the Promotion of Science (2,560HMY, 180staffs)**
- **JST - Japan Science and Technology Agency (1,059HMY, 1,475staffs)**

(Source) MEXT

33
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Foresight and Community Engagement

Pirjo Kyläkoski
Head of Strategy, Tekes

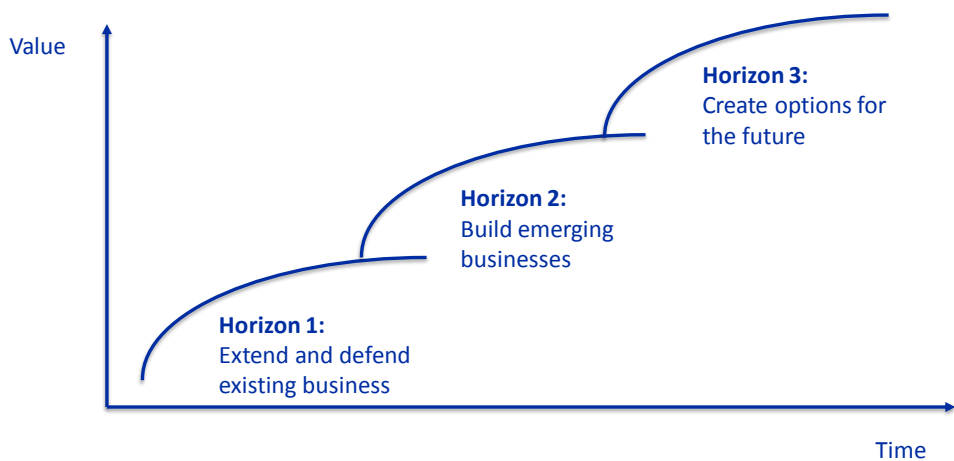
Tekes





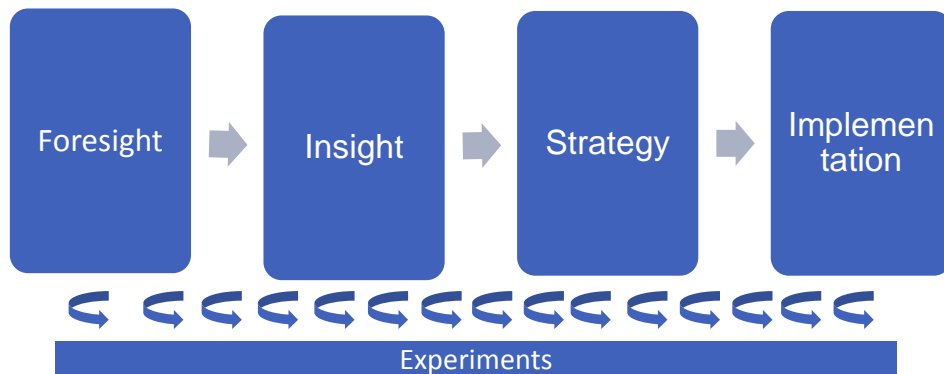
3

The Three Horizons for Growth

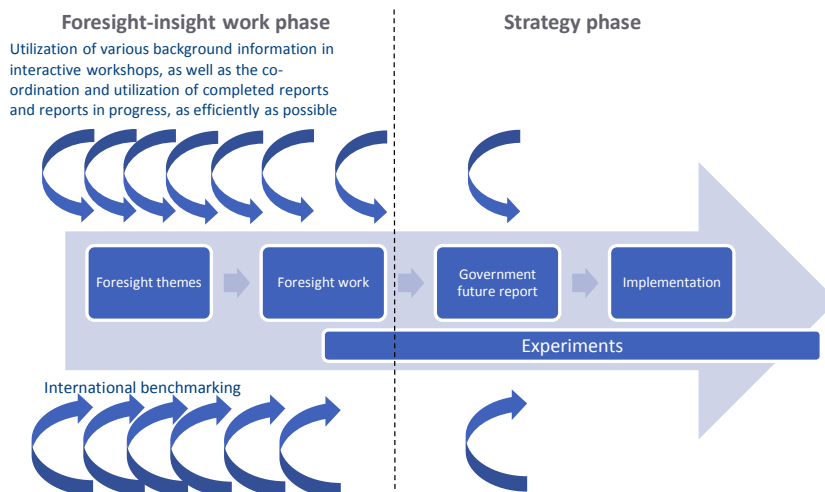


Source: McKinsey & Co / Baghai, Coley, Whyte, 1999

Foresight utilization

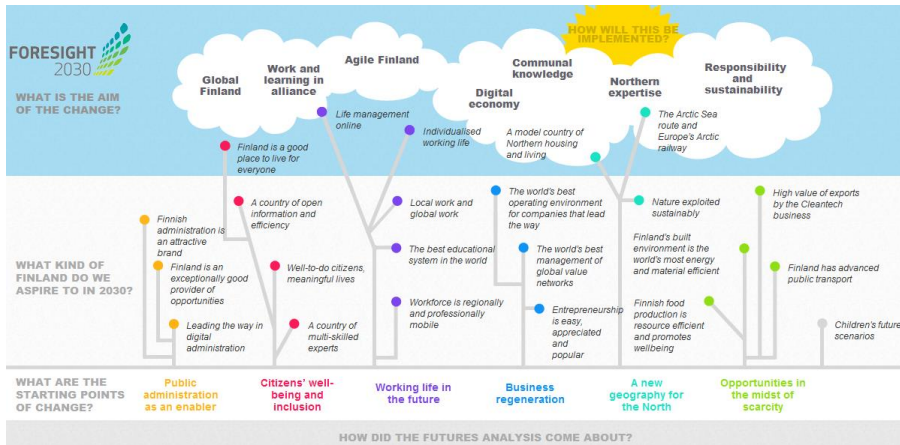


Governmental Foresight Process

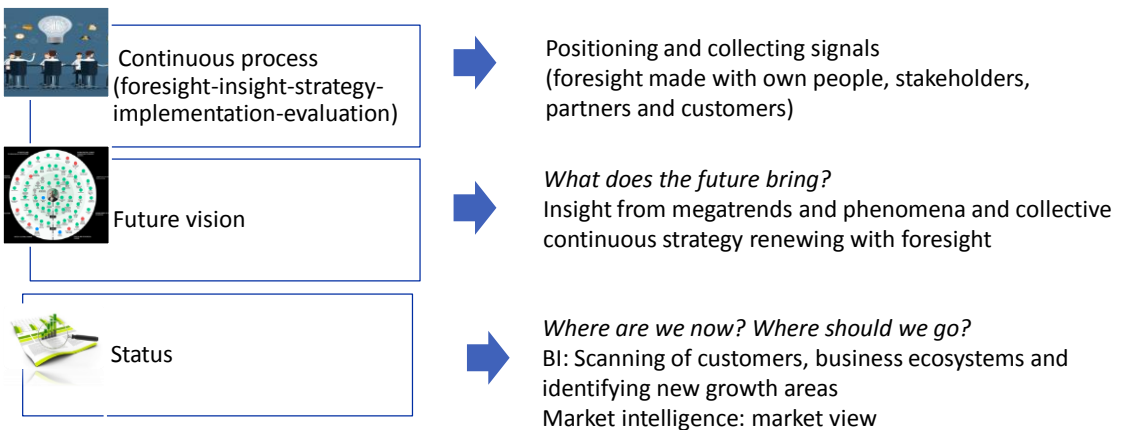


Governmental Foresight

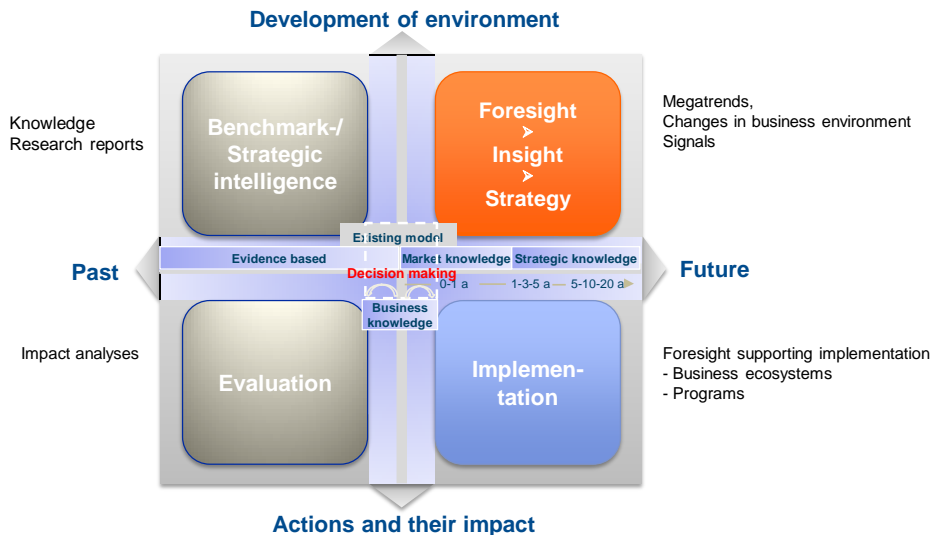
<http://tulevaisuus.2030.fi/en/>



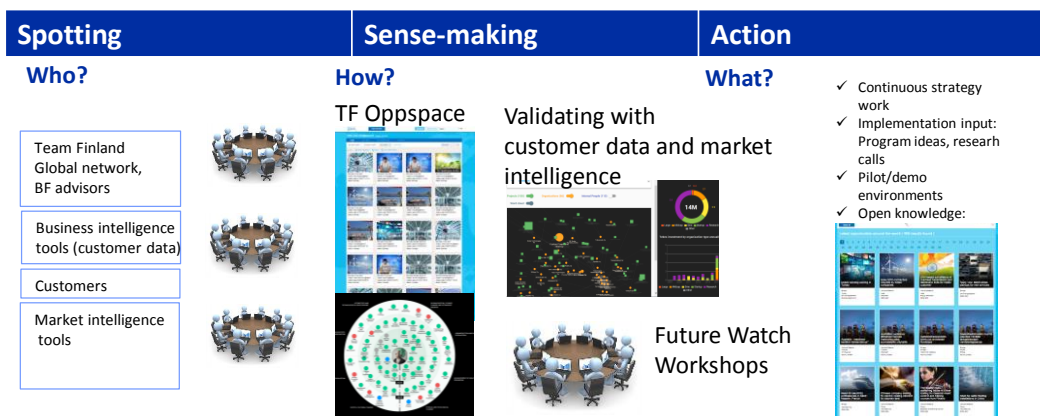
Business Intelligence and Foresight



Meaning of Strategic Knowledge



Future Watch Process and supporting Tools

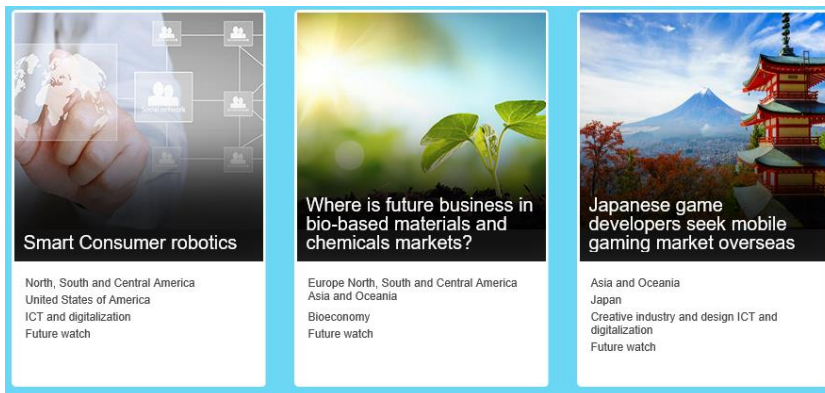


Future Watch and Market Opportunities -service

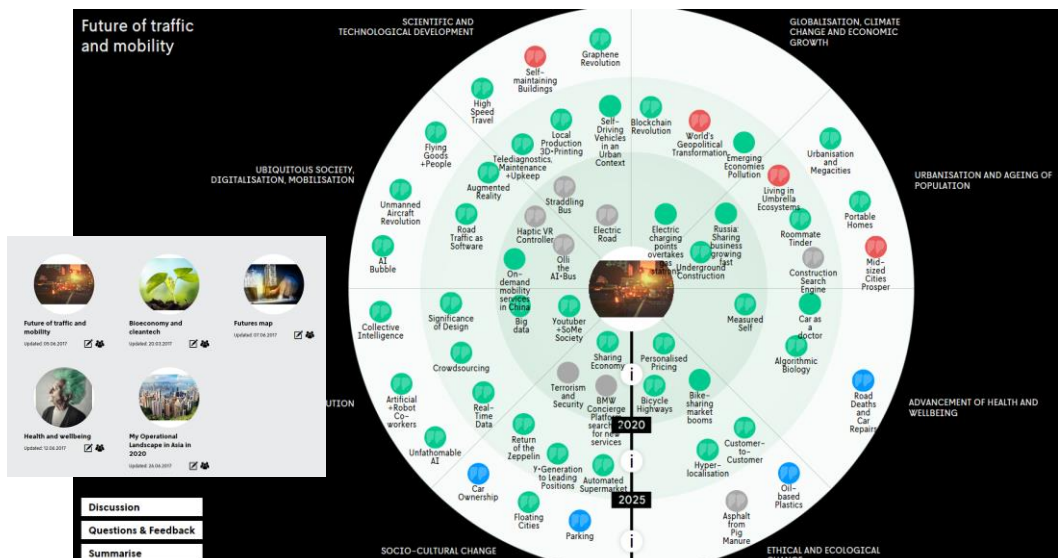
Sales leads

Business opportunities and Future Watch

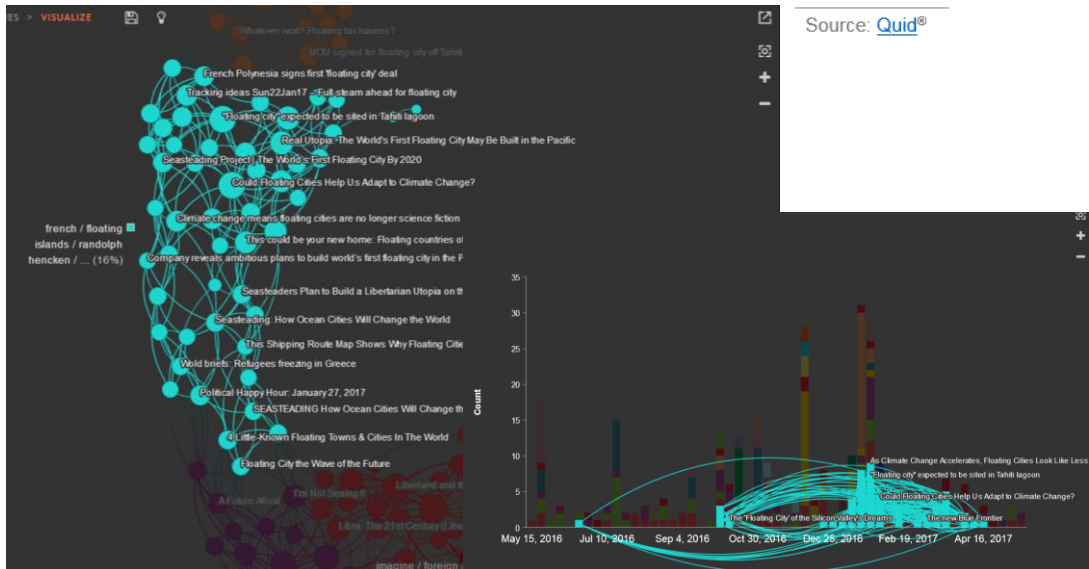
Country outlooks



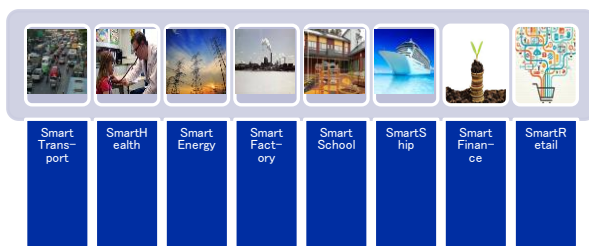
Example: Phenomena maps (integrated to Oppspace)



Example: Identifying rising phenomena



Towards Digital Finland



- Vision of:
 - 1) the potential in digital platform economy
 - 2) critical success factors
 - 3) phase of development



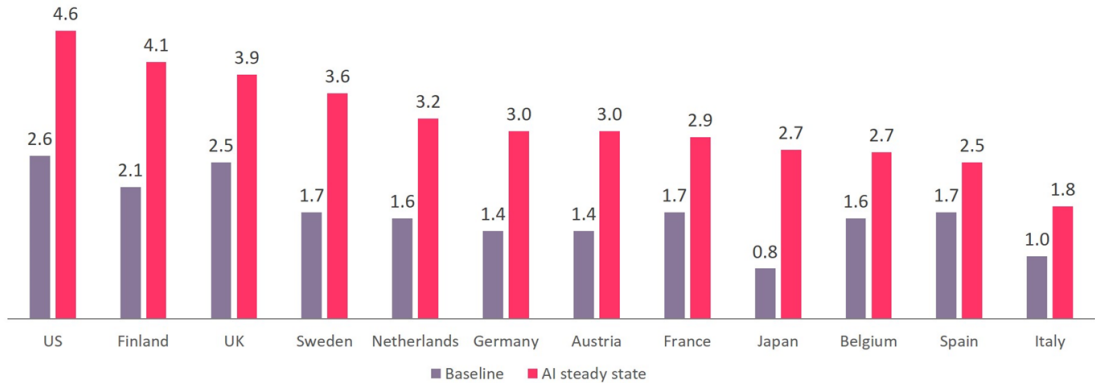
- Prioritization in the portfolio
 - attractiveness and basis for intervention
 - balancing the portfolio



- Concrete implementation plan
 - actions needed, schedules and responsibilities
 - resources and competences needed

Finland with and without Artificial Intelligence

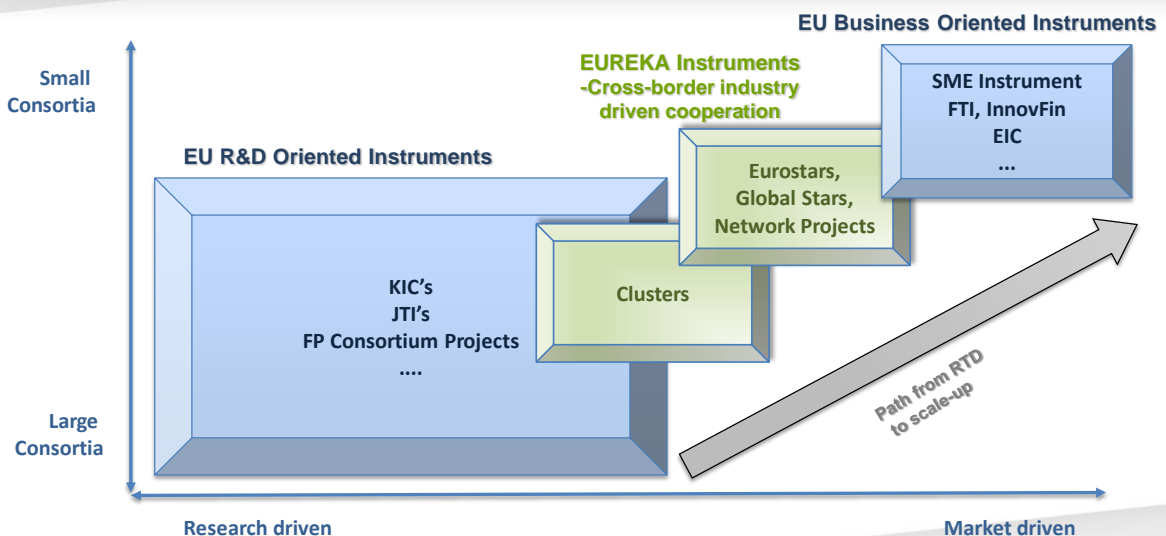
Annual growth rates by 2035 of gross value added (a close approximation of GDP), comparing baseline growth by 2035 to an artificial intelligence scenario where AI has been absorbed into the economy



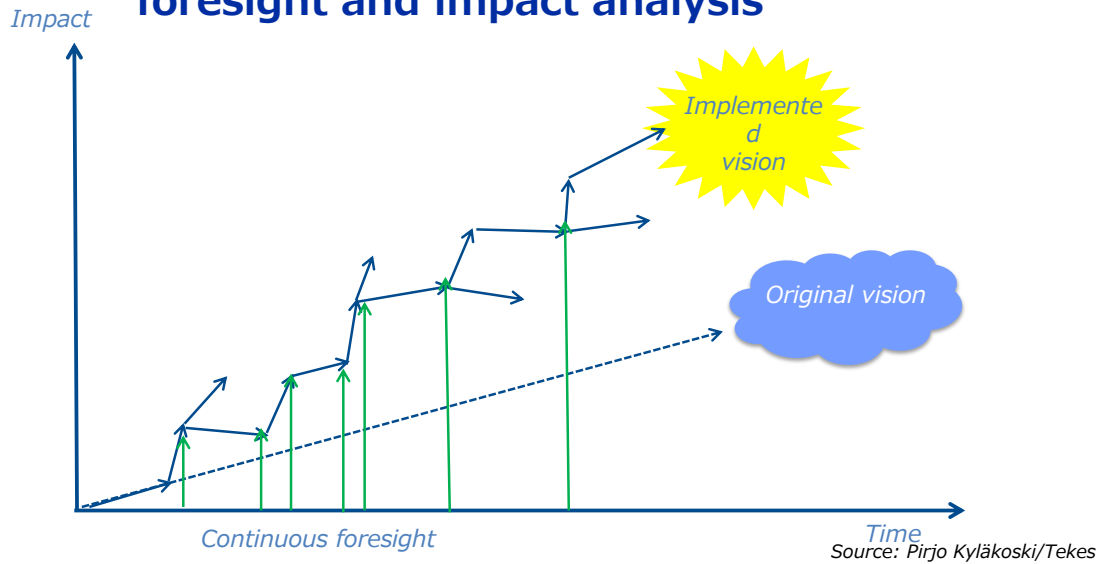
The European Innovation Landscape

-EUREKA is Key for Industry Driven Cross-Border Cooperation in Europe

EUREKA 
Innovation across borders



Experimental implementation with continuous foresight and impact analysis



Thank you – let us make our global future together

Pirjo Kyläkoski
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Beyond the Horizon

Foresight in Support of the Preparation of the EU's Future Policy in Research and Innovation (BOHEMIA)

Matthias Weber

Head of Center for Innovation Systems and Policy
AIT Austrian Institute of Technology, Vienna

8th International Conference on Foresight "Foresight for Strategic Planning"
Tokyo, 29 November 2017

Overview

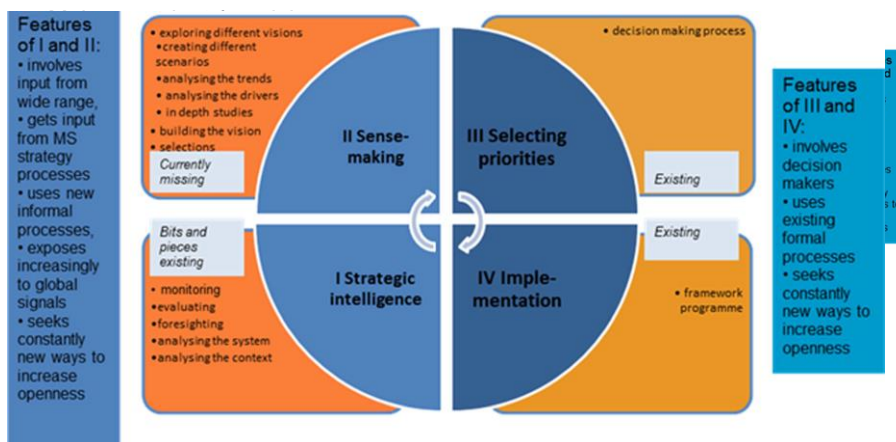
- 35 years of foresight for policy at European level
 - Origins
 - Current policy developments
- The BOHEMIA Project – Foresight in Support of the Preparation of the EU's Future Policy in Research and Innovation
 - Phase 1: Context scenarios
 - Phase 2: Delphi
 - Phase 3: Targeted scenarios and tentative recommendations
- Process experience and impact

Origins of foresight in support of European R&I policy

- The early days (1980s and 1990s)
 - FAST programme on Forecasting and Assessment in S&T
 - Institutionalisation: Forward Studies Unit, Institute for Prospective Technological Studies IPTS
 - Dedicated foresight, forecasting and technology assessment actions under all framework programmes since the early 1990s
- Foresight 'fatigue' (2000s)
 - Continuation of a variety of foresight projects, ...
 - ... but scepticism about relevance for and impact on policy-making
- Reinvigoration in times of global turbulence (2010s)
 - EFFLA – European Forum on Forward-Looking Activities
 - Capacity building: Foresight Correspondents' Network within the Commission
 - Embedding Foresight in the sense-making and design phase of the policy-making cycle
 - Mainstreaming of foresight as instrument in strategy formulation

3

Current developments: embedding foresight in policy-making



- What needs and opportunities for R&I?
- What means and approaches of R&I policy?

Source: EFFLA

4

Current developments: NEW mission-oriented R&I policy

- EU has subscribed to the UN's Sustainable Development Goals (SDGs)
 - Change of the political expectations with regard to publicly funded R&I
- Additional „rationale“ for R&I policy
 - Frontier research and research on enabling technologies continue to be very important, but ...
 - ... public R&I agendas are increasingly justified by their expected contribution to resolving major societal challenges
- Consequences for the content and the design of FP 9 and the organisation of research and innovation
 - Inter- and transdisciplinary research with a transformative ambition
 - Research for understanding and for resolving societal challenges
 - New intervention logic: More emphasis on experimentation and adaptation
 - Moving from individual projects to an iterative upscaling logic
 - Tighter embedding in sectoral policies to shape the demand-side of innovation

5

BOHEMIA – background, purpose and objectives

- A strategic foresight study to contribute to the proposal for FP9
 - Research results of FP have an Impact in society ~5-10 years after its completion
 - Major challenges at the time horizon ~2035 as starting point
 - Taking into account openness and variability of future contexts
- Part of a wider strategy for co-design of FP9 with stakeholders, based on foresight and other forms of strategic intelligence
- Objectives
 - Draw a picture of possible alternative futures setting the societal, economic and political conditions and boundaries for EU R&I policy
 - Assess possible future evolution of socio-economic as well as of scientific and technological challenges, needs and opportunities
 - Suggest issues which could be addressed by EU R&I policy and funding

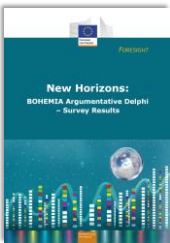
6

The BOHEMIA project

- Phase 1:** Extensive review of available foresight to produce meta-scenarios relevant for Europe and deeper insights in topical fields (published June 2017)
- Phase 2:** Delphi survey to gain insights on future technologies, societal issues, and R&I practices based on the scenarios (completed in Summer 2017)
- Phase 3:** Analysis to combine meta-scenarios and Delphi results; policy recommendations (ongoing)



The report describes a range of futures we might be facing in the 2030s, and suggests ways how research might create options for Europe to cope and flourish.

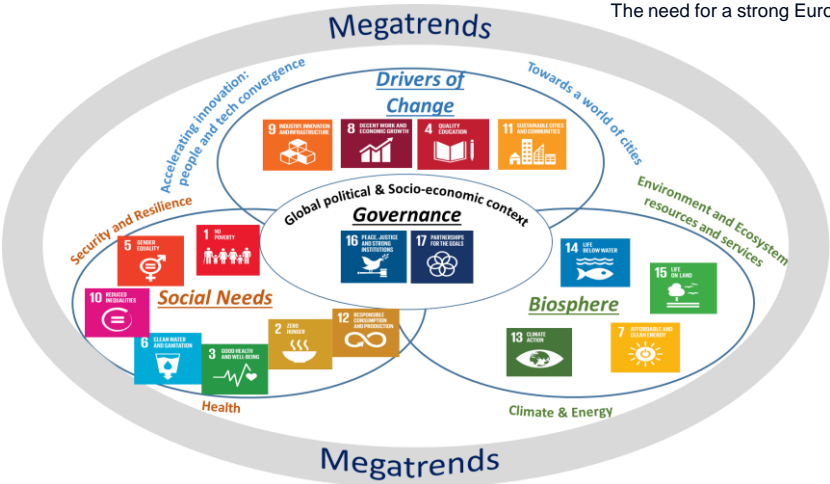


This report describes the full results of the Delphi survey, covering 150 statements about the future of research and innovation in Europe

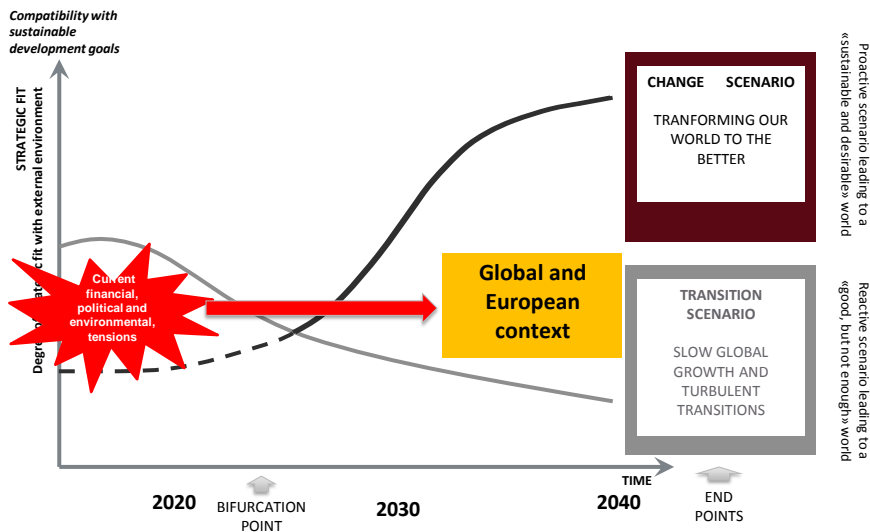
Phase 1 – Meta-Scenarios

Analytical context
Global megatrends

Normative context
Sustainable Development Goals
The need for a strong Europe



Dealing with uncertainty? Change and transition scenarios



9

Contrasting scenarios of global and European scope

Two types of scenarios to illustrate the possible transitions:

- 'Perseverance Scenarios': current structures and institutions persevere, leading to a continuation of current cleavages
- 'Transition scenarios': Europe spearheads the structural transition to 'the future we want'

7 Perseverance Scenarios

- Turbulent transitions
- Climate calamity
- The age of over-exploitation
- Health divide
- Security race
- Losing the race against the machine
- Urban jam

7 Transition Scenarios

- Transforming our world for the better
- Low carbon transition
- Towards a new well-being
- Towards health for all
- Building societal security
- The innovation revolution for everyone
- Urban bloom

10

A turbulent tomorrow: the 'perseverance' scenarios in short

- **Governance:** Megatrends continue to shape the world → deepening disparities; overall failure of our leaders to make the right choices
- **Health:** unequal access to health services → new diseases, epidemics, rich/poor divide widens
- **Security:** technology fixes → further enhancement of root causes of risks
- **Cities:** Urbanisation unabated → sprawl, pollution and congestion feed each other
- **Innovation:** Fast technological progress drives global economy → SMEs struggle in the "gig" economy
- **Environment:** Green commitments and technologies → incremental improvements
- **Climate:** climate change effects increasingly visible → critical shortages in resources, increase in natural disasters

11

Transition to a better age: The 'change' scenarios, in short

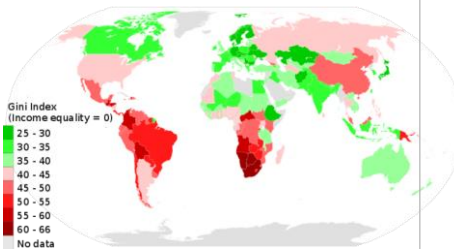
- **Governance:** Commitment to SDGs → Social, political and environmental progress in Europe and the world
- **Climate Change:** Low Carbon Economy → Mitigation of climate change
- **Environment:** Circular and bio economy → Respecting planetary boundaries
- **Health:** Equitable healthcare and regulation → longer healthier life
- **Security:** Security embedded in society → resilience
- **Innovation:** Digital job markets and productivity-enhancing technologies → new work opportunities
- **Cities:** Cities as hotspots and laboratories of good governance → smart system innovations in transport, energy, resource management

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Global political and socio-economic context

Perseverance: Turbulent transitions

- Socio-economic dynamics
 - Inter-generational conflicts triggered by demographic developments (ageing, youth bulges)
 - Reinforced by limited resources, poor education and lack of employment opportunities
 - Strong migration pressure



Tracey Hunter in 2014 based on Table 2.9 of The World Bank: World Development Indicators

Global political and socio-economic context

Perseverance: Turbulent transitions

- Socio-economic dynamics
 - Inter-generational conflicts triggered by demographic developments (ageing, youth bulges)
 - Reinforced by limited resources, poor education and lack of employment opportunities
 - Strong migration pressure
- Technological dynamics
 - Untamed digitalisation („hyper-scalability“) intensifies competition and triggers structural unemployment
 - Acceleration of technological change outpaces any policy strategy
- Political dynamics
 - Resource and Security concerns prevent common strategies
 - Global power shifts marginalise Europe's influence
- Global priorities
 - Addressing systemic risks (energy, urban, environment, etc.) and global tensions (severe military conflicts) when they arise

Change: Transforming the world for the better

- Socio-economic dynamics
 - Highly performing innovation ecosystems through inclusive digitalisation + new welfare models
- Technological dynamics
 - Digitalisation + low-carbon transition => more sustainable production-consumption system and business models
 - Acceleration and convergence of technological change geared towards reaching the SDGs
- Political dynamics
 - Shared (global) goals serve as soft coordination devices, EU as strong regional driving force & benchmark for cooperation
 - Multipolar system, with strengthened global governance to support cooperation and convergence
- Global priorities
 - Joint global agendas „towards a world where nobody is left behind“, which supersede traditional growth objectives
 - Closing intra-EU and global divides to strengthen cohesion

Environment and ecosystems resources and services

The age of over-exploitation

- Challenge of supplying a growing world population
- Growing demand for resources not counter-acted by systemic strategies, ...
 - Rising consumption of raw materials, energy and other resources
 - Competition between different types of resource use
 - Uncertainty about commodity price development
- ... leading to environmental degradation...
 - Ocean ecosystems & freshwater over-exploited
 - Soil degradation and habitat conversion
 - Loss of biodiversity and increased pollution
- ... and erosion of economic base in affected areas
 - Coastal zones, desertifying regions, and agricultural areas particularly affected
- What if?
 - Social and technological change alleviate, but do not resolve these challenges

Towards a new well-being

- Respect for planetary health
 - Maintaining high levels of biodiversity
 - Sustainable exploitation of the natural resource base
- Transition to a circular economy limits resource demand
 - Major improvements in resource-efficiency
 - Significant positive externalities
 - Decoupling economic growth from material consumption
- Major environmental benefits from new technology ...
 - Zero marginal cost services enabled by networks & ICT
 - Nano-, bio-, materials & IC tech for „green“ purposes
- ... and new production-consumption models
 - New jobs in distribution & maintenance of long-life products
 - From ownership to sharing
 - Full control of local rather than global supply chains
- What if?
 - The promise of the oceans: Sustainable use as food and energy resource

Accelerating innovation: people and tech-convergence

Losing the race against the machine

- Massive acceleration of innovation
 - Global frontier firms harness the power of digitalization
 - Growing productivity gap
- Major network externalities foster concentration
 - Platforms and IP ensure control
- Europe struggles to take leadership in 'hyper-scalable' economy
 - Mega-multinationals take control over new firms in Europe
 - Higher volatility makes infrastructure investments risky
 - Slow scaling up hinders technological leadership
- Example: Integrated services in Agroindustry 4.0
 - Precision farming with IT dynamics
 - IP on agricultural organisms
 - Multinational retail chains tied to agro-industrial clusters

The innovation revolution for everyone

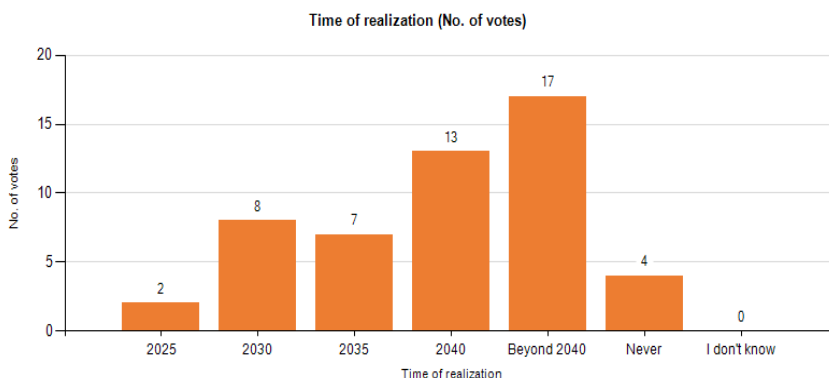
- Massive acceleration of innovation fully embraced in Europe
 - Major investments in RTI and smart infrastructures
 - Adjustment of regulatory system
 - Research facilities attracting the highly skilled
- An open system for R&I
 - Broader engagement in R&I activities
 - Inclusiveness + social solidarity as guiding principles
- Leadership opportunities
 - Europe global leader in science-based regulation and standardization
 - Fast-growing European start-ups compete with leading firms worldwide in key technology fields
- Example: Social and economic balances
 - Innovations in social and economic policy (basic income models, life-time social budgets)
 - 'Grand Coalition' for Digital Jobs

Phase 2: Questions & Assessments in the Delphi survey

- **Assessment of statements about future S&T developments as well as societal developments and changing R& practices**
 - Online, real-time argumentative Delphi
- **Time of Realization in 5 year steps**
 - What is the time of realization? (until 2020, 2021-2025, 2026-2030, 2031-2035, 2036-2040, 2041 and later, never)
 - Ranked arguments for the Time of Realization
- **Significance** ☆☆☆☆☆
 - **A) Significance of R&I:** Is R&I significant for the topic? Very significant to not significant
 - **B) or: Significance for EU R&I policy:** Is the topic significant for EU R&I policy? Very significant to not significant
 - Ranked arguments on significance
- **Focus: qualitative discussion of significant developments**
 - „Likely“: Significant and likely realisation by 2035/2040
 - „Uncertain“: Significant, but uncertain time frame of realisation
 - „Wildcards“: Unlikely realisation, but high significance if realised

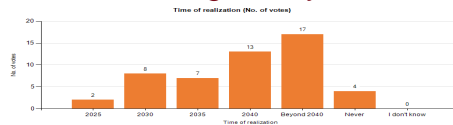
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Ex: More than 90% of all materials and waste is physically recycled or re-used energetically in the circular economy



20

Ex: More than 90% of all materials and waste is physically recycled or re-used energetically in the circular economy

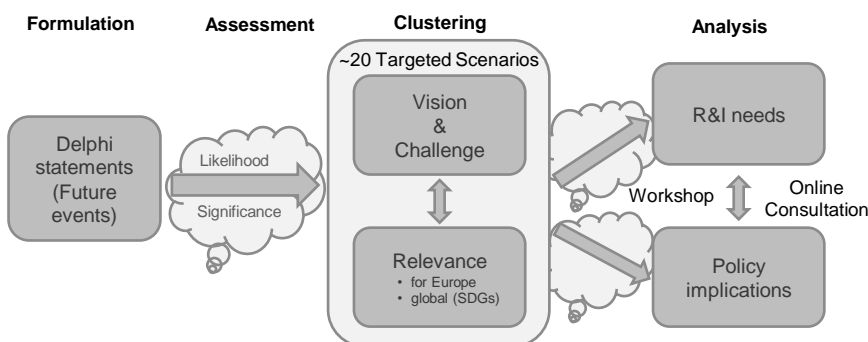


Arguments regarding the time of realization	No. of votes
Current recycling rates vary widely depending on the waste stream or country. A single figure of 90% may be inaccurate and too ambitious in some cases.	27
The European Commission adopted an ambitious Circular Economy Package, which includes a common EU target for recycling 65% of municipal waste by 2030.	26
A high level of recycling requires massive investment.	23
As consistent progress has been made in life-cycle assessment methodologies, there will be more public pressure to recycle and reuse.	20
This figure can only be achieved if it includes the reuse and service-life extension of goods, which is not subject to the second-law of thermodynamics and prevents waste rather than manage it.	16
Large scale utilisation of biowaste is a clear trend.	11
The main problem will be to curb the current inertia of the free market and the current consumption strategies.	7
Technically and politically, it is not a difficult target.	3
The re-use sector within the recycling sector has the potential of creating a huge amount of jobs for low-skilled people.	1

Average relevance = 3,85/5 with limited dispersion

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Phase 3: Exploiting the Delphi results



Targeted scenarios outline:

- Vision at 2040
- Relevance for Europe and globally (SDGs)
- Implications for EU policy
- Items for an R&I agenda

Example: Circular economy and rare resources

Vision and relevance

- The expected shortage of a range of rare resources, in particular metals, will be counter-acted by a range of technological and systemic responses by 2040
- Ambitious targets yet to be fully achieved
- Europe uses its strong role in R&I in this area to foster its economic position and reduce environmental impact.
- Towards SDG 12 Responsible Consumption and Production

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Example: Circular economy and rare resources

Policy implications

- Agriculture
 - Extent of exploitation of renewable resources vs. food production
- Environment,
 - Regulatory requirements for extraction, processing & usage of materials/resources
- Trade,
 - Ease of global access to resources
- Industry,
 - Working conditions in industry and mining
 - Business models and design for long-life products
- Research and Innovation.
 - Substitution of materials
 - Extraction and processing methods
 - Recycling and re-use
- External policies
 - Global political stability
 - Cooperation with other countries and world regions

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Example: Circular economy and rare resources Items for an R&I policy agenda

- Understanding oriented research
 - Geology, impact of extraction impacts of waste management practices
 - Fundamental properties of materials
- Regulatory science and science for policy
 - Toxicity
 - Environmental impact assessment
- Solutions oriented research and innovation
 - Materials technology and substitution
 - Depolymerisation and materials separation
- Scaling up experiments, demonstrations and social innovation
 - Circular industrial systems
 - Refitting
 - Demonstration of waste management techniques
 - Scale up in nanotechnology

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Phase 3 – Targeted scenarios at draft stage

(seeking a tradeoff between *coverage* and *overlaps*)

Drivers of change

- Future of Knowledge Production
- Nano-to-Macro Integral Manufacturing
- The Electrosphere of Sensors
- Ambient Emotional intelligence
- Continuous Cyberwar
- Advanced ICT-Based Security

The Biosphere

- Low-Carbon Economy
- Next-Generation Bioeconomy
- Cheap Renewable Energy Sources
- Making More out of Scarce Ressources
- Making an Economic Case for Nature

Social needs

- Re-Construction of the Meaning of Work
- Towards a More Diversified and Sustainable Food Supply System
- Assisted living
- Human Organ Replacement
- Precision Medicine
- Defeating Communicable Diseases
- Mobility as a Smart, Sustainable and Intermodal Service

Governance

- Decision-Making Supported by Open Expert Systems

26

Recommendations: Policy alignment

Targeted scenarios ...

- ... provide narratives of change
 - Embedded in shared ambitions reflected in the seven transition meta-scenarios
 - Firmly rooted in Delphi results, but sensitive to future uncertainty
 - Derive items for future R&I agendas, as well as ...
 - ... future issues and opportunities in other than R&I policy areas
- ... point to need for policy alignment in terms of
 - Joining forces in R&I between several, but not necessarily all European countries
 - Improving coherence between R&I policy and sectoral policies early on
 - Strengthening integration and mobilisation of stakeholders and citizens in programme design and implementation
- ... are instruments for strategic dialogue across policy areas
 - Need to address future change from different policy angles

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Recommendations: International cooperation

- Governance frames for global challenges and global crises (food, climate, demographics, cities, security...)
- «Big decisions» on major options (nuclear, geo-engineering...)
- Sharing visions and seeking policy consensus
- Scope, governance and the limits of delegation
- Better exchange/integration of foresight programmes and futures literacy

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Process experience and impact

- Joint development of meta-scenarios and targeted scenarios with foresight correspondents' network of the European Commission helped establish a common reference frame for Commission-internal debates about FP 9
- External interactions (Delphi, online consultation, presentations) consolidate future assessments and provide inputs to the formation of stakeholder opinions
- Key orientation documents for FP 9 draw on inputs from BOHEMIA first phase
- Final results on targeted scenarios provide inspiration for future „new missions“ to be pursued by FP 9 in conjunction with sectoral policies

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Next steps

- On-line consultation to validate the targeted scenarios and their policy implications – November/December 2017
- Final report with recommendations – January 2018

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Center for Innovation Systems and Policy
Vienna (Austria)

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Download scenarios report

<https://publications.europa.eu/en/publication-detail/-/publication/b2d78a84-3aae-11e7-a08e-01aa75ed71a1/language-en>

31

Annex: A brief view on trends and activities

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The global trends

1. Pervasive influence of digital platforms on economic value networks, social movements and political governance
 2. Growing political and economic conflicts over access to natural resources (water, food, materials)
 3. Increasingly noticeable effects of climate change lead to extreme weather events in several world regions
 4. Jointly, these trends trigger political instability and migration flows
- Underlying Reasons
 - All four trends are already noticeable today.
 - They could be counter-acted only by collective action at global level.
 - This requires effective global governance mechanisms, which are currently not in place and unlikely to emerge in the coming years.

The regional trends

1. The rise of the African continent
 2. Major environmental problems in urban agglomerations, in particularly in some Asian, Latin American and African countries
 3. Widening social disparities in many countries
- Underlying Reasons
 - Growth of agglomerations outpaces upgrading of infrastructures.
 - Social disparities aggravate due to poor governance and digital divides

The national trends

1. Ageing societies (partly) compensated by migration
 2. Stagnation of economic growth (in traditional terms) in industrialised countries, but qualitative welfare improvements
- Underlying Reasons
 - Economic growth in monetary terms is outweighed by repair costs
 - Digitalisation and advances in other areas (synbiology, renewables, etc.) improve quality of life at stable or lower social costs

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Current foresight activities of AIT

1. Growing significance of local foresight activities involving cities, citizens and other local stakeholders
 2. Foresight and Technology Assessment for the Austrian Parliament on socially contentious issues associated to emerging socio-economic and S&T developments
 3. Policy and corporate strategy development (e.g. on Industry 4.0, Future of Work, smart energy, health systems, etc.) underpinned by foresight
 4. European foresight and its embedding in political decision-making
 5. Foresight methodologies for transformative socio-technical futures
 6. Combining web-/data-mining, simulation and stakeholder participation in real-time experimentation
- Further information
 - www.ait.ac.at/ueber-das-ait/center/center-for-innovation-systems-policy/
 - www.foresight-platform.eu/
 - <https://ec.europa.eu/research/foresight/index.cfm?pg=strategic>

36



Data-driven Horizon Scanning in the NISTEP

**“Foresight Open Platform” and
“KIDSASHI”**

29 November 2017

NISTEP S&T Foresight Centre
Hitoshi KOSHIBA



Science and Technology
Foresight Center



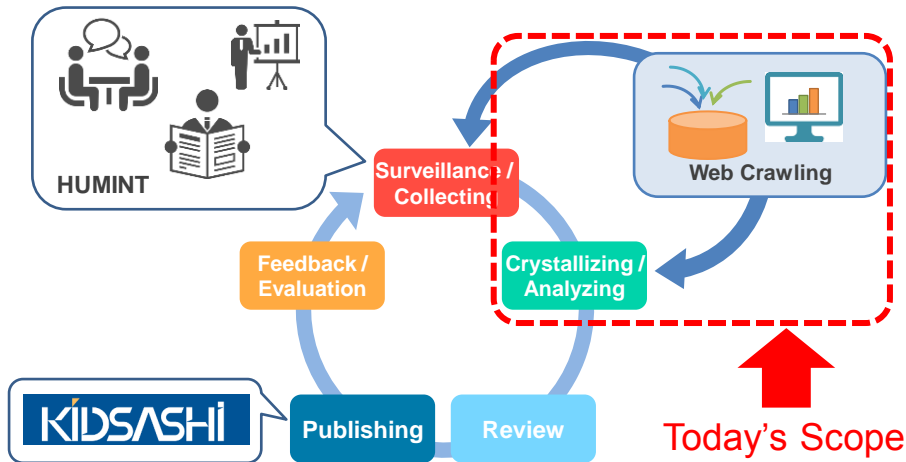
NISTEP's Horizon Scanning

Horizon Scanning is the activities which find out new movements (indication of changes) that might provide big impacts to society in the future and obtain invisible opportunities and risks.



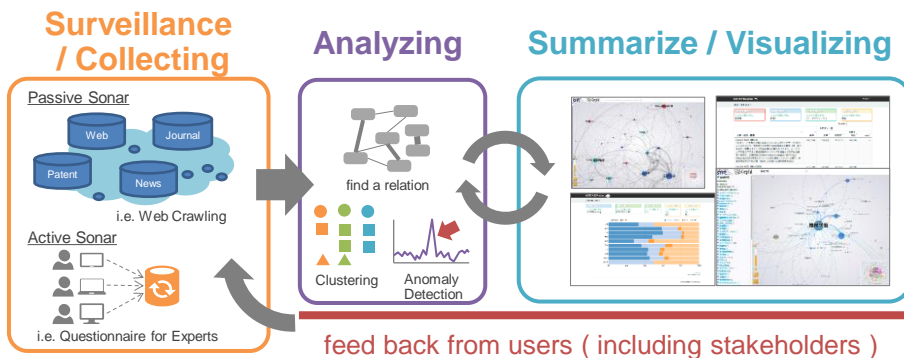
NISTEP's Horizon Scanning Cycle

We construct Horizon Scanning Cycle
through both ways of Human insights and ICT systems



3

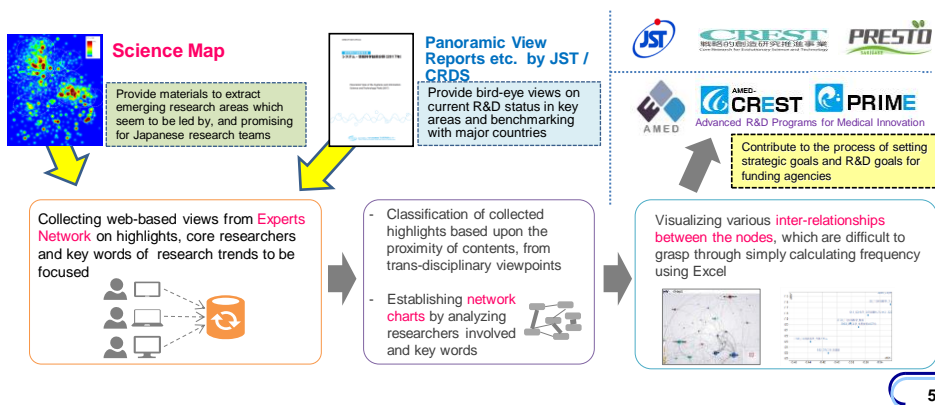
Horizon Scanning Process through ICT Systems



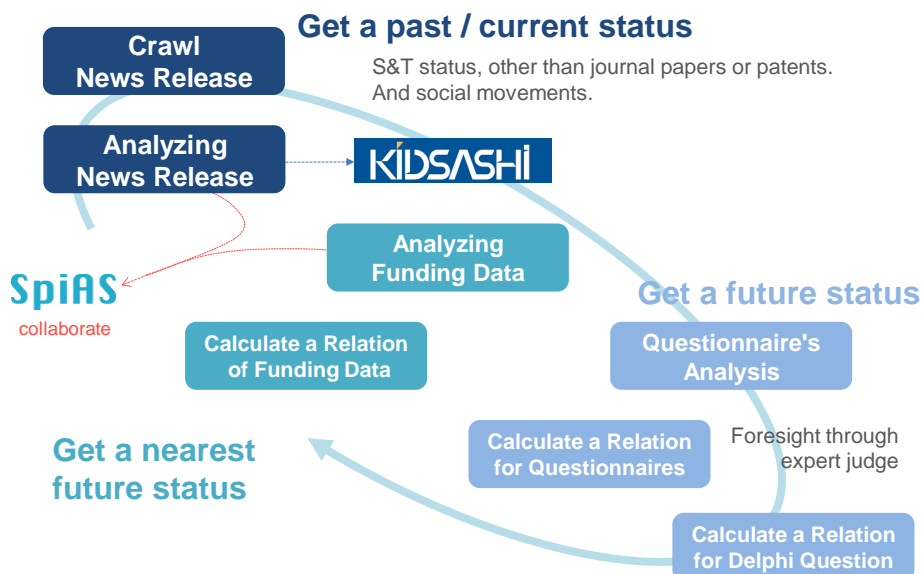
Utilizing ICT as an information platform
to provide evidence / clues for strategic R&D planning

4

- 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)

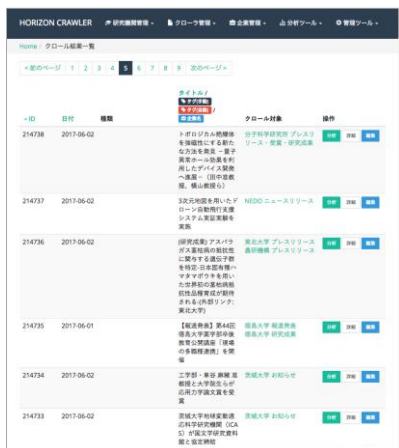


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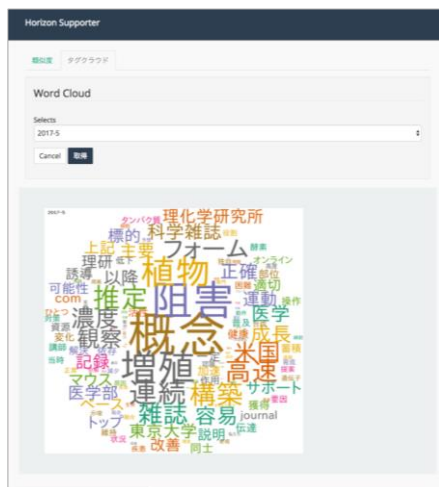


6

- We crawl about 300 web sites, day by day.
 - ◆ Web sites : University, Research Institute, and the others.
- Our system : clustering / tagging these contents **automatically**.



7



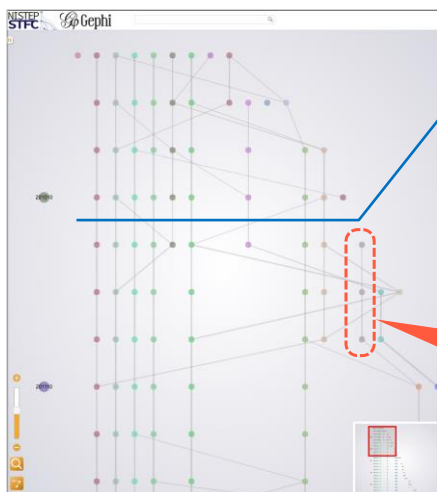
Monthly word cloud



Trend dashboard

8

■ Time series analysis through topic model.



Jan. 2011

Bottom-up
Analysis

X axis : Time series (Upside is past)

○ is topics

Line means relationship / similarity

This topic-line had relationship
of
East Japan great earthquake
disaster (11, March, 2011)

Our method can detect social events, automatically

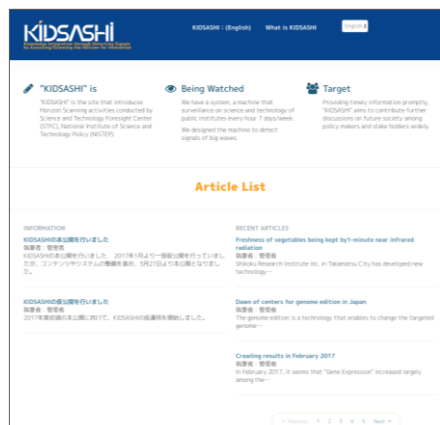
9

<https://stfc.nistep.go.jp/horizon2030/>



We report, our detect “weak signals” that results of horizon scanning at our web media “KIDSASHI”

Knowledge Integration through Detecting Signals by Assessing/Scanning the Horizon for Innovation



10

Estimation of relevance between text and funding area

top-down
Analysis

Horizon Supporter

種別: サダクラウド

Rough/Absurd Classification

対象の文章

トピックから総論の形に近づくにつれて、特定の分野に属する性質が強くなる。さらに高度であっても関連性があることを示す。トピックから総論の形に近づくにつれて、特定の分野に属する性質が強くなる。さらに高度であっても関連性があることを示す。トピックから総論の形に近づくにつれて、特定の分野に属する性質が強くなる。さらに高度であっても関連性があることを示す。

5文字以上、単語ではなく文章の入力が求められます。

結果の選択

☒ 研究テーマの分野分類を指定します。(調査票方式、高度)

☐ 類似するアルファベットの分野分類を指定します。(長短句ベースのサイエンス分類、数十分)

Cancel 決定

分野: 理工系 - 数物系科学 - 物理学 (関連度: 45.7%)

分野: 理工系 - 工学 - 応用物理学・工学基礎 (関連度: 17.2%)

分野: 理工系 - 総合理工 - ナノ・マイクロ科学 (関連度: 16.6%)

分野: 理工系 - 工学 - 材料工学 (関連度: 12.3%)

Classification using deep learning

- ◆ Data-set: KAKEN Database (2005-, About 27,000 cases)
- ◆ Method: FastText (≈Word2Vec)

Classification Result

分野: 理工系 - 数物系科学 - 物理学 (関連度: 45.7%)

Science & Engineering Physics

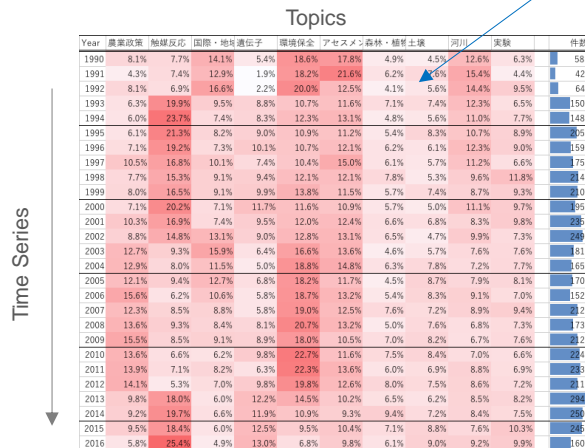
Mathematics & Physics Relevance: 45.7%

11

Funding Data Analysis

- Purpose: Detect to trends from text
- Target: Projects title and abstract
- Method: Topic Model (LDA)

Average of Topics Per Document of each Year



12

Step1: Collects a funding data (project's descriptions. i.e. title, abstract, date, etc.)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
	ID	金額	年度	種別	分野1	分野2	分野3	分野4	課題名	ライフログ	創造支援	ロボ・コエ	情報検索	位置情報	認知科学	情報入力	その他	件数	Max
1										Topic 0th	Topic 1th	Topic 2th	Topic 3th	Topic 4th	Topic 5th	Topic 6th	Topic 7th		
2	KAKENHI-PROJ	¥4,160,000.00	2016	若手研究(B)	総合系	情報学	人間情報	ヒューマン	Investigating cognitive en	6.3%	18.8%	18.8%	6.3%	18.8%	6.3%	6.3%	18.8%	創造支援	183
3	KAKENHI-PROJ	¥4,030,000.00	2016	若手研究(B)	総合系	情報学	人間情報	ヒューマン	行動解析を用いた自然言語	16.7%	5.6%	38.9%	5.6%	5.6%	16.7%	5.6%	18.8%	ロボ・コエ	34
4	KAKENHI-PROJ	¥4,030,000.00	2016	若手研究(B)	総合系	情報学	人間情報	ヒューマン	物体操作を介した心的状態	18.8%	6.3%	6.3%	6.3%	31.3%	18.8%	6.3%	6.3%	位置情報	23
5	KAKENHI-PROJ	¥3,510,000.00	2016	若手研究(B)	総合系	情報学	人間情報	認知ロボ	認知支援ロボットの開発と	6.3%	31.3%	18.8%	6.3%	6.3%	6.3%	6.3%	18.8%	創造支援	23
6	KAKENHI-PROJ	¥3,380,000.00	2016	若手研究(B)	総合系	情報学	人間情報	認知科学	認知科学におけるブライ	5.6%	27.8%	27.8%	5.6%	5.6%	5.6%	5.6%	16.7%	創造支援	23
7	KAKENHI-PROJ	¥3,380,000.00	2016	若手研究(B)	総合系	情報学	人間情報	認知科学	情報科学におけるブライ	3.8%	3.8%	34.6%	3.8%	42.3%	3.8%	3.8%	3.8%	位置情報	11
8	KAKENHI-PROJ	¥1,240,000.00	2016	若手研究(B)	総合系	情報学	人間情報	ヒューマン	脳から脳野を介した	4.6%	22.7%	4.6%	15.6%	4.6%	22.7%	4.6%	22.7%	創造支援	11

Step2: Classification scientific fields (based on KAKEN) and/

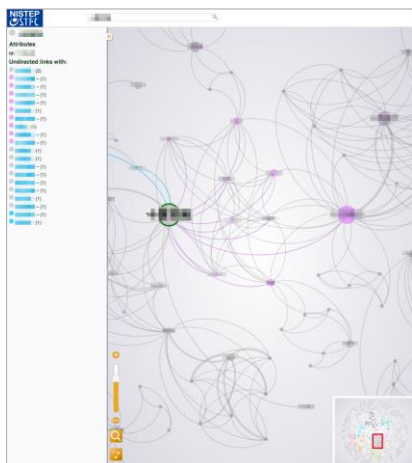
Step3: found trends, based on these semantics

ar	To	Count	ライフログ	創造支援	ロボ・コエ	情報検索	位置情報	認知科学	情報入力	その他	件数
			Topic 0th	Topic 1th	Topic 2th	Topic 3th	Topic 4th	Topic 5th	Topic 6th		
2000	22	0.077	0.133	0.080	0.033	0.058	0.256	0.056			
2001	20	0.124	0.133	0.090	0.075	0.087	0.180	0.068			
2002	22	0.084	0.206	0.153	0.049	0.101	0.120	0.049			
2003	24	0.174	0.104	0.117	0.070	0.108	0.167	0.028			
2004	23	0.108	0.124	0.064	0.068	0.097	0.193	0.030			
2005	32	0.084	0.178	0.141	0.052	0.069	0.187	0.054			
2006	39	0.126	0.217	0.107	0.119	0.100	0.118	0.050			
2007	50	0.089	0.161	0.164	0.094	0.110	0.161	0.048			
2008	35	0.111	0.117	0.218	0.075	0.128	0.156	0.040			
2009	38	0.093	0.134	0.160	0.088	0.114	0.205	0.036			
2010	46	0.092	0.153	0.190	0.067	0.148	0.179	0.052			
2011	63	0.105	0.160	0.135	0.078	0.131	0.195	0.059			
2012	74	0.125	0.133	0.156	0.081	0.142	0.205	0.039			
2013	62	0.138	0.115	0.211	0.082	0.131	0.139	0.056			
2014	47	0.113	0.142	0.205	0.097	0.123	0.141	0.057			
2015	29	0.171	0.114	0.165	0.097	0.088	0.159	0.096			

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A Case of questionnaire analysis

- A case of questionnaire analysis to the NISTEP expert panels
 - ◆ about 2000 experts are join.
 - ◆ Contribute to the process of setting strategic goals and R&D goals for funding agencies



We ask, research areas and researchers that we had to attention

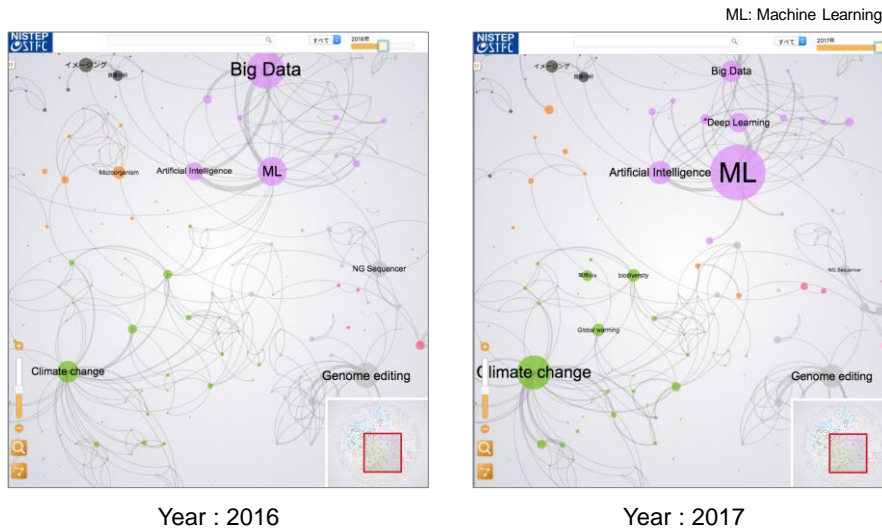
Researcher names or research keywords correlation's visualization

We can detect hub and/or core researcher, more easily

14

A Case of questionnaire analysis

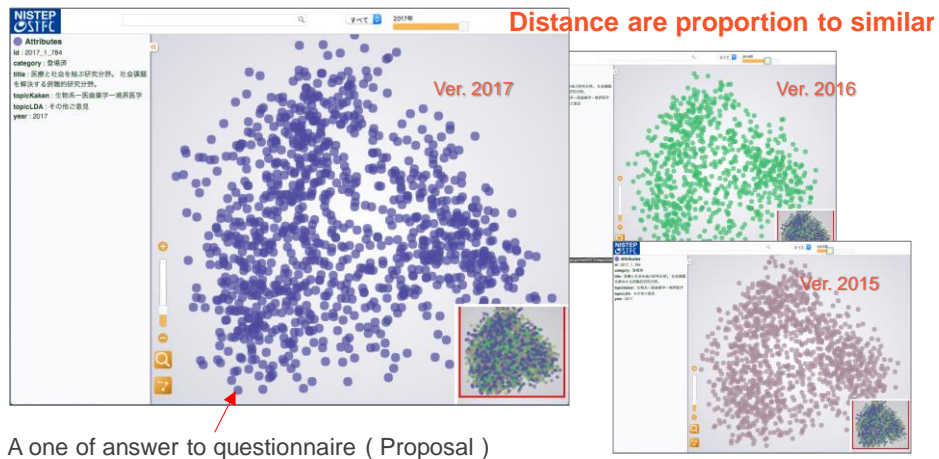
- Case of research key words, can visualize time series.



15

A Case of questionnaire analysis

- We analyze the contents of propose similarity and mapping to 2-dimensional space (using multi dimensional scaling)



16

- NISTEP tries to develop the way to Digital Driven Foresight / Horizon Scanning Methods.
 - ◆ Currently, we constructs our method based some data scientific tools (i.e. machine learning, natural language processing, etc.).
 - ◆ Our purpose is to final out the most effective way to compose these tools for our analyses.
- **Please share your practices and/or experiences**



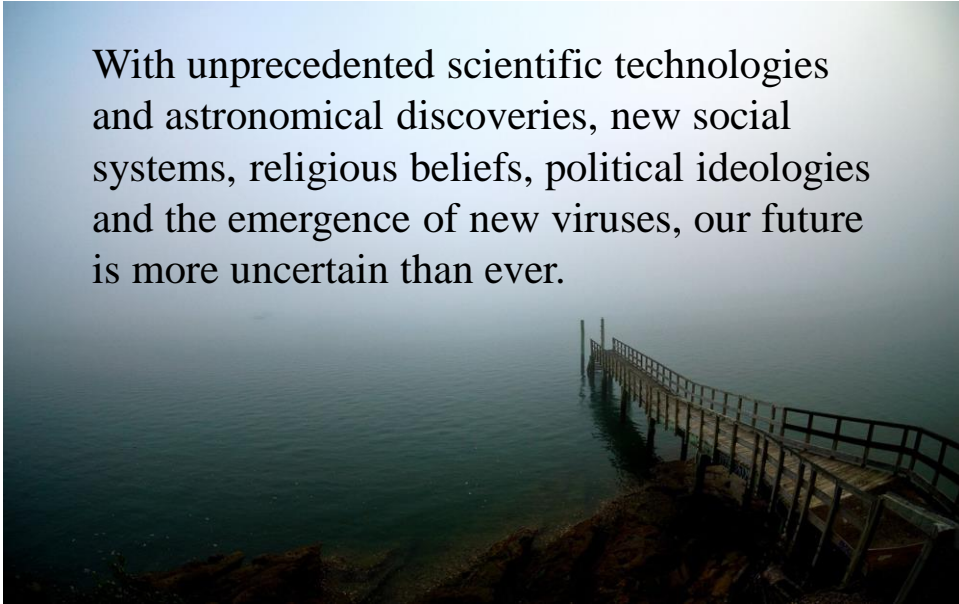
Passing the Baton from the Public to the Experts in the Race to Develop Innovative Ideas

Seongwon Park & Byongsam Choi
Center for Strategic Foresight
Science and Technology Policy Institute



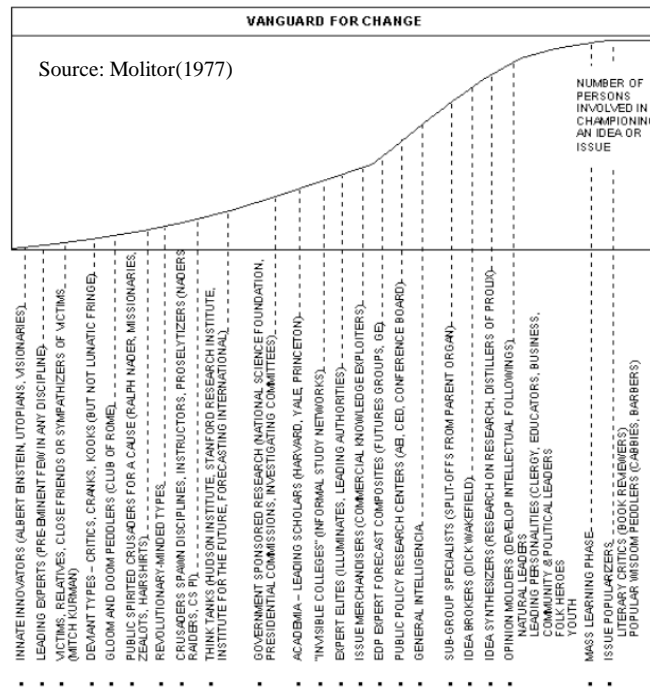
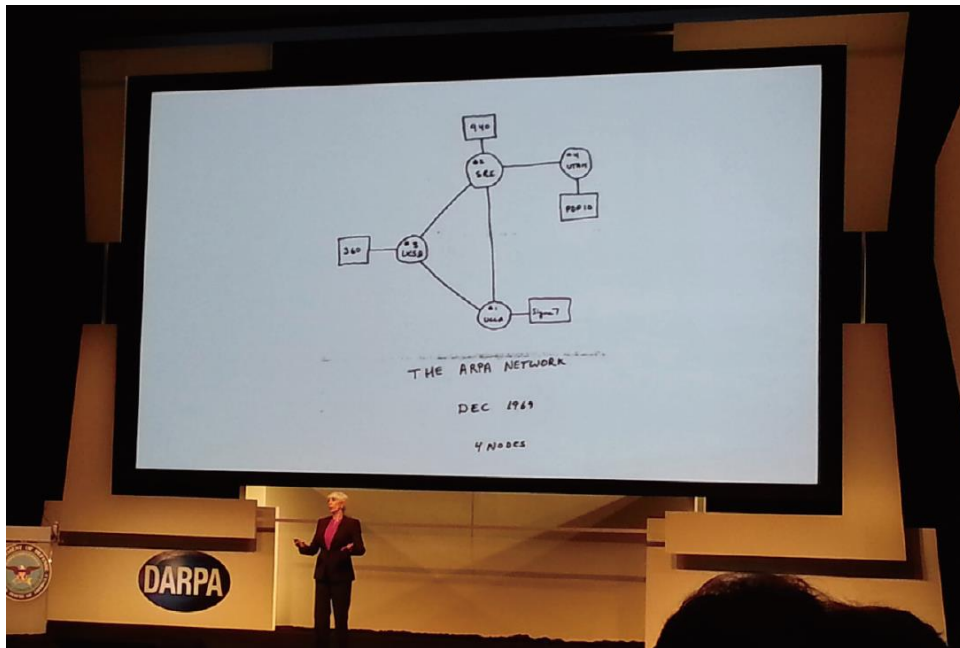
1. BACKGROUND TO THE RESEARCH

With unprecedented scientific technologies and astronomical discoveries, new social systems, religious beliefs, political ideologies and the emergence of new viruses, our future is more uncertain than ever.



Yet when it comes to preparing for an uncertain future, most academia and industry are vulnerable, as they have tended to focus only on trend analysis.

A trend is a certain tendency that can be observed as a leading phenomenon in society, but trends are not useful when it comes to anticipating or responding to a dynamic future, as it is forecast to disappear.

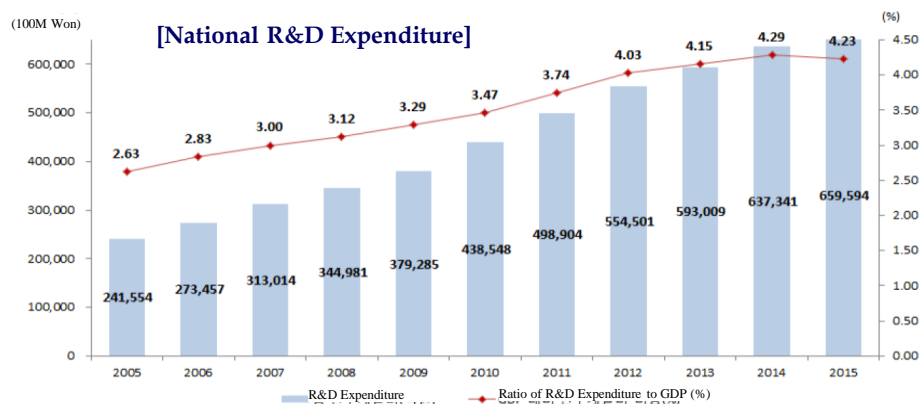




- Our research focuses on how to facilitate the development of emerging technologies into innovative technologies by designing an *engineered evolution* of emerging issues.
- We tailored Molitor's emerging issues analysis to derive a short-cut for the analysis through which emerging issues are rapidly transformed into national R&D programs that lead to innovative solutions for emerging issues.

2. THE X-PROJECT IN KOREA REFLECTING MOLITOR'S E.I.A.

Insufficient output compared to input of R&D



Germany in 2030 is clear from petrol and diesel



NEXT
NextX 소개
질문하기
나의활동
로그인

당신의 질문이 세상을 바꿉니다
변화는 궁금증으로부터 시작을 씁니다
일상의 질문이 위대한 혁신을 만듭니다
물음표가 느낌표로 변하는 거대한 프로젝트
세상을 바꾸는 위대한 질문이 시작됩니다

위대한 질문 시작하기

• 당신의 한 줄 질문은?
질문을 입력하여 주세요

• 당신의 질문이 당신과 우리 모두에게 확실한 이유는?
이름에 대해서 간단히 써주세요

• 당신의 질문에 대한 해법을 찾아 본 적이 있나요?
• 예 • 아니오

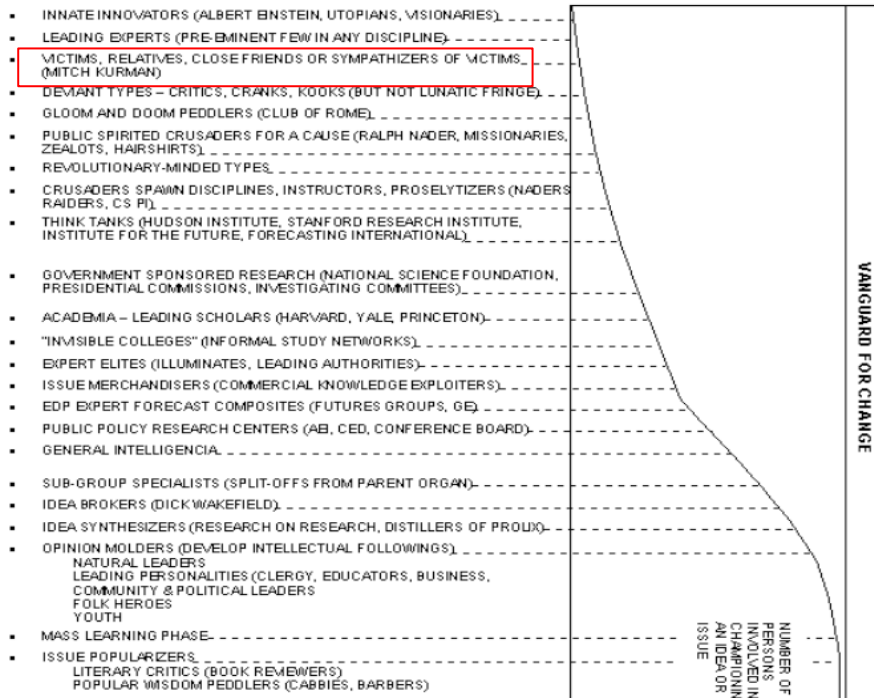
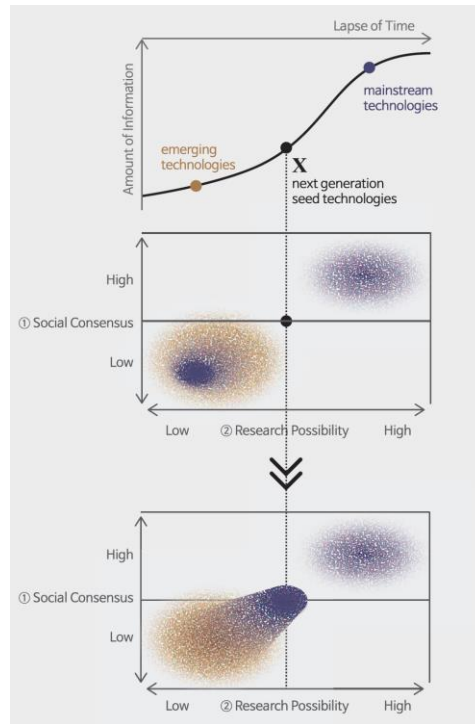
• 당신의 질문의 키워드를 하나 이상 입력하여 주세요. (ex. 인문학, 취업, 사교육)

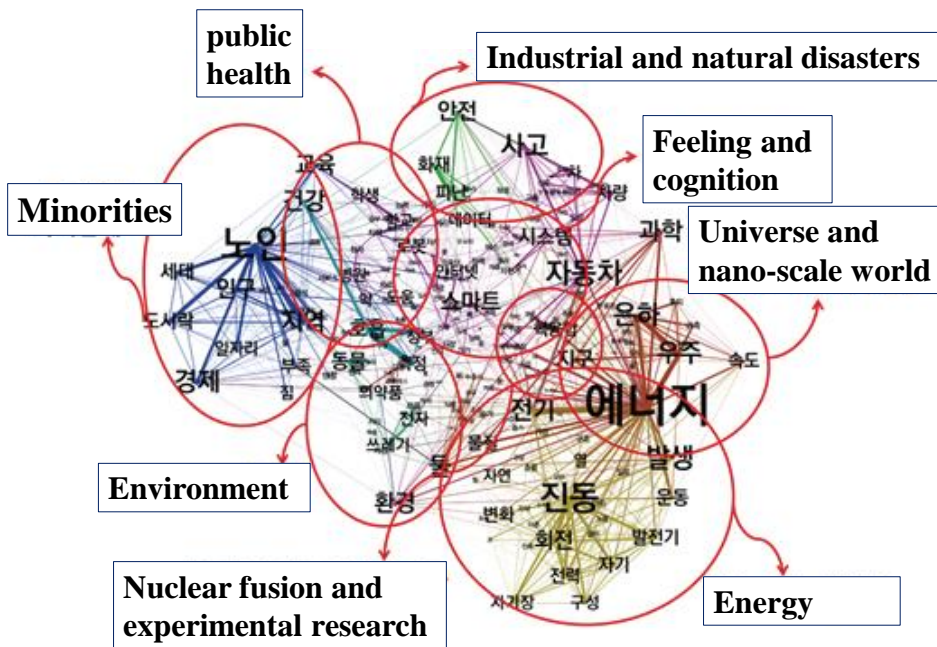
등록하기

한국연구재단지원
한국연구재단지원
한국연구재단지원
한국연구재단지원

(주)한국연구재단 (주)한국연구재단 (주)한국연구재단 (주)한국연구재단







A question

냉장고는 왜 불투명하게 만드나요??

조회수: 318

공익성 5 | 감인성 6 | 실용성 4

Qhinh · 2015.06.23 07:34

daom1311님 말씀처럼 빌트인이 보편화 된다면 정말 유용하게 쓸것을듯 싶네요. 사실 냉장고는 가정에 필수한 물건으로서 집 구조에 따라서 그냥 냉장고를 놓아도 필요한 곳도 있으나 투명한 냉장고를 만들어 줬으면 해요. 어떤 하나로 불투명하게 만들수도 있구요.

tre333님 말씀처럼 햇빛 반사도 생각해 봤는데, 냉장고 위치가 대부분 그늘진곳? 아닌가 싶기도 하구요...

X commentator · punky111 · 2015.06.24 16:29

만약 양면형 냉장고라고 가정할 경우 출버 같은 곳에 투명 창을 만들어 보는것도 괜찮을 것 같습니다. 투명 디스플레이로 온도 등을 알려주면서요!

Qhinh · 2015.06.25 08:19

punky111님!

출버에도 실질적으로 투명 창 만드는것도 하나의 방법이겠네요. ^^

X commentator · GIAGO · 2015.07.02 10:43

2010년에 일본에 만든지 제품도 있습니다.
<http://www.toxel.com/tech/2010/08/16/12-cool-and-unusual-refrigerators/>

2014년에 삼성전지에서 전시회에 출품한 시제품이 있습니다. (아래 웹페이지의 사진)
<http://www.sjipanehd.com/focus.php?subaction=showprod&id=1320403258>

2013년에 투명 LCD를 사용한 냉장고를 LG전자에서 만들었다고 알린 적이 있네요.
<https://www.youtube.com/watch?v=l419E-oIKcl>

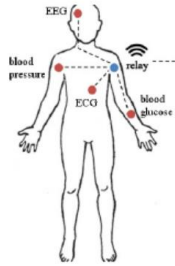
지금 기술로는 그냥 유리만 사용하는 것이 있고, 아직 기술이 덜 성숙하지만 투명 LCD를 이용하는 것도 가능합니다. 유리의 경우, 단열 문제와 소음, 그리고 파손 우려가 커서 선호하지 않는 것 같구요. 투명 LCD는 제작비용이 너무 비싸서 아직은 경제성이 없어서인 것 같습니다. 아마도 투명 LCD 제작 단가가 많이 하락하면 현실화 될 것 같습니다.

Public novelty realizability
interest

Voting
= Curation

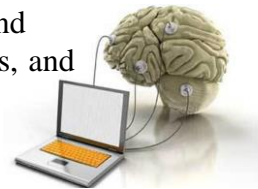
Comments
= Maturation

Can we find human bio-signals by passing through all interceptive matters?



Can we create a spray that makes a virus easily visible?

Can we measure, store, and remove dreams, memories, and emotions?



Can we make a nuclear-controlling technology capable of treating nuclear waste and developing new materials?

Selection Standard	Question examples as a ground for the decisions by category
Suitability	<ol style="list-style-type: none"> 1. Do the research plans of the research teams meet the purpose of the X-questions of the public? 2. Are the research plans regarded to achieve the public purpose of the X-questions? 3. Are the research results considered to fundamentally address the X-questions? 4. (Black mark) Do the research plans and results of the research teams cause another problem from the perspectives of EHS* and ELSI**? <p>* EHS: Environment, Health, Safety ** ELSI: Ethical, Legal, Societal, Implication</p>
Novelty	<ol style="list-style-type: none"> 1. Are the theories or methods suggested that have not applied to the existing researches? 2. Are the targets of the test and data analysis and collection extremely new? 3. Do the research teams try to solve the problems using the technologies, resources and materials that are regarded to be useless? 4. Do the approaching methods of the research teams break the commonly used principles or rules of the existing research field? 5. Are the new technologies developed? 6. It is possible to lead specific technologies in the world by performing the research projects by the research teams? 7. It is possible to come up with the innovative results by developing the existing technologies at a lower cost in a smaller size?
Practicality	<ol style="list-style-type: none"> 1. Are the methods specifically suggested? 2. Are the relevant research experiences used? 3. Do the research teams have capabilities of research? 4. Are the specific results expected? 5. Are the research budget planning appropriate? 6. Do the researchers clearly recognize the conundrums they will face in the process of research performance? 7. Is it able to procure the materials or resources to be used in the research? 8. Are the research purposes clear? 9. Are the selection and role distribution of the research members valid and specific? 10. (Conditional) Is it expected to produce significant test results even if it doesn't look possible to generalize the research results?

Outcomes of the X-Project

[Questions]

6,218 problems were collected on the website; discovery of future research-oriented problems; question derivation from courses and workshops targeting students; derivation of problems through text mining; and various offline events

The final **50 X-problems**

[Research Teams]

A total of **310 research teams applied** for the contest. The 270 qualifying teams were assessed by the judging panel (researchers of humanities and social science, high school students, graduate students, and research teams at small and medium-sized firms)

54 teams were finally selected by passing the public verification test.

3. WHAT WE LEARNED FROM THE X-PROJECT

- There was an enormous social consensus on the necessity of public participatory national R&D projects.
 - The questions raised by the public were very challenging, novel, and complex, and thus researchers need break-through approaches to address them.
 - Through experiencing the X-project citizens can regard themselves as ones who are not only recipients of the benefits of the development of science and technology, but also contributors of the development of them.
-
- The X-Project attempted to realize the third model of the public understanding of science that Callon(1999) described by encouraging the public to raise questions that need to be addressed by Korean society, to participate in selecting research questions for national R&D projects and in selecting appropriate research teams, and by supporting the research of nationally recognized researchers.
 - The X-Project contributed to calling the public's attention to the issue of how science and technology affect society. If we expand these opportunities, we can facilitate an *anticipatory society* in which people can adapt to new changes, create necessary changes, and take responsibility for a better society.



X-Project Execution Process



The 50 X-Questions of 2015

Field	No.	X-Question
Safety	1	Can we find the human bio-signals by passing through all interceptive matters?
	2	Can we make a life-saving bag that can be worn in everyday life and simply operated in a variety of emergency situations?
	3	Is it possible for a ship not to sink even if it capsizes?
	4	How can the risk of traffic accidents be communicated to both the driver and the pedestrian quickly using five senses?
	5	Aren't there traffic lanes that can always be seen in bad weather and change efficiently according to traffic flow?
	6	How do we build a new crisis management framework necessary to enter the civilized era of prevention?
Environment	7	Can we predict and eliminate algal blooms, the world's environmental disaster, using data?
	8	Is it possible that using unmanned technology facilitates the real-time ecosystem monitoring that shows environmental changes, and the collection and DB construction of bio-data for bio resources?
	9	Can we create an air vehicle that purifies yellow dust, particulate matters, and air pollution in the air in an eco-friendly manner?
	10	Is there a technology that can handle food waste quickly and simply through high-speed fermentation, desalination, or separation by ingredients?
	11	Is there a way to utilize the urban heat island effects as energy?
Medicine	12	Is it possible for teeth damaged by cavities or other factors to be easily regenerated with simple treatments or medications?
	13	Can we easily identify what medication the tablets or capsules prescribed are via mobile devices? (Creativity Prize)
	14	Are there new treatments or medications that can prevent and treat multiple diseases?
	15	How can the Internet of Things be utilized to prevent infectious diseases and stop the spread of them?
	16	Can we create a spray that makes a virus easily visible upon being sprayed?
	17	Can we measure or control intravital nutrients and harmful pollutants by ourselves?
	18	Can we scientifically predict and specifically look at our body's future shape or condition?

The 50 X-Questions of 2015 (continued)

Field	No.	X-Question
Science/ Energy	19	Is it possible to efficiently make electricity using various energy harvesting technologies?
	20	Is it possible to develop high-efficiency power engines that closely resemble the energy efficiency of living organisms?
	21	Can we make a nuclear-controlling technology capable of treating nuclear waste and developing new materials? (Innovation Prize)
	22	Is it possible to make a gravity-controlling technology?
Sensation	23	Can we objectively measure the degree of pain?
	24	Can we expand, reduce, or interconvert human senses?
	25	Can we appropriately eliminate or control anger?
Brain	26	Can we measure, store, and remove dreams, memories, and emotions? (Grand Prize)
	27	Is there any way we can make the brain rest without sleeping?
	28	Are there ways that ensure a pleasant sleep?
Product	29	Can we make a computer that is as thin as paper and transformable?
	30	Can we make glasses or a telescope that can clearly see around despite bad weather?
	31	Can we make a wireless audio system that can be heard alone without noise even from a medium or long distance?
	32	Wherever we are, can we experience five senses vividly, as if we are on-site?
	33	Can we develop a new material that enables us to stay cool in summer and warm in water by wearing the same clothes?
Data	34	Can we make a technology to detect and inform us of our own bad habits or mistakes?
	35	Is there a way to systematically know what information is reliable in a flood of information?
	36	Can we enhance the matching rate between job seekers and corresponding jobs through the development of human resource capacity and the establishment of guidance using Big Data? (Future Prize)

The 50 X-Questions of 2015 (continued)

Field	No.	X-Question
Minorities/ The Vulnerable	37	Can we easily communicate with the hearing-impaired or cerebral palsy patients?
	38	What is the Internet of Things needed for the disabled?
Space	39	What is the reform plan of the urban space structure for the creative knowledge-based society?
	40	Can we build an urban spatial service system that is specialized for individuals?
Society	41	Can we improve the integrity of Korea by introducing science and technology?
	42	Is there an innovative way to dramatically reduce suicide rates in Korea?
	43	Is there a win-win approach to deal with the care of the elderly and children?
	44	What is the way to solve the problem of uncultured lands that are abandoned due to the reducing rural population and aging population?
	45	Can all the people monitor in real time how the taxes of the people are being used? (Value Prize)
	46	What is a way of utilizing game play data to prevent and treat gaming addiction?
	47	Can we solve the problem of social addiction by changing the addicted target to turn the addiction into a positive immersion?
Education	48	Is there a new type of personal authentication method with both safety features and convenience?
	49	If there is a platform service which can freely ask questions or present ideas within an authoritarian classroom or company, can this lead to a questioning culture?
	50	How can we achieve a satisfactory public education without promoting private education?



Evaluation and foresight in public research funding

Anand Desai

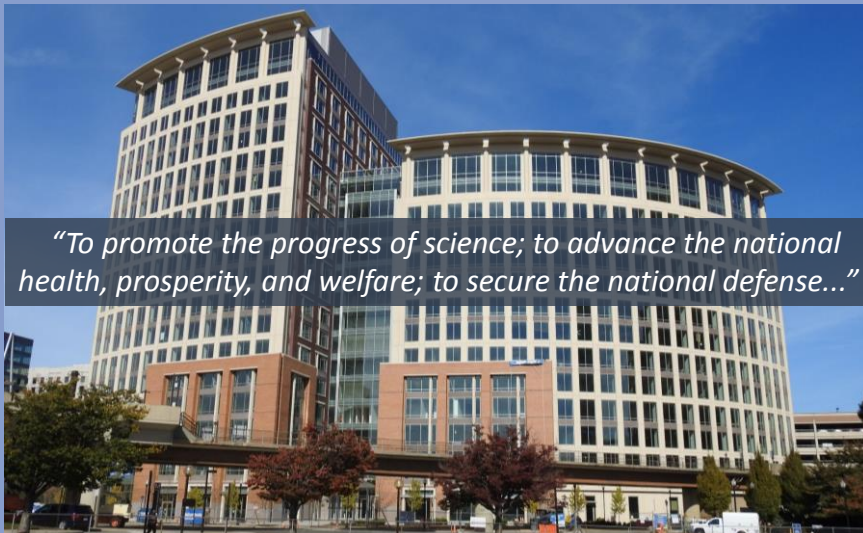
Section Head, Evaluation and Assessment Capability
National Science Foundation

**8th International Conference
on Foresight**

NISTEP

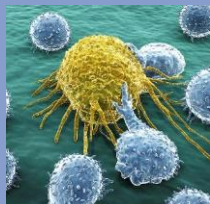
Tokyo
November 29, 2017

Our Mission

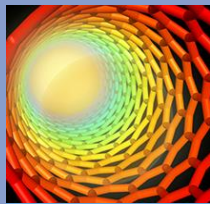


2

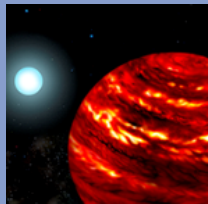
NSF Funds Research and Education across all Fields of Science and Engineering



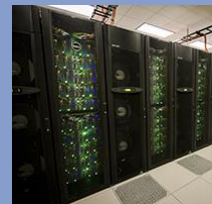
Biological Sciences



Engineering



Mathematical & Physical Sciences



Computer & Information Science & Engineering



Geosciences (including Polar Programs)



Social, Behavioral & Economic Sciences



Education & Human Resources



Integrative Activities



International Science & Engineering



Future directions

- NSF's 10 Big Ideas



NSF's 10 Big Ideas



5

Text mining

1. Find active NSF awards that match each of the **Big Ideas**.
2. Find mention of **specific country** near **terms that indicate engagement**.
3. Generate score for each engagement identified and aggregate for each award.
4. Aggregate scores for each combination of Big Idea and Country.
5. Display as "Energy Flow" plot.

Research Ideas: Harnessing Data; Human-Technology Frontier; Windows on the Universe; Quantum Leap; Rules of Life; Navigating the New Arctic
Process Ideas: NSF 2050; Mid-scale Infrastructure; INCLUDES; Growing Convergent Research

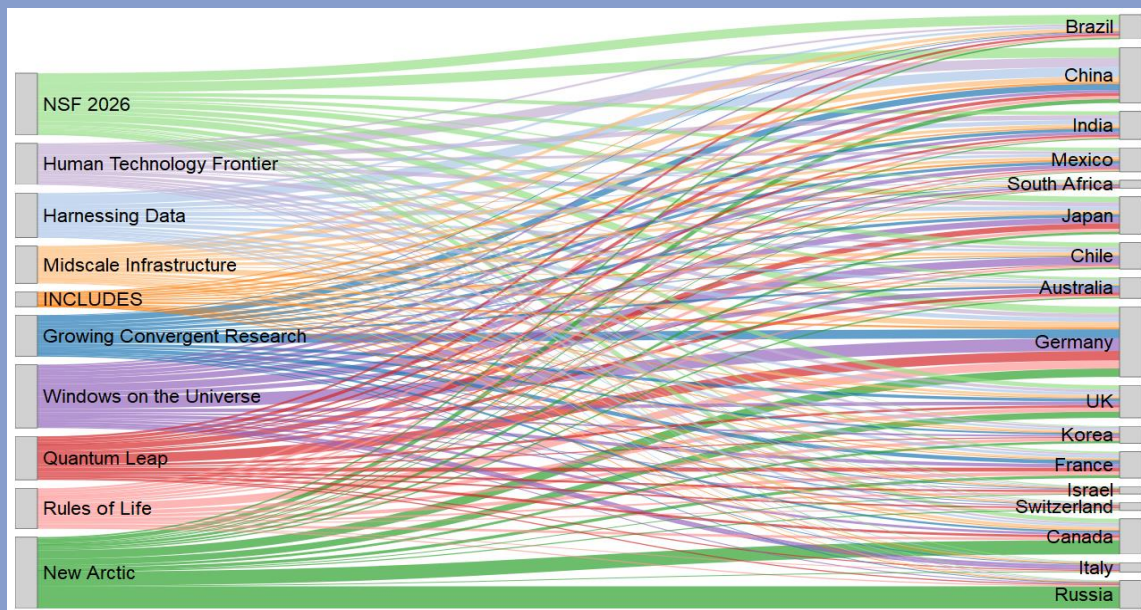
16 Countries: Australia, Brazil, Canada, Chile, China, France, Germany, India, Israel, Japan, Korea, Mexico, Russia, South Africa, Switzerland, and United Kingdom



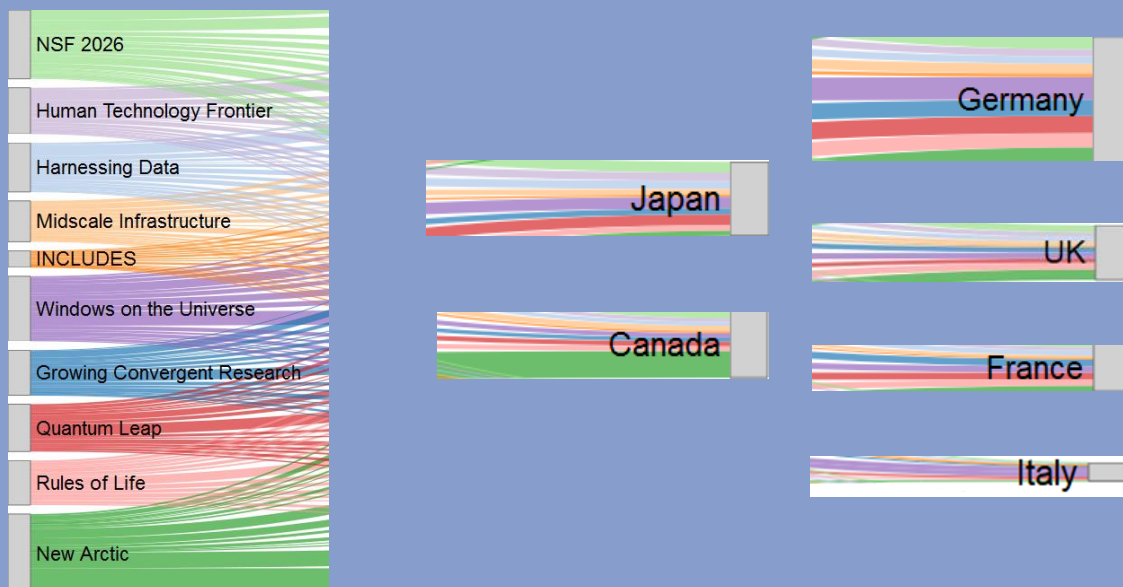
6



Energy Flow Plot of NSF Big Ideas to International Engagement



Engagement in the NSF Big Ideas with G7 Countries

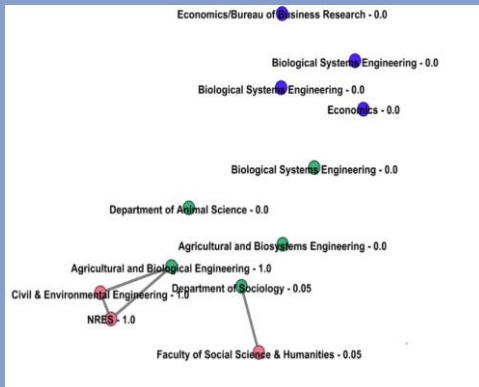


Before and After networks

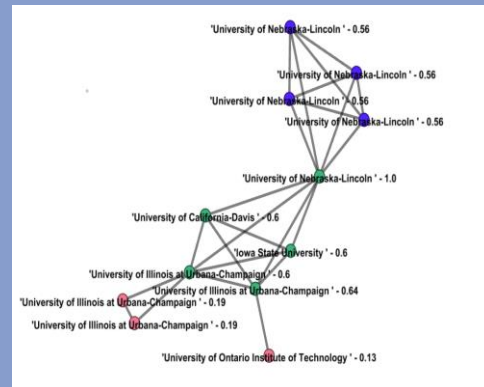
INFEWS: FY16 Investment: #1639340 and 1639478

The INFEWS-ER: a Virtual Resource Center Enabling Graduate Innovations at the Nexus of Food, Energy, and Water Systems

Before INFEWS by Department



After INFEWS by Institution



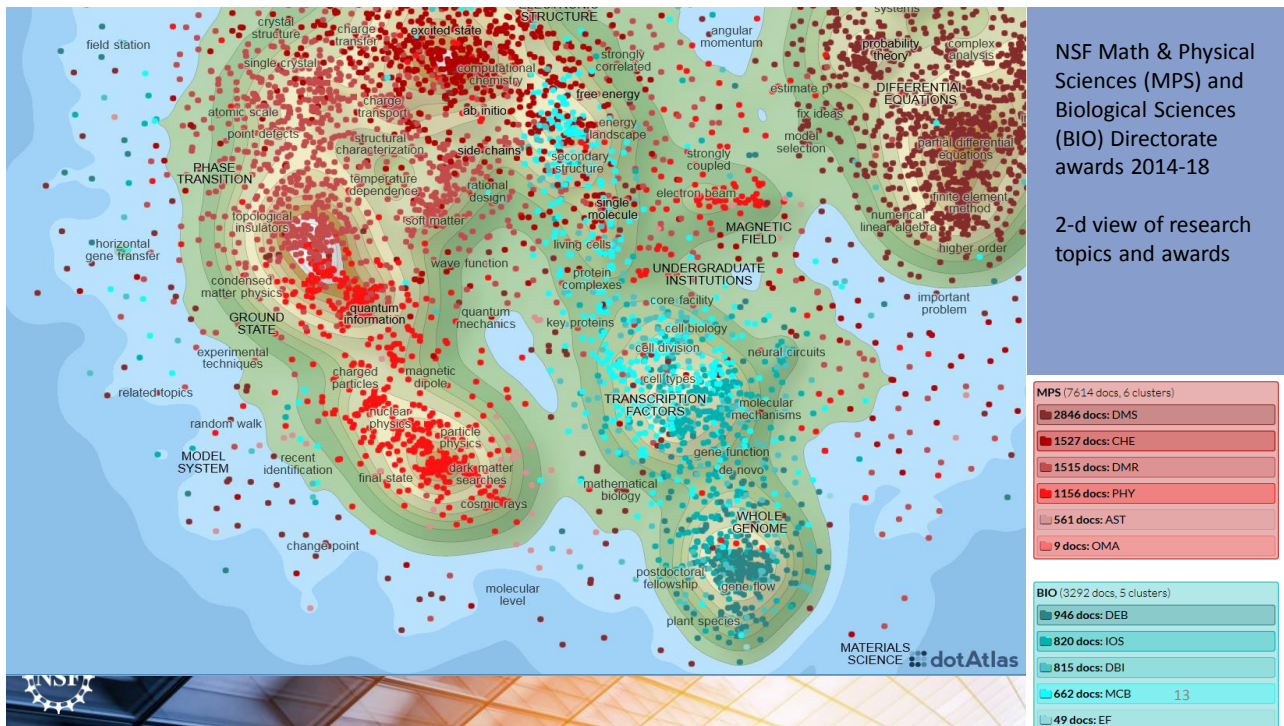
11

Challenges of Convergence Research

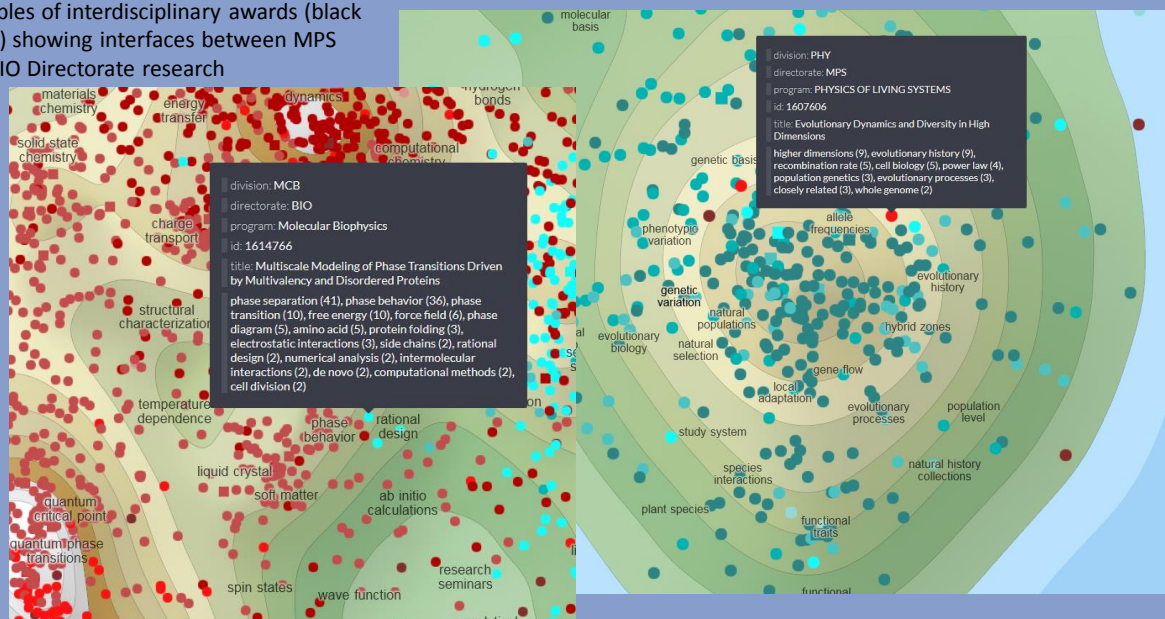
- Facilitating convergence research
- Peer review of convergence research proposals
 - Identifying reviewers
 - Training reviewers and program officers



12



Examples of interdisciplinary awards (black boxes) showing interfaces between MPS and BIO Directorate research



Challenges of Convergence Research

- Facilitating convergence research
- Peer review of convergence research proposals
 - Identifying reviewers
- Assessing convergence research



15

Assessment

- Describe the current research landscape
- Identify research questions
- Develop the study design
 - Evidence



16

Questions?





ENGAGING POLICY WITH MULTIPLE FUTURES

Joshua Polchar
OECD Strategic Foresight

8th International Conference on Foresight
29 November 2017
Tokyo



Strategic Foresight Unit

Advance the use and impact of high-quality strategic foresight in global policy dialogue, in national governments, and in OECD substantive work

- Duncan Cass-Beggs (Counsellor for Strategic Foresight)
- Joshua Polchar, Julia Staudt (Policy Analysts)



Strategic Foresight Unit

Advance the use and impact of high-quality strategic foresight in global policy dialogue, in national governments, and in OECD substantive work

- Global policy dialogue
 - Office of the Secretary General
 - High-level meetings
 - Futures of the OECD
- National governments
 - Friends of Foresight ambassadors
 - Government Foresight Community
- OECD work
 - Directorate focal points and Going Digital initiative
 - Projects with national governments



INTERFUTURES

**FACING
THE FUTURE**

Mastering the Probable
and Managing the Unpredictable

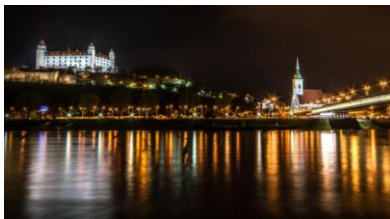
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

(1979)

International Futures Programme 1990-2016



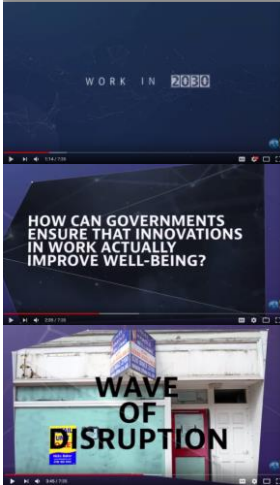
Our work in four examples





Foresight for Global Digital Disruptions

<https://youtu.be/ej80SmMMhz0>



Foresight for Global Digital Disruptions

<https://youtu.be/ej80SmMMhz0>





Government Foresight Community

October 2017



Slovakia

Sustainable Development Agenda





Going Digital Scenarios



Scenario	Empowered individuals in a mobilized collaborative world.	States as platforms	Global tech platforms are the new world order.	AI enabled abundance and panopticon.
Enlightenment	Decentralized control by individuals	Control by governments	Control by large technology firms	Ubiquitous ("Data is the new oil")
Enlightenment	Global commons	Spillatment	Walled gardens	Universal
Future end market scenarios	Millions of new SMEs, More multi-national	Mix of sizes of firms, Firms accountable to societal purposes	Large platform firms dominate	Firms replaced by AI
Productivity scenarios	High (rapid diffusion, disruption)	Medium (but possibly higher social value)	Medium (Both machine and still human value)	Extreme
Trade	Global (digital) free trade, Most e-commerce	Within national regional blocks	Within national governance of platforms	Fluid and changing patterns shaped by AI

GOING DIGITAL

Making the transformation work for growth and well-being



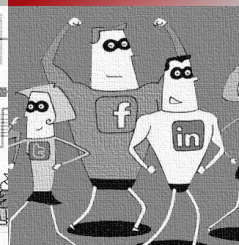
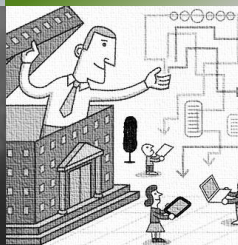
Going Digital Scenarios



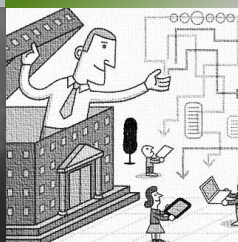
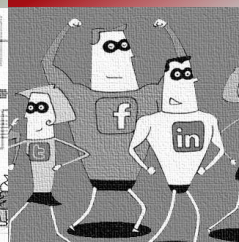

Scenario 1
iChoose


Scenario 2
**Platform
Governments**

Scenario 3
Tech Titans

Scenario 4
**Artificial Invisible
Hands**



 Going Digital Scenarios			
Scenario 1 iChoose	Scenario 2 Platform Governments	Scenario 3 Tech Titans	Scenario 4 Artificial Invisible Hands
			
Empowered individuals in a multilateral grassroots world	e-Governments on divergent digital development paths	Global tech companies and their citizen-customers	AI-enabled abundance and all-knowing algorithms

 And much more!

	Trends Shaping Education 2016
	Development Centre Studies Securing Livelihoods for All FORESIGHT FOR ACTION
	OECD Development Pathways Multi-dimensional Review of Kazakhstan VOLUME 1: INITIAL ASSESSMENT
	The Next Production Revolution IMPLICATIONS FOR GOVERNMENTS AND BUSINESS
	OECD Science, Technology and Innovation Outlook 2016
	OECD-FAO Agricultural Outlook 2016-2025
	OECD Environmental Outlook to 2050 THE CONSEQUENCES OF INACTION

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THANK YOU

MERCI

ご清聴頂き、ありがとうございました

谢谢

감사합니다

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2018 年 9 月

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<http://www.nistep.go.jp>