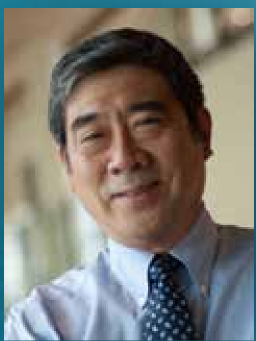
東京大学
THE UNIVERSITY OF TOKYO

科学技術イノベーション政策の科学（STIG） 2014 年度国際シンポジウム
Science, Technology, and Innovation Governance (STIG) International Symposium 2014

よりよいガバナンスによる科学技術イノベーションの有効活用

Making the Most of Science and Innovation through Better Governance

実施報告書




日　時　2014 年 11 月 28 日（金）13:00 - 17:45
会　場　東京大学本郷キャンパス　福武ラーニングシアター
主　催　東京大学科学技術イノベーション政策の科学（STIG）教育・研究ユニット

STIG
SCIENCE, TECHNOLOGY, AND INNOVATION GOVERNANCE

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総合司会：松浦 正浩（東京大学公共政策大学院）

＊基調講演1 につきましては、原稿の確認が取れ次第再掲します。

● Opening Remarks / 開会挨拶

城山 英明（研究代表者・東京大学公共政策大学院）

Hideaki Shiroyama(Research representative, Professor,
The Graduate School of Public Policy, The University of Tokyo)

松浦正浩：　約束のお時間になりましたので、始めさせていただきます。本日は、STIG 国際シンポジウムにお越しいただき、皆様ありがとうございます。2014 年度の東京大学科学技術イノベーション政策の科学国際シンポジウムを始めさせていただきたいと思います。私は本日の司会を担当いたします、東京大学公共政策大学院の松浦でございます。早速ですが、本プログラムの代表、本学公共政策大学院院長の城山英明から開会のご挨拶を申し上げたいと思います。

城山：　ご紹介いただきました、公共政策大学院の院長をしております城山と申します。主催者を代表しまして、一言ご挨拶させていただきます。今、松浦さんからもご紹介がありましたけれども、東京大学における STIG 科学技術イノベーション政策の科学教育プログラムの 3 年目の国際シンポジウムとして、本日このようなかたちで開催させていただきました。海外から来られた先生方、また、お忙しいところお集まりいただきました皆様方にまずは感謝申し上げたいと思います。

　プログラムとしては 3 年目でありますが、教育プログラムは昨年 2013 年度にスタートし、本年 2014 年度が 2 年目です。3 年前には、まさにこのプログラムの立ち上げ時の国際シンポジウムにおいて、海外においてどのような科学技術と政策に関するプログラムを行っているかということで、本日もお越しいただいている Oye 先生等にもお話をいただきました。また昨年は、東京大学の STIG だけではなく、国内 5 つの人材育成プログラム拠点大学と合同で、エビデンス・ベースド・ポリシー・メイキングに焦点を当てて、国際シンポジウムを開催させていただきました。

　それに対して、今年はむしろ科学技術のダウンストリームといいますか、実際の利用段階での話、どのように、より良いかたちで科学技術イノベーションを活用していくかに焦点を当てて、今日半日、会議をさせていただきたいと思っております。若干タイトな日程にはなっておりますけれども、最初に Oye 先生から、主に薬事規制とシンセティック・バイオロジー（合成生物学）の話を問題提起をしていただきます。それに対して、日本側でどのような研究を行っているか、あるいは、実際に再生医療等に関してどのような法制度ができているかを素材として提供させていただきたいと思っています。

　2 つ目のセッションでは、規制のあり方や、そこにどのようにパブリックエンゲージメントの成果を使っていくのかというあたりを、Michael Rogers 先生からお話しいただきます。まず Rogers 先生からヨーロッパの経験をお話いただき、次に大阪大学の平川先生から日本の事例のお話をいただきたいと考えております。

　3 つ目は、主に都市レベルの実際のイノベーションプロセスについて、ヨーロッパの例を David Laws 先生からお話いただきます。それに対して我々の方でやっていることを松浦先生、鎗目先生からお話をさせていただくということになります。

　最後、4 つ目のセッションでは、ある意味では 2 年前のシンポジウムの補完的な展開になりますけ

れども、最近イギリスでこの分野に関して極めて精力的に活動されているユニバーシティ･カレッジ･ロンドンの試みについて、Blackstock 先生からお話をいただき、今後、どういうことができるかといったことも話し合っていきたいと思っております。

　このように今年度は、少し科学技術政策の現場の話に則して議論させていただきたいと考えております。このプログラムは今年でまる 3 年を迎えようとしておりますが、今後の方向性についていろいろな示唆をいただければと思いますし、皆様方の実際のご経験等もぜひお話をいただき、様々なかたちで双方向で議論できればと思っておりますのでよろしくお願いします。半日と短い機会ではありますけれども、積極的にご参加いただき、有意義なものにさせていただければと思いますので、よろしくお願いいたします。

● Response Presentation / 応答発表

佐藤 智晶 (東京大学公共政策大学院)

Chiaki Sato(The Graduate School of Public Policy, The University of Tokyo)

佐藤智晶： 東京大学公共政策大学院特任講師の佐藤智晶と申します。本日はこのような貴重な機会をいただき、本当にどうもありがとうございました。

私の報告は日本における現状です。先ほど Oye 先生がおっしゃっていた通り、私のキーメッセージも同じで、reforms cannot be ended なんですね。サマリーにありますように、最近のエボラ出血熱に対応する薬をどうやってマーケットに持ちこむかという話ですとか、認知症対策の予防薬や治療薬が今盛んに作られようとして努力されていますけれども、それに対応する規制がまだ整備されていないという状況があります。それに対して、様々な試みがなされています。そこに挙げておりますのが、ノンランダマイズド・クリニカル・トライアルですとか、オフレーベルで薬を作るですとか、より効率的にデータを集めて、患者さんに早くお薬を届けるという試みが考えられていますけれども、まだ解があるわけではありません。本日は、日本における再生医療ないし再生医療製品等という話と、いわゆる日本版 NIH の話をしようと思っています。

再生医療については、ポイントは 2 つあります。1 つは、医療技術の規制と医療関連製品の 2 本立ての規制にしたことです。製品を対象とする従来の薬事法規制の中に入れ込んだものと、もう 1 つは手技そのものに若干規制を加えるというかたちの、2 本立ての規制が行われたという点に特徴があります。アメリカと比べますと、アメリカの FDA は手技の規制をする規定を持ちませんので、訴訟が起きたりもしています。その点、日本でもどこまでが規制対象の手技なのかという点については、同じく問題が生じる可能性があります。

2 つ目は、先ほど Oye 先生もおっしゃっていましたけれども、Conditional pre-market approval、いわゆる「条件・期限付き承認」というものが認められたということです。人間の人体組織を使って再生医療関連製品を作ったりした場合、再生医療関連製品はどうしても個人差が出やすい。そのため医薬品と同様な規制を加えるわけにもいかないでしょうということで、この「条件・期限付き承認」が導入されたという経緯があります。

私がここで申し上げたいのは、実は再生医療製品等で扱われているこの Conditional pre-market approval というものが、果たして再生医療のためだけの議論で終わるのかどうかというと分からないということです。個別化医療の分野で議論されている話というのは、実は同じような内容です。Oye 先生の基調講演にもありましたけれども、医薬品、とりわけ、がん治療薬の部分でも同じような議論があります。ですので、日本でも再生医療をトライアルとして、医薬品ですとか医療機器にも議論がつながってくるのではないかと思っております。

次に 2 つ目、「ジャパン NIH」と言うと政府に怒られてしまうかもしれませんが、特徴として一番大事なのは、これまで各所ばらばらにやっていたバイオサイエンス、ヘルスケアへのリサーチファンディングというものを、一度統合してみましょうということです。まだまだアメリカの NIH に匹敵するような規模のリサーチファンドはないですけれども、それでも統合したというところに意味があるのではないかと思います。

ただ、法的な課題としていくつか挙げることができると思われるのは、第 1 に、リサーチファンドのプライオリティを決めるときに、科学者がこの分野が伸びるはずだと考えてファンドをつける方

法と、一定の国民の負託を受けた政治家がこの分野は大事だから研究費をつけようと考える、その対立が当然あります。それをどうやって調整するかという点に、当然注目をしなければならないだろうと思います。現在のところは、政治家が会議の構成メンバーになっている健康・医療戦略本部というものがあり、そこが中心的に行うことになっています。そのなかで、科学者の役割をどこに見出せばいいんだろうかということが問題になるのかなと。アメリカでも、オバマ大統領と NIH のプライオリティセットのところで若干揉めた経緯がありますけれども、日本でもこれからどうなっていくのかが面白いかと思います。

2 つ目ですけれども、NIH は「リサーチファンディングエージェンシー」だとよく言われます。単にファンドをつけるというだけではなくて、規制分野ですとか、リインバースメント（保険収載）についても、早い段階で議論を深めることが考えられないのかなと思っている次第です。アメリカでも、Medical Device Post-market Surveillance の部分で、そのような仕組みというものが進められているところでございますが、日本でも考えられる必要があるのではないかというふうに思っています。

最後は、ここに Needed new Public-Private Partnership と書いたのは、医薬品の分野で特に起きている問題です。医薬品のシーズというものがどんどん枯渇してなくなってきているんですね。そのなくなりつつあるシーズに関して、アメリカの NIH では、製薬企業がいったんこれは駄目かもしれないと思って研究を中止したものを再利用する仕組みを作ろうとしています。NIH と企業がタイアップした上で、研究者の皆さんにもう一度研究してもらおうと。それでもし成果がでた場合には、製薬会社も一定の利益を得ることができるという仕組みが考えられたばかりのところです。これが成功するか分かりませんけれども、医薬品の種がなくなりつつあるというのは全世界共通の課題ですので、日本でもやはり議論する価値があるのではないかと思っています。

そういう意味では、NIH が考えなければならない問題というのは、単純にファンドがないですとかっていうことではなくて、規制や保険収載の部分との議論を進めていくことであったりとか、新しいパブリック・プライベート・パートナーシップの仕方を考えていく必要があるのかなということです。

まとめとなりますが、先ほど冒頭にも申し上げましたけれども、reforms cannot be ended。基本的には Oye 先生がおっしゃっていることと同じことを、私も実は考えておりました。再生医療の規制は、これが最終形態ではないと思っています。より改善していく必要があって、とりわけ state of the art に照らして変える必要がありますし、新しい科学的な知見、また、ソサイエタル･バリューが変われば当然変えていく必要があるでしょう。2 つ目ですけれども、ジャパン NIH、日本医療研究開発機構も、おそらく早急に、日本の NIH はどのぐらいいいものなんだろうか、悪いものだろうかという議論が出ると思いますが、その判断には少し時間が必要だろうと思っています。その点を踏まえて、私としては日本の現状の報告と法的課題というかたちで報告を終わらせていただきます。どうもありがとうございました。

松浦：　ありがとうございました。続きまして、次は柴山先生からお話しいただきます。

● Response Presentation / 応答発表

柴山 創太郎 (東京大学工学系研究科)

Sotaro Shibayama(The Graduate School of Engineering, The University of Tokyo)

柴山創太郎：　こんにちは。ご紹介にあずかりました、工学系研究科の柴山と申します。本日の第 1 セッションは、バイオ医薬分野におけるリスクマネジメントということで、冒頭から Oye 先生から多岐にわたるお話をいただいてきたところでございます。私からは、かなり焦点を絞って、こちらにありますタイトルの “Weakening Scientific Integrity”、日本語で申しますと、「弱体化するサイエンティフィック・インテグリティー」とでも言いましょうか、私どもが日本のバイオ医薬分野で行ったケーススタディのお話をしたいと思います。

まず、背景を少しだけ整理させていただきますと、いわゆるアカデミア、サイエンスのガバナンスというのは非常に分散的であるということが言えると思います。と言いますのも、サイエンスの発展というのは、科学論文の出版によって礎を作られています。その審査は基本的にはピアレビューによって行われます。ボランティアベースで個人の科学者が論文を審査して、論文を審査しているということです。例えば特許の審査においての特許庁のような、中央集権的な仕組みは存在していないということです。

この仕組みにおいて 1 つキーになるのが、サイエンティストは正直ベースで行動してもらわないと困るということです。ピアレビューをする際に、科学者が嘘をついているかもしれないと思ってその論文の真偽を精査していくということは非常にコストがかかりますので、基本的には科学者は正直だと思わざるを得ない。ということで、これはある種のパーミッシブ・アプローチだと言えるのかなと思います。

しかしながら実際には、あまりオネストではないパブリケーションというようなことも、まま見られます。「ファブリケーション」、ねつ造とか盗用とか、そういったことはよく起こるわけです。こういったことが、科学を取り巻く様々なステークホルダーに悪影響を与えているということは明らかです。

最近の統計を少しお見せします。これはリトラクション、論文の撤回の推移です。ここ 40 年ぐらいの間にリトラクションの数は約 10 倍に増えています。また別の統計では、100 人中 2 人ぐらいは不正行為を行ったことがあるというようなことが言われているわけです。日本のデータに関して見ても、これは最近のミスコンダクトの報道件数ですけれども、上昇の傾向があるということが言われています。

こういった背景を踏まえますと、なぜ科学者が正直な行動をしなくなってしまうのかということを把握しておくことは、サイエンスのガバナンスを高めていくという意味では非常に重要であるということが言えるわけです。多くの先行研究には、2 つぐらい問題があります。1 つは、ミスコンダクトを測定することが非常に難しいということ。「あなたは不正行為をしましたか」と質問しても、誰も「はい」とは答えないわけですね。そのあたりの難しさがある。もう 1 つの難しさが、ミスコンダクトが増えているとは言っても、実際の件数はそれほど多くないということで、なかなか意味のある分析をすることは難しいという状況がございます。

この研究で何をするのかと言いますと、あまり過激でないタイプのミスコンダクト、我々はこれを “questionable research practices” というふうに呼んでいますけれども、このマイルドなタイ

プの不正直な行動に注目して、ある程度の統計的な分析を試みました。“questionable research practices” には、いろいろエレメントがあります。有名なものでは、俗に「サラミ法」、サラミ・スライシング、論文を細切れにして数を稼ぐ行為があります。あるいは、オーサーシップの乱用もあります。我々がここで注目、利用しようと思ったコンセプトは、“Dishonesty Conformity” というふうに呼んでいるものです。論文を投稿すると、レフェリーがいろいろとコメントを言ってくる。中には到底受け入れられないような内容を言ってくるレフェリーもいます。そんな時にあなたはどうしますか？という質問です。中には、論文をアクセプトされたいので、仕方なく従ってしまおうというようなことが起きるわけです。これを、“Dishonesty Conformity” と呼びます。

10 年ほど前に、同じコンセプトを研究した人たちがいました。彼らはこれらの行為を、“Academic Prostitution” だと呼びましたが、言葉が過激なので、我々は別の呼び方で、“Dishonesty Conformity” と呼んでいるということです。

我々は、日本のバイオ分野での教授、准教授レベルで、360 人からデータを得ました。どうやってこれを計るのかですが、サーベイのなかで、最近のピアレビューの結果について教えてくださいと質問をしました。「major revision を要求されたケースで、あなたが科学的に間違っていると思うようなことを言われたことはありますか」と。Yes ならば、その時に何をしましたかということを聞きました。「出版を諦めた」とか、「他の雑誌に提出した」とか、「反論して再投稿した」とか、最終的に「やむを得ず従った」と、こういう回答があるわけです。

実際にデータを見てみますと、6 割ぐらいが、「やむを得ず従った」、残り 2 割ぐらいが「反論した」となりました。さらに 15％ぐらいは、別の雑誌に提出した、2％は出版自体諦めたと。その結果がどうなったかがこちらです。上のほうがこの赤いグループ、従った人たちですね。この人たちは、その雑誌にめでたくアクセプトされたと。一方で、反論した人たちは半分ぐらいしかアクセプトされないということで、不正直ベースで行動すると、結構、アクセプトというメリットがあるんだなあということになってしまうわけでございます。

次に、この不正直な行動は、どういう人たちに見られる行動かということを、リグレッション、回帰分析で見ていきます。いくつか簡単に結果をサマリーしますと、コンペティション、競合が 1 つの理由になります。これはまあそうかなと予想できます。准教授のほうが教授よりも不正直な行動をとりやすいと。これも、昇進等々の競合があることが影響するのかなということですね。ローパフォーマンス、生産性が低い人たちのほうが不正直になりやすいということです。これもある種納得できるかなと思います。ちょっと解釈がよく分からないんですけれども、ベーシックとアプライドのフィールドを比べると、ベーシックフィールドのほうがディスオネストなケースが多いんですね。我々がこの研究をするときに、インパクトファクターが高いジャーナル、有名な雑誌のほうが不正直な行為が多いのかなと予想していたんですけれども、結果は逆でした。

これを解釈してみますと、誰も読まないような雑誌というのがやはりありまして。そういったところだったら不正な行為をしてしまってもいいんじゃないか、という心理があるのかなと、とりあえず、そういった解釈をしております。

最後に、海外経験、海外研究経験の有無です。海外経験のない人のほうが不正直行動が多いという結果が得られました。日本人の研究者に関して言うと、海外経験というのは大体アメリカの経験ということなんですけれども。我々はこれも、研究を始める前の想定としては、アメリカのほうがやはり競合が激しいですから、不正直な行動が増えるのかなと思っていましたが、結果は逆でした。解釈としては、例えばアメリカのほうがインテグリティに関する教育、トレーニングがきちんとされている

とか、そういった背景があるのかもしれません。

時間が限られておりますので、あと 1 つ、2 つで終わりにしたいと思います。こちらのスライドは、サーベイのなかで追加的に聞いた質問 2 つです。これはアティチュードに関する質問です。左のほう、自分の過去の研究と矛盾する結果が出たときに、それを出版するべきだと思うか、思わないかという質問に対して、ほとんどの人が「賛成」だと。きちんとそれを出版しますよ、正直に行動します、と答えています。

もう 1 つ別の質問です。論文を書くときに、都合の悪いデータは省いていいかどうか。それは違うんじゃないかという回答者が半分ぐらい。こういう質問をすると、みんな自分は正直だと回答するんですけれども、そうは言っても、そこそこの分散はあります。これと、先ほどお見せしたレフェリーに正直に反論するかというところですね。この 2 つは、想定通り相関しているということでございます。

最後に、我々の研究はまだ始まったばかりでして、これからいろいろと追加的なデータをとって、実際にどういったことが不正直の決定要因になっているのかというところを分析していきたいと思っております。どうもご静聴ありがとうございました。

• Keynote Speech 2 / 基調講演2

マイケル ロジャース (前E C委員長科学技術顧問)

Michael Rogers (Former Adviser in Science and Ethics, Bureau of European Policy Advisers, The European Commission)

"Recent trends in Risk Governance in Europe: From Precaution to Smarter Regulations"

「欧州におけるリスクガバナンスの最新動向：予防原則からスマートレギュレーションへ」

Michael Rogers: Good Afternoon: I want to start by looking back at the evolution of public policy concerning risk governance over the last 20 years or so. Firstly, it should be appreciated that in the early days there were only two groups involved – the experts who carried out the risk assessment and the regulators who took this expert information and used it to create risk regulations. Of course there are many more players and factors that come into play in modern risk governance and my story concerns this evolution.

A good example of such early risk governance concerns a cholera outbreak in London in 1854 (a bit before my time). A local doctor (John Snow) undertook a simple epidemiological study and identified the source of the outbreak. He then conducted the simple risk management action of removing the pump handle! This comparatively simple early risk governance system was replaced by the modern complex system of detailed risk regulations in the aftermath of WWII and then in recent years by post-modern prospective risk regulations. However, before considering this I should complete the story about risk assessment.

Risk assessment is encapsulated in this slide. It is the scientific determination of the relationship between the exposure to a given hazard (let's say a particular chemical) and the realisation of a particular harm (let's say a specified cancer). The relationship is probabilistic. There is a certain exposure which leads to a certain probability of harm. The risk management action that follows from the risk assessment is to decide on how much harm is acceptable and then decide on the exposure control point. Of course the exercise is bedevilled by uncertainty and the risk managers have to build in safety factors.

Turning to prospective or precautionary risk management, this in essence involves early action to mitigate a risk scenario before the evidence is well established. The risk managers, faced with uncertain science regarding a potentially serious risk, take an early (ex-ante) precautionary risk management decision. This is followed by a research programme aimed at reducing the uncertainty and then the risk management action is either confirmed, increased in severity, or reduced.

This slide shows the many components of risk governance or, if you like, the "risk labyrinth". The aspects which concern the expert community are assessment and management. However, the aspects which concern the public are perception and trust. Then for manufacturers there is risk issue management, by which I mean the sort of thing that happened to the Perrier Company in 1990.

In February 1990, Perrier became aware that some of their bottles of fizzy water were contaminated with small amounts of benzene. The levels were way below dangerous levels but the company decided to withdraw the product from sale on a worldwide basis until they found out where the benzene was coming from. In risk assessment terms there wasn't a problem but their risk issue management action helped maintain consumers' trust and when the company put their product back on the shelves there were no problems.

There is an interesting meeting taking place in Brussels next February with the appealing title "Scientific Evidence Never Comes Alone!" This risk labyrinth slide illustrates this point very clearly.

The next slide is a map of all risks with Hazards along the x-axis and Harms on the y-axis. The Hazard-Harm pairs are plotted within contours indicating the degree of certainty in the relationship. It is not a graph in the conventional sense. It is a "mapping". In the centre we have an island of certainty i.e. all the hazard-harm relationships that have been demonstrated at the 95% certainty level. You will see that I have put a cross in this zone, which could, for example, represent Itai-Itai disease in which cadmium contamination of rice caused kidney damage in Japan in the 60's and 70's. The cause of Itai-Itai disease was not accepted initially by the mining companies but it was eventually confirmed with a high degree of certainty.

In the next zone we find the risks with a degree of certainty between 50% and 95%. These two zones correspond, if you like, to the test for guilt in a criminal trial (beyond reasonable doubt) and the test for guilt in a civil trial (on the balance of probabilities). I have placed a Y in this second zone, which could represent, for example, cadmium exposure at low levels which has been demonstrated to have the potential to reduce male fertility.

Which brings us to the question of precaution in risk regulation: The first question concerns the meaning attached to precautionary risk regulation. The starting point for me is the "Rio Definition" which states that if one has evidence of uncertain harm then regulators have permission to act before the uncertainty is reduced. The stronger definition, which is much favoured by some "green" organisations, is that if there is evidence of uncertain harm then regulators are <u>obliged</u> to mitigate the uncertain harm.

The third broad definition is to reverse the responsibility for the risk assessment from the regulator to the risk producer. In effect the regulator says to the manufacturer "We don't have the expertise in this area but you, the manufacturer, should be fully aware of the risks associated with your products and should perform the necessary risk assessment for the regulator". This is the current EU approach to chemicals regulation.

The European Commission issued a Communication on what was meant by the Precautionary Principle which provided 5 criteria for its application. The first criterion is a straightforward proportionality criterion. The action the regulator takes should be proportional to the degree of harm to be avoided. The second and third criteria are straightforward market considerations. The action should non-discriminatory and consistent with what has been done before. The fourth is that the action should be based on a cost-benefit analysis. The final criterion is for me the most important but the least applied. It is critical to the post-modern approach and states that the action taken should be subject to review in the light of new scientific data which the regulator should obtain.

The Precautionary Principle (PP) was formally introduced in the Maastricht Treaty of 1992. Some 8 years later the Commission's Communication described what the Principle meant in practice. This Communication led to what I call the "War of Questions"! It seems that the United States does not like the Precautionary Principle. They don't mind precaution in risk regulations. In fact many US regulations are precautionary in nature. However, they seem to dislike the idea of a "Principle" that might be judged in a court of law. So there was my so-called "War of Questions" between the US challenging the PP and the EU which wanted to apply it in various regulations. Clearly the PP encourages prospective rather than retrospective thinking about risk governance and the next slide introduces one of the best examples of its use.

This example concerns Bovine Somatotropin (BST). BST is a milk yield enhancing injection used with cows in the US and elsewhere. However, there was an enormous opposition to this technology in the EU, not least because it is a hormone and was confused with endocrine disruptors in the public mind. (There was a newspaper story in Italy at about that time suggesting that young boys were developing breasts because of endocrine disruptors in the environment.) So there was a lot of political pressure to ban this technology because of uncertain risks but also because we had an overproduction of milk at the time (the so-called milk lake) partly due to subsidies. So in 1990 the European Council took regulatory action.

The Council banned the agricultural use of BST for 10 years. The regulatory action also launched a research programme on the harms that might arise from the use of BST in milk production. This research found that there was no human harm from the use of BST in milk production. In fact BST is naturally present in milk which we use for example every day in our coffee. However, the research uncovered a serious animal welfare issue. The cows producing enhanced milk yields from BST injections had an increased incidence of infections of their teats which had to be treated with antibiotics and the enlarged udders meant that the cows had increased walking difficulties. These research results ensured that the temporary ban became a permanent ban which has never been challenged: In my view because the PP had been applied correctly. However, also in my view, this is a very rare example of the correct comprehensive application of the PP.

Coming back to the Transatlantic "War of Questions" an American academic and I were tasked to carry out a co-funded Transatlantic "dialogue programme" to compare and contrast the regulatory application of precaution in the US and the EU. We held about seven formal dialogue meetings and this was supplemented by a large research effort by Duke University in North Carolina. We came up with this sort of table shown on the slide (but keep in mind the question marks). These are not definitive but for example the EU is more precautionary about the use of hormones in beef production which is banned in the EU: Whereas, it is used extensively in the US. (Some people would even argue that this technology produces tastier and tenderer beef!). The EU has maintained its ban in spite of losing the case before the WTO.

Looking at other examples on this slide, we see that the US was very precautionary about mad cow disease while the EU has been very precautionary about the use of phthalates as softeners in plastics (e.g. in baby feeders) - with little scientific basis according to the industry. The US was very precautionary about the use of CFCs in aerosols etc., partly because they had an available alternative chemical, which they were ready to use immediately to replace chlorinated fluorocarbons. The US is a bit more precautionary than the EU about nuclear power and so on. The interesting case at the bottom of the slide is the use of diesel as a fuel. The EU has promoted the use of diesel because it's a very useful way of reducing the emission of climate change gases. The US has done the opposite with diesel cars because in fact they want to combat the production of micro-particles, which can cause health problems.

Clearly there are divergences but if you examine a much larger sample, and Duke University examined around 3,000 examples of risk regulation in the US and the EU, we find that there is broad parity between the US and the EU. This is of more than academic interest. There is a strong feeling in Europe that if we sign up to the transatlantic trade agreement (TTIP), which is currently being negotiated, there will be a reduction in the "high grade" EU regulatory standards in favour of the aggressive marketing of the US. Our research has demonstrated that we regulate risks at about the same level of precaution and thus that it is highly unlikely that there will be any great change if TTIP goes through.

This year I've been spending a lot of time studying the complex question of how to build trust in risk regulation. Certainly looking at this slide the question of fairness is critical. If you consider trust in the regulation of nuclear power, post-Fukushima, it is clear to say that there is an enormous difference in perceived fairness between those who bear the risk, those who live close to nuclear reactors, and those who benefit from the generated electricity but live much further away. Turning to the question of competence, one could question the competence of the International Council on Radiological Protection and their insistence on a linear no-threshold model for radiation risk against currently accepted threshold models. This bedevils regulators' attempts to set more realistic regulations.

The third criterion for building trust is efficiency, which relates to the question "Are public resources devoted to risk management cost effective?" Part of the answer to this question concerns the quality of advice concerning the underlying science. This slide features the EU's current Chief Scientific Adviser, Professor Anne Glover. I know her quite well. She was appointed in 2011, comes from a good biotechnology background and is very competent in what she does. Professor Glover has given the advice that there is no evidence that GM technologies are any riskier than conventional foods and as a result several green organisations have called for her dismissal. Unfortunately there has been no support from the incoming Commission President Juncker, and it looks as though she has lost her job. She will probably leave in January and at the moment the Commission hasn't taken the decision to replace her. I think it's a great tragedy and will have a negative impact on "efficiency" in risk regulation.

The next slide concerns Regulatory Impact Assessment (RIA) which became an important regulatory tool in 2002, two years after the PP Communication. RIA is now required for all Commission legislative proposals above a certain size. It involves a balanced appraisal of all impacts and includes a wide-ranging consultation. The current EU chemicals regulation became EU law in 2006. It was necessary because the previous legislation was not fit for purpose since it divided the regulation of existing chemicals from that of new chemicals. New chemicals had very strong regulation. Existing chemicals, which could be equally hazardous, were not really evaluated at all.

There were major policy options to consider such as regulating at EU level or at Member State level. (The EU decided on a central approach.) There were major industrial aspects as the chemical industry is one of the EU's biggest industrial sectors. There were economic impacts – testing and registration costs were estimated to be around $2 billion. The environmentalists were keen because the health benefits were estimated to be of the order of $50 billion (but these were never fully evaluated). There was an enormous stakeholder consultation resulting in more than 6,000 contributions.

This slide highlights the main changes introduced following the RIA. There was a simplification of the information provision requirements from the industry. Polymers were taken out of the REACH process because they represented very low risks. A reinforced authorisation system was introduced for very problematic chemicals (those which are e.g. carcinogenic or mutagenic) but which could sometimes be "authorised" on socioeconomic grounds. However, the new rules insist that there has to be a process for finding alternatives in case of authorisation. The final version of REACH includes streamlined administration, greater legal certainty for producers relating to confidential information, etc. The benefits of RIA are clear.

This slide summarises broadly the overall benefits of regulatory impact assessment. It investigates costs, benefits and risks. It improves competitiveness. It's a transparent public tool with an enormous public consultation and is evidence based leading to smarter regulations. It helps to build public trust.

Moving from "precautionary" to "smarter" regulations, one should ask what might be wrong with precaution as it is applied. First of all, the fifth criterion that it should respond to research has very, very rarely been followed through. I did an analysis of all the cases which mentioned precaution in the European Court of Justice case law, and only in one case, did they consider responding to uncertain science and then the court ruled that it wasn't their job to order scientific research. So this criterion is in fact not followed at all. The problem is that without an effective review of regulations based on precaution, the result is to paralyse progress in certain fields. Two big fields where precaution has found strong application are genetically modified crops and nuclear radiation exposure. (Although I would say in contradiction to Professor Oye, we actually have 11 authorised crops in Europe, or it might be 12 by now, but admittedly only one of them is being cultivated.)

By introducing the Precautionary Principle, or a precautionary approach, you encourage societal pressure, which may be counter to established expert evidence. I am not saying that societal pressure is wrong but emphasising that science is not concerned with faith, but with evidence. Any of us who has been at a party and been caught up in conversation with some anti- or pro-, this or that, will know that the public often base their opinions very much on what they consider to be faith or values to which regulators also have to respond.

The implementation of an approach based on the precautionary principle should start with a scientific evaluation, as complete as possible, and where possible, identifying at each stage the degree of scientific uncertainty. This is in the preamble of the communication and again it's very rarely followed.

The next stage in this regulatory evolution is the introduction of the Smart Regulations initiative shown on this slide. Smart regulations have four objectives, Retrospective Action, Prospective Action, Current Action and Continuous Action, trying to improve the way in which regulations are transposed into law. You finish up with this sort of continuous cyclical curve shown on the current slide. The cycle is completed by ex-post evaluation, which constitutes a brilliant new factor. In essence the regulator is required to look back and see whether regulations met the need for which they were written. RIA is carried out for all significant regulations nowadays. The Commission is also concerned about the way that regulations are implemented. (In the past a lot of regulations were left to the member states to implement in ways which suited them and often they were not implemented very effectively.) Last but not least, we need to improve the way in which regulations are transposed into words and that these words should be fully understandable and clearly appreciated by all stakeholders.

The Commission has now introduced the REFIT Programme. This is the Regulatory Fitness and Performance Programme, which concerns the systematic retrospective analysis of the entire stock of EU legislation. One particular examination looked at water regulations, which resulted in a reduction in the number of water regulations in the EU from 18 to 9, saving some € 30 million in the process. This involves a simple examination of whether the regulations met the need for which they were written and deciding to get rid of those which didn't. From this year onwards, the European Commission will schedule in its annual work programme, a set of regulations which have to be re-evaluated to check their fitness to meet the original requirements.

I would suggest that one of the reasons why the EU system has been very successful in this post-modern phase is because the European Commission has the sole right of initiative in introducing new regulations. It still has the sole right in spite of the evolution of the European Parliament's and the European Council's powers. Since the Commission is able to do this without being lobbied, it means that they can actually play the game of public policy, introducing new ideas and seeing how they work. I would label this as a sort of Darwinian approach to public policy evolution. It's the institutionalisation of policy change. I think it's been extremely rapid. In just 14 years, we moved from the communication on the Precautionary Principle, which launched precautionary risk regulation, through to Regulatory Impact Assessment, through to Smarter Regulations, and finally to the REFIT Programme, which is looking back on regulations, which were put in place and which we may no longer deem to be necessary.

Thank you very much.

● Response Presentation / 応答発表

平川 秀幸（大阪大学コミュニケーションデザイン・センター）

Hideyuki Hirakawa(Osaka University, Center for the Study of Communication-Design)

平川秀幸：　ただいまご紹介にあずかりました、大阪大学の平川です。本日はこちらのシンポジウムにお招きいただきまして、まことにありがとうございます。私からは、タイトルにございます、パブリックエンゲージメントについてお話しいたします。これは、今ロジャースさんのお話にあったリスクガバナンス、あるいは、もう少し広くイノベーションまで含めた科学技術ガバナンス、イノベーションガバナンスを考えるなかで、トラスト、信頼の問題、あるいは様々な知的なインプットを様々な社会のステークホルダーから意思決定のなかにインプットしていく。そのために必要なこととして、パブリックエンゲージメントという考え方が重視されてきています。これが日本でどのように発展してきたのか、また、どのような問題を抱えているのかということをお話したいと思います。

私は大阪大学で、コミュニケーションデザイン・センターというところに所属しております。そこでは、公共圏における科学技術政策、Science and Technology in Public Sphere（STiPS）というプログラムを進めています。これは､東京大学の STIG のシスタープログラムになっておりまして、文部科学省の「政策のための科学」教育研究拠点の 1 つです。STiPS では､このパブリックエンゲージメントというのを 1 つ大きな教育研究の柱にしており、そういった観点からお話をしていきたいと考えています。

本日のお話のアウトラインとしてはこちらになります（図示）。日本でのパブリックエンゲージメント、それが具体的にどのようなものをこれからお話しいたします。その発展と、重要視されるようになってきた社会的背景をまずお話しします。続いて、そうした活動が具体的にどういうふうに展開してきて、また、どういうふうに今現在なっているのかということをお話しします。最後に、特に福島の原発の事故、東日本大震災の後のいわゆる 3.11 後の 3 年半ぐらいの状態と、今後の課題をお話したいと思います。

これらの本題に入る前にまず、パブリックエンゲージメントというのはどういうものかをモデル的に示したものをお見せしたいと思います。タイポロジーということで示したんですけれども、科学技術のガバナンス、先ほどロジャースさんがお話になったリスクのガバナンスという点ですと、この図の中では主にこちらのほうの領域になります。パブリックエンゲージメントが重視される、あるいは行われるコンテクストというのは、大きく分けて 2 つあります。1 つは政策決定。リスクの問題であるとか、あるいは科学技術政策、そうしたことに関する政策決定、ポリシーのコンテクストです。もう 1 つ、より科学技術の研究開発の現場につながっている大学で、あるいは社会で。大学の外に出れば企業との連携がありますし、具体的な市場、マーケットでのインタラクションということも入ってきます。そういうリサーチアンドデベロップメント、あるいはイノベーションのコンテクストというのがもう 1 つです。

さらにパブリックエンゲージメントそれ自体も、大きく分けてこれらとのつながりが、こうした政治、政策、あるいはイノベーション、研究開発そのものの意思決定に近いものと遠いものがあります。遠いものでは、主にパブリックエンゲージメントというのは、基本的に対話とかインタラクティブなコミュニケーションを重視しています。そのインタラクションとして特に、図の下のほうではいわゆる専門家と非専門家のダイアローグ、対話ということを重視しています。具体例としまして、「サイ

エンスカフェ」と呼ばれるものが、ここのところ日本でも盛んに行われてきています。

それに対して、より政策の意思決定に近いものというのは、単に専門家、非専門家という関係ではなく、実は下のコンテクストで一見非専門家と見えるなかには、例えば企業のマネージャーがいたり、別の分野の専門家がいたりというケースがあります。あるいは、医療関係の問題であれば、患者団体の人、あるいは患者当事者。それゆえに様々なステーク、アイデアを持っていたり、あるいは様々な関心事、あるいは期待、イクスペクテーションを持ったりする。そういったハイブリッドなパブリックの間で行われ、単に対話ではなく、むしろなんらかの結論、いろいろなアイデアを出していくことをアウトプット、アウトカムを重視しています。デリバレーションというふうにここでは置き換えていますけれども、そうしたことが重視されるようなタイプのものがあります。

このようなかたちで大きく分かれているのに対し、さらに、こうしたパブリックエンゲージメントと呼ばれるインタラクティブなもの以外にも、広くは科学や技術、そして社会との関係に関しては、特にコミュニケーション、科学技術コミュニケーションというところでは、昔からアウトリーチ、研究の内容を社会に向けて還元する、発表するといったアウトリーチがあります。英語では “Public Awareness of Science”、科学についての様々な関心を高める。あと、“Public Understanding of Science”、科学についての理解を広める、深める。日本語では、「科学技術理解増進活動」というのがあります。それから、“Public Acceptance”。新しい科学技術について、社会がどう受容するか、その受容を促すようなコミュニケーションです。

そうしたものもありますけれども、これらは伝統的には、インタラクティブというよりは専門家や行政、企業から一般の社会に対して、どちらかといえばワンウェイで、一方向的に情報を伝える、啓蒙するというスタイルのコミュニケーションだったのに対し、パブリックエンゲージメントでは、より対話的、ダイアローグ、あるいはデリバレーション、インタラクティブなプロセスを重視します。これを念頭に置いた上で、その先にいきます。ちなみに、より意思決定に近い側のものとして、実践例としては、参加型テクノロジーアセスメントと言われるようなものが、アメリカ、ヨーロッパ、また日本でも様々行われています。

さて、ちょっと急ぎながらになりますけれども、こうした活動が日本でも実は行われているその歴史的背景をざっと見ておきたいと思います。大きく分けて 2 つの背景があります。1 つは、特に日本では今から 20 年以上前、1980 年代終わりから 90 年代初頭にかけて問題になった、いわゆる「理科離れ」、科学技術離れというのが大きな背景としてあります。理科系の学部や大学院を出てもメーカーや製造業に行かずに、金融、証券などの別業界行く。ちょうど僕らの世代が、まさにそういう世代でした。そうしたことから「理科離れ」ということが問題になり、これが 90 年代の科学技術政策のアジェンダの 1 つになっていきます。そのなかから、「科学技術コミュニケーション」とか、「科学技術理解増進」というのが必要だという話になっていきます。

もう 1 つ、特に 90 年代なかば以降、科学技術に関連する危機的事件が数多くありました。例えば、特に 95 年というのは 1 つ象徴的な年でした。1 月の阪神淡路大震災で、高速道路を含めたくさん建築物が倒壊しました。3 月 20 日には、理工系の大学院生やポスドククラスの人たちが実際に犯行に及んだ、地下鉄サリン事件もありました。さらに年末には、高速増殖炉もんじゅの事故もありました。その他、薬害エイズ事件とか様々な事件が 95 年から 96 年にかけてあったんです。その後も原子力に関しては、東海村の再処理工場での火災事故とか、99 年には JCO 臨界事故で 2 名作業員が死ぬという事故もありました。さらに、これに続いて 2000 年代にも、今度は食品分野で BSE が国内で発生し、さらにアメリカで発生した BSE の問題で、輸入再開問題が大きくクローズアップされました。

現在に近いところでは、東日本大震災と福島原発の事故がありました。こちらはこうしたことを背景に作成した年表ですので、参考として見ておいていただければと思います。

こうした背景で、政策、ポリシーの発展、さらにそのパブリックエンゲージメントに関する実践や研究というのが発展してきます。それを、次に見ていきたいと思います。

まず90年代。90年代は基本的には、英語では“Public Understanding”あるいは“Public Acceptance”、こうした活動が主に行われてきました。特に95年の様々な事故などが起きた後、信頼回復のためにもっと科学について知識を広めるというような戦略をとったりしました。それと同時に、特に90年代終わりになると、科学技術と社会に関しての様々な研究が、政府の様々な助成金によって行われるようになってきました。そして2000年代になると、これらを踏まえて、新しい政策、コンセプトというのも出てきます。例えば、日本では5年ごとに科学技術基本計画が策定されます。2001年からの第2期科学技術基本計画のコンセプトの1つには、社会における科学技術。社会のための科学技術というコンセプトが出てまいりました。

さらに、2004年の「科学技術白書」。こちら、皆さんの資料に入れておりませんけれども、文部科学省の科学技術白書では、科学技術ガバナンスの必要性が示されました。国民の各層、各主体から能動的に発せられる意思を、政策形成等の議論のなかに受け入れるようなことが必要だと、そういう意味でのパブリックエンゲージメントが必要だということが、ここでは唱えられていたりもしました。

2000年代にはもう1つ重要なものとして、RISTEX（Research Institute for Science and Technology for Society）という、新しい研究助成組織ができました。これによって、実はかなり多くの、特に科学技術と社会の間をつなぐような研究が行われるようになりました。その中で、パブリックエンゲージメントに関する社会的な実験、研究というのも行われてきました。私自身もそうでしたし、東大のSTIG代表の城山さんたちも、このRISTEXのファンドでいろいろな研究をさせてもらってきています。大体180ぐらい、様々なステークホルダーインボルブメントとか、学際的な研究とか、それらを重視したプロジェクトが進められてきました。

それから2000年代、さらに科学コミュニケーションということが重要だということで、例えば、東大や北大、早稲田大学で、科学コミュニケーションに関するトレーニングのプログラムがスタートしたり、「サイエンスカフェ」の取組みが広がったりということがありました。もう1つ重要なこととして、先ほど最初にお示ししました図式のなかで、よりデリバレーション、アウトカムを重視したものとしては、参加型テクノロジーアセスメントの実践が様々行われました。こちらのリストはRISTEX研究プログラムのプロジェクトでデータベースを作ったものから引っ張ってきました。90年代終わり頃から30以上の様々な大小のプロジェクトがあります。その中には実際に国の政策や、また、地方自治体の政策かに関連したものも多くありました。これに関連して、科学技術基本計画のコンセプトも様々に進化してきたというのがこの図です。

さらに、3.11以降も様々なことがありました。特に福島原発の事故の後で、やはり科学に対する信頼がすごく落ちた。それを受けて様々な試みがなされています。細かい部分は飛ばしますけれども、様々な試み、リスクコミュニケーションであるとか、もう少し広くガバナンスに関連するようなテーマのコミュニケーションの重要性ということが言われていたりします。2年ほど前からは、最初にお示ししました図式の中での、政策ではなく研究開発やイノベーションのコンテクストの中で、パブリックエンゲージメント的な対話的な活動を活用していこうという動きも、文部科学省のプログラムで始まったりもしています。

ここまでお話してきました流れ、特に2000年代に関する流れを振り返ってみると、いろいろな可

能性や達成もあるんですけれども、様々な限界もありました。まず達成としては、例えば、先ほどの一覧表を見せましたけれども、参加型テクノロジーアセスメントの実践、社会実験というのがたくさん行われました。また、サイエンスカフェのような、コミュニケーションの場も広がったということが挙げられます。しかしながら、そうした試みの大部分は、少数の例外を除くと基本的には政策からは離れています。政策の意思決定からは切れた、社会実験に留まっています。また、そうしたことを行うための制度化というものも進んではいません。そういう意味では、非政治的な、あるいは非政治化されたかたちでのサイエンスコミュニケーション、あるいはパブリックエンゲージメントというかたちになっている。大部分は昔ながらの PUS/PA、パブリックアクセプタンスに留まっているというふうに言えます。

　さらに、この図の左右の関係で言うと、全体としてはこちらのほうに留まっていて、ここはまだまだ萌芽的なものしか始まっていないということです。そういう意味で、今後必要なこと、課題と思われることを最後に挙げておきました。どうやってこの政策と研究開発、大学の現場では例えば工学部と公共政策の間で、より研究の中身に関連するようなコラボレーション、インタラクションがどう実現できるのか。そのためにはインセンティブもいろいろと考えなくてはならないでしょうし、その制度化も様々なかたちで必要でしょう。そのための方法論やツールを揃える、整備することも必要になってくると思います。

今日は発表しませんでしたけれど、EU でも、例えば Responsible Research and Innovation、「責任ある研究、イノベーション」というコンセプトで、新しい多国間研究開発・イノベーション促進プログラム Horizon 2020 という大きなフレームワークのもとで協力が進みつつあります。こうしたものとの協力関係を作りながら、日本でも並行して展開するのが必要ではないかということを最後に挙げさせていただきました。時間が若干伸びましたけれども、以上で終わりにいたします。ご静聴ありがとうございました。

● Q&A / 質疑応答

松浦： 先ほどと同じように、Rogers 先生と平川先生のご発表に関して、何かご質問等があればお受けします。

参加者： Rogers 先生、平川先生、ご発表ありがとうございました。私、お二方に共通した質問を 1 つしたいと思います。それはリスク管理というものに関するコアエレメント。あるいはキービジョンと言ってもいいと思いますが。それは研究機関、それから民間企業、それから市民の団体でもそうなんですけど、いずれにも共通して 4 つの要素があるだろうと。

1 つはやはり誠実さ、オネスティ。2 つ目には、やはりこれは説明責任というものです。それを遵守するアカウンタビリティがあると。3 つ目としてはやはり公開性、オープンネスというものがあるだろうと。あと、4 つ目として、このコラボレーションというんですか。先ほど平川先生おっしゃいましたけど、専門家、非専門家をつなぐダイアローグ、コミュニケーションというんですかね。このオネスティとアカウンタビリティとオープンネスとコラボレーション､あるいはコミュニケーション。この 4 つがリスク管理のキービジョンになると思うんですがいかがでしょうか。まずは Rogers 先生からお答え聞きたいと思いますが。

Michael Rogers： Thank you very much: That's a key question in fact. When I lived in Japan, some 40 years ago, Japan was a highly efficient country, which was managing things extremely well, largely based on a very intimate relationship between industry and government and the public accepted this situation, broadly because it was effective and worked. Following a number of accidents and disasters, not only in Japan, but also in Europe, that sort of public trust has been enormously eroded. Now we have the problem that experts coming from industry and giving advice to risk regulators are broadly distrusted.

We have the appalling situation of a real expert in the European Food Safety Authority actually being maligned because she was leaving to join the international organisation concerned with risks in the food industry. There isn't an easy way around this and what I think is essential is first of all that we have to accept that the experts in this field broadly come from industry. Secondly, we have to persuade in some way by using the sort of dialogue processes, which were described so ably by the last speaker, a much better dialogue between experts and the public. We should also encourage experts, who usually find it much easier to speak to other experts, to engage with the public. It will take a longish time but it's the only way in my view that we can get around this problem.

平川： 私のほうからも簡単にですけれども回答いたします。まさにご指摘いただいた 4 つの、オネスティ、アカウンタビリティ、オープンネス、コラボレーションというのは非常に重要です。しかもこれはそれぞれ独立したものではなくて、相互に支え合っているものだと思うんですね。例えば、

特にこのなかで重要なのは、コラボレーションという視点で、実際に世の中で大事だと考えられている問題、様々な期待、エクスペクテーションであったり、懸念であったり。それと実際に地域社会のレベル、あるいは国や世界のレベルで問題となっている問題に、実際にその問題に直面してる当事者の人たちとその問題解決を一緒に考えると。そもそも何が問題なのか、どういう解決が望ましいのか。そういうことをやっていくなかで、信頼っていうのも再び回復されてくると思うんです。そういう意味で、このコラボレーション、それにそのオープンネス、アカウンタビリティ、オネスティ、それぞれが非常に関連してくるのかなというふうに考えました。

それから、今 Rogers さんがおっしゃった点にも関連するんですけれども、もう 1 つ重要なのは、社会との関係をよくしていくのと並んで、やはりサイエンスアドバイスのあり方をちゃんとやっていく。オープンネスということも関係しますけれども、やはり透明性であるとか、説明責任ということ。これを踏まえながら、かつ有効に、エフェクティブにちゃんとアドバイスが使われる。政治と政策とサイエンスの関係というものをちゃんと再構築していく必要があるのかなと。実際に今ヨーロッパ、イギリスあるいは OECD などでも議論されていますけれども、それも重要なポイントかなと思いました。どうもありがとうございます。

Michael Rogers： Thank you: I just want to add one thing about transparency. There is enormous pressure from the public to have much greater transparency in the medical field. For example, the European Medicines Agency is predicated on making more and more information available. However, total transparency can have unforeseen side effects. If, for example, during an early stage clinical trial some people die of cancer, but the deaths are essentially random and have nothing to do with the medicine which is under trial, making the results easily available could have unforeseen results. A member of the public seeing the deaths from cancer is likely to decide that that medicine is not for him or her and perhaps forgo a potentially useful pharmaceutical. So transparency is an important issue, but it has to be approached with caution and can have unintended consequences. Total transparency can produce big problems.

松浦： 少々時間が押してしまいましたが、ここでいったん休憩にしたいと思います。Rogers 先生、平川先生、どうもありがとうございました。15 分間休憩の後、3 時 15 分くらいに後半を始めさせていただければと思います。

• Keynote Speech 3 / 基調講演3

デイビッド ローズ (アムステルダム大学)

David Laws (University of Amsterdam)

"Hot Adaptation: Working between facts and stakeholders"

「ホットな順応的管理：事実とステークホルダーの間で」

松浦： そろそろ後半を始めたいと思います。シンポジウム後半は、アムステルダム大学の Laws 先生から、「ホットアダプテーション」というタイトルでご発表いただきたいと思います。

David Laws： *Konichiwa.* First, I want to thank Shiroyama-sensei and others for the opportunity to come and talk with you. I am going to shift a little bit from the prior discussions as was indicated and talk in a way about two differences. One, I think you could see what I am going to say that instead of talking about science or science and technology in society, you could think about – in my talk about society in science and technology and in that case also where people from society have something to say about the conditions under which this debate or discussion occurs and about how to interpret the results of it. That they are unwilling to give that over and that becomes very important, the setup of these interactions in what unfolds in the stories that I tell.

The other thing I am going to talk about is the domain of the local and that's characterized by this that there is – and the local is going to introduce a new set of actors in addition to what was a policy wonks, engineering, geeks and nerds, science nerds. There are going to be local people in these stories and you are going to see them and hear them talk about their experience and I think you will see that they are quite articulate about it. But the important things to feature are that there is going to be someone who is going to take an action. We're talking about where this gets put into place, the implementation part that action highlights people's stakes. It highlights consequences. It triggers doubts about what's going on, how is this going to affect me, my business, my family, the place where my family has lived for a long time. It also sets a local context for action. We're not talking about general principles but how general principles unfold in people's backyards where they have knowledge about those backyards that may be important to the way things that unfold, and it initiates then, you could say, an exchange, an exchange of views, an exchange of experiences, sometimes, an exchange of insults.

What it also triggers is the process of framing, where facts, experience and values mix as people try to make sense of what's going on, what's likely to happen as they look at their experiences. We could think of this as an exploration of our relationships with each other as a community and also an exploration of our relationships with nature , with the environment in which we live whether that's a – gene drivers being put into fish and then fishermen watching what happens or something else, like that. In this fasion then a potential for our community actually develops. The question is around questions that are likely to be very controversial to the people who are involved in that. The community has one way or another, a destructive potential, it can escalate, it can deepen the polarization around the issues but also I think I hope to be able to show you that there is a constructive potential also inherent in that and to maybe bring out some insights about what shapes the role that this community has in its development.

A quick map of what I am going to be talking about. I am going to be drawing two distinctions and looking at a series of cases that are going to move and I will show you just the way. On the one hand, I am going to talk about cases where knowledge is relatively closed where science is right, and where we can turn to it for that knowledge. And in other cases where science is open, where questions are uncertain, where causal changes might not be understood and in fact where action, if you think about putting gene drivers into the environment, are going to shape our understanding of what actually occurs. So the action is going to inform, the action is an experiment or a continuation of prior experiment and of course these cases have a funny way of moving from this area to this area as action highlights new features.

I am also going to be talking about a distinction between where the engagement, where the kind of reasoning is cool where we try to limit the role of emotions to move away from it, to depoliticize, to deescalate the situation and cases where reason is hot, engagement is hot because people's lives are affected in very immediate and tangible ways and the way in which they interact with the situation is shaped by that. I am actually going to be arguing that that can be a virtue, right, the process of reasoning isn't one of just marginalizing the influence of emotion, but people reasoning under those kinds of conditions that motivated cognition can reason very well even lay people about technical subjects.

My cases then are going to move. I am going to start with a case that's up here, though the local people think it should probably be down here. I am going to then move and I am going to use that case to illustrate why we go from cool to hot, why local action is likely to be hot and what that means, then I am going to talk about a case where the science is relatively closed, though surprising but the issues in the way they are engaged are hot. Then I am going to talk about a third case that moves over here towards what I call hot adaptation and that you will hear the resonance of this with what's often referred to as post normal science. There is an important box up here that are policy dialogues that try to set aside alongside these kinds of things, other forms of engagement between the variety of actors or stakeholders who are engaged. So our map is we are going from up here, down here and over to here and if you keep that in mind as I move through the cases it might help.

So I am going to start now with a very Dutch case. This is a case in which technology, science, nature and society are mixed up together over a period of more than 100 years, so it's a historical case and also a contemporary case. It's a polder here and actually technically it's a *droogmakerij* in Netherlands which is a dry making but where land was reclaimed from water and then interestingly enough what you see here as dry land around it was pit and so it was dug out. So, on the surface the situation is completely changed, so what's land here was once water and what's water here now was once land. So the situation has completely reversed itself and you see the interpenetration of nature and technology and society as people live in this area. Now, this balance or at least the stable situation is disrupted by a new policy plan that comes, and this is a policy to create new nature to bring wetlands into play to try to create environments for wildlife and to return some of the farmed land to natural habitats.

You can think of this area and this is a diagram made by local citizens you will see in a minute as a big sponge. It's land filled with water and if you know that water is heavy and if you push down on a sponge the water is going move somewhere, it's going to move around and the dispute that you will hear about in a minute develops over what's going to actually happen to that water, once you put the weight of this new nature on this very sensitive landscape. Okay, so there is a policy of local concerns developing about what this is going to mean but they developed in part because of the consequences they have for local businesses, for people's homes but also because people disagreed about the facts. It wasn' t that they just didn't like what was going to happen to them, they had a different view about what was going to happen in their backyards and they rebelled.

So the policy starts out then or the controversy starts out with this kind of hot cognition, the predecessor to what I am calling hot adaptation. The interesting thing is science turned out to be, or at least part of science on their side, so this person up here is a very prominent expert on just these kinds of issues about water management who happen to be taking a group from the UN, I think, on a tour to show them how the Dutch handled water management. Local people saw him began talking with them and he agreed with them that they had a point that their analysis of the situation brought out issues that the policy experts had not considered. The scientists who were informing it and he joined their protest. Now their protest then spilled over into – here this is a museum for, let's say, policy follies where they pointed out the ways in the actual landscape, the policies weren't working as intended. They also had competence, they had technology themselves and here you see them actually starting to alter some of the things that the policy put in place. They actually started to change what was going on the ground.

Now, this hot cognition then didn't just lead to technical disagreements, it certainly did about that but it also spilled over into a kind of political theater so because of the resistance on the part of the government to this, there was a kind of escalation that occurred and you see here the republic of Horstermeerpolder, this area is called Horstermeerpolder, they succeeded from the Netherlands.

Here you see the flag Horstermeerpolder. Here you see them setting up blockades at the borders of the republic – the new republic stopping traffic and checking people's identification as they drove through the streets of Horstermeerpolder. Here is the anthem. I won't play it for you, it's in Dutch but it's a sort of folk anthem, lightning and thunder rains lots of protest, the inhabitants of the polder are angry, but do their best to reverse the water tide, no wetlands, but then what should the Meadow Lakes that's what they call area B, away with the doom and gloom.

Here you see a series of photos of some of the protests that they then staged and that attracted a lot of attention. Tractor is going through the street, "stop the green lies." The green lie was that the creation of nature will be beneficial, they disagreed with it. They organized a parade and here all policymakers' dream; the policy is being burned by the president of the newly formed republic. So it's very effective evocative political theater that also was effective in disrupting the expression of the new polder. So rather than engagement here what we get is a kind of escalation that disrupted the implementation but didn't do anything further with it, right.

Though it did lead to a new story emerging with so many fellows suffering to have to live in a gutter, listen to the residents, here you hear the voices of people speaking about implementation or else we'd rather be dead, we are the people with experience, stop the green lies otherwise you may repent, okay.

Now, having shown a little bit about how this heat develops particularly as local action is undertaken where local views may come into interaction or at least to be contested by or contest views of experts and how this – particularly when people's lives were affected in immediate way, a kind of heat develops. I now want to turn to two cases that really show the difference between what I call the closed and open views which I think Bruno Latour captured with his idea of Janus-faced science, the science that knows and science that does not or not yet know.

And look at two cases that bring this into play. The first is as promised an urban case, so this is about a conflict between two technologies, one is light rail transit that was being introduced in a major urban center in Canada up here – this kind of train up here and the second is MRIs because the light rail would go near a hospital and the people at the hospital were saying that the train needed to be put underground because they were worried about the effects of the electricity on the performance of the magnetic resonance imaging machinery in the hospital and their ability to fulfill their tasks. People from the city were saying absolutely not, the risk isn't there, that's absurdly expensive, there is no way we can go through with it and they are caught in a fight. And here now both sides had their experts that were saying why they were both right and people as you can well imagine can fight for a long time on those kinds of grounds.

Finally, they wore themselves out, they realized and here is the view, the words here now quotes from the person who was responsible for managing then the interaction between the antagonists in this story about what was going on. They realized that they were stuck that they could talk forever until they were blue in the face and neither one was going to convince the other that they were right so it was a matter then of saying, "How are we going to get around this, what do we need to know in order to get around this?"

Then we have a shift. We have a shift towards often called joint fact-finding, that they jointly identified a series of questions. They jointly identified and here what's important that the science is relatively closed someone who they had confidence they both could agree to, could answer those questions and this consulted and became not a servant of one side or another, not one group's expert or the other group's expert but it was working for the group as a whole, and this was the real shift in the process.

What it prompted was a very surprising result. The consultant came back and said, "Guess what, you're both wrong. You can leave it above ground, you can put a below ground is not going to make any difference, what you need to do is shield MRIs with lead because there is going to be an effect but putting it underground won't help with that."

What he did for the actors involved though is it led to a legitimate or a justifiable basis for action. They could both go back to the groups that they represented and said, "We got advice together, we asked the good questions, the new proposals informed so the city people could go back to their political bosses and say this is what we have to do. There is a basis for it and the healthcare people could go back to the governing board of the hospital and also say "This is what needs to be done and it's going to be effective, we have confidence in addressing the concerns."

Now, I want to shift to a slightly different problem, where these questions about the technical, about the scientific aspects, are more open. This has to do with radioactive waste disposal. Low-level radioactive waste disposal, still where some of these things come up and here then we start to have a picture of reframing. This is a quote again by the person who was running this process and after the discussion had been going for a while he says, "I am listening to what's going on around the table for the past few days of our discussions and I am saying if we just went ahead with the discussion as it was planned it would be absurd, it would be an insult and it wouldn't take account of what's going on."

So the only thing to do then is to revise the agenda, to expand it, to address the concerns that have come up and to see if there is a way to deal with it. And many of those questions you can imagine were technical questions. But taking them up then became difficult, one of the questions was about their health effects of low-level ionizing radiation, everyone had a strong view, those views disagreed. And so they thought well, let's get an expert from the outside, but then they wanted independent expert. But in a field like this anyone who has been involved for a long enough to really have the kind of expertise you want has some point – they have dedicated their professional lives to it, so they are invested in it in some way. T hey are not from mars, they are not from outside of the situation so it became very hard to identify someone.

When they did identify someone this is the charge they gave him that the goal is not to get someone to say what the truth is. What we want to do as a group, what we feel it's our responsibility to do and giving advice and this was a group of citizens who were giving advice about what to do with low-level radioactive waste, to try to understand what the debate is, what people think on one side, what people think on another and this was the question that they asked the expert to deal with. And I don't want to defame him at all but it wasn't going to be a simple presentation but it wouldn't be experienced as a partisan presentation.

He began then, and you see the contrast here, with "I regard it as a privilege to be here to tell you what I think that consensus opinion about the effects of radiation is, not only in the US but internationally." So instead of arraying the debate I am going to tell you what I think the truth is. It was a hard question for him to take up for some reason and then the conversation eventually emerged and addressed the question but only, because the people pushed back the question is what are some of the other views that you might have not touched on that would lead people to different conclusions perhaps. And we want to understand those views because we're going to have to make recommendations about what is responsible, what's fair, just, and in the interest of all. Then we want to understand the disagreements not just be told what the consensus opinion is, particularly in a field where if you looked at the history of regulation, you could see that it was changing that it wasn't stable overtime. They saw themselves as acting in this kind of temporal context where things were likely to change. And so given that the response was to try to understand the level of agreement and disagreement and the nature of those disagreements in making decisions.

So now it's going to get a little bit wordy but I'll go slow and I'll try to say. So then we get what I would say is a kind of effort to take responsibility that citizens actually who were

行詰め

involved in this is someone who was a carpenter worked on the historic preservation of houses but became a very eloquent participant in this discussion saying something about how he views it and because they were initially asked to just give recommendations on disposal site criteria, and they refused to that. Notice here what they are doing is taking account not just for the recommendations but the conditions on which they are doing this, the agenda that they are pursuing the kind of expertise that they are doing, the interaction that they have with the experts and here the kind of advice that they are willing or unwilling to give. So the reason I am uncomfortable is because it's exactly what they being the authority of the agency want to hear. And he gives a different view, a contrasting view and this became the view upon which this group created its own constitution for acting, for trying to make sense of this situation and providing advice that they thought be reliable and in the interest of the people of the state that they were representing. This body ought to keep itself aloof enough, independent enough, and become educated enough so that it can tell the authority what the authority may not want to hear, if we deem it in the best interest of the safety of the people of the state. If that means ignoring the federally mandated time limits, so be it. We are going to be bound by our relationship, the democratic relationship to the people that we're representing here as citizens, so be it. That's not what the authority wants to hear because they are mandated to work onto those timeframes and constraints.

And then the punch line, "I think we should be free to say, and this is tradition of New England's folk wisdom. That's full of beans and you better do something about it." That they weren't willing to take on the assumptions that we built into the process. But they saw themselves as exercising their capacity as citizens and actually highlighting those assumptions, testing the appropriateness of it and revising both in terms of the actual content but also in terms of the organization that this process took.

So you'll hear in that, I think, echoes of a post normal approach where the need for public involvement is not only because of a general pressure on science where the public is concerned but where problems don't have neat solutions. At the time they were engaging in this radioactive waste disposal that did not have neat solutions, where the phenomena are ambiguous and where, if you looked around at the cases, you found that most of them had developed in ways that were unanticipated by the very people who were involved and where the techniques were all open to methodological criticism. And the debate then they saw, this is the citizen speaking but it was very well captured by Funtowicz and Ravetz discussion, enhanced by the exclusion of all but academic or official experts, they saw it as their responsibility to wade into this debate and to bring into play their knowledge of local conditions, which can determine which data is strong and relevant or at least be part of that debate which cannot be the exclusive. They were unwilling to let be the property of experts and where a keen awareness of how these general principles are realized in their backyard, they saw as being a very important feature.

Okay, those are the three cases, I have included this in the notes, I am not going to go into it here, but this is a much more general case, here you can see Hilary Putnam talking about the general organization of and about – if you want to know what's right and good you have to organize yourself in accordance with even around technical subjects with democratic standards.

Now I want to move on to an epilogue and this isn't the case really about technology but it's very interesting. It's again a process where there is a conflict. In this case it was between people who catch fish and people who were advocates for protecting birds. The conflict develops because you can see catching fish in this case involves driving these big vehicles onto the beach and the birds not only very small but there is no trees on the beach so they live and reproduce in the sand and because they were endangered, these vehicles were direct threat and this triggered a severe – a policy exist in the United States, the Endangered Species Act, where it gave people the right to limit beach access to protect these birds. But the person who was in charge of the park realized as well that these people were their neighbors and that if she was going to be in charge of a park and have a harsh implementation of the law that she would be fighting with her neighbors. They demonstrated their political ability by blocking access for traffic to this whole area where recreation is the center part of the economy and so they basically pulled the plug on the local economy and thus got some action.

Now, many things are interesting about this case but I want to highlight two. The first is something that's been part of the last two stories as well, which is that the group worked by consensus. There was no voting and the commitment to consensus had two implications that I think are very important to consider. First now we are talking about the details of organizational design, right, not the broad process but this is turning in this case but in these other cases as well on that. The first is it creates a commitment to listen because if I just disagree with you and you disagree with me and neither of us is really listening to another, we're engaging in what sometimes called a dialogue of the death. Then we're not going to get anywhere. So the only way we're going to get anywhere is by acknowledging that the other may have a point and that we need to at least engage enough to see that. The other is that it engages a kind of pragmatic, a practical commitment to try to craft together some kind of step, some kind of plan that would meet both of our concerns, recognizing they both may be legitimate. At least we may not be able to tell still, that we will be finding out by acting. So that's one that the details of the process matter and here this consensus rule really was important for transforming the discussion from a destructive one where at the beginning these people could not be in the same room with each other, the behavior was beyond uncivil, it was one step short of physical violence, to a situation where at the end.

This is the second point I want to make. The fishermen but also the advocates and the people on the other side were experts from the national government, from the state government, from large nongovernmental organizations, so it was a very diverse group. 23 organization representative around the table. They built into the conclusions, their own recommendations, that were taken forward is the new policy that if they realize that they were making a bet, they were making a guess about how the fish and the birds were going to behave in the future. And that might not be the case. They couldn't control them and so they did two things. They built in – they gave with triggers emergency powers to the administrator of the local part, the district in this case, to implement action if the data suggested that things weren't working out as they had planned. But that was contingent upon then that administrator also reconvening this group to revisit the new evidence and then to revise the plan in light of it. And the interesting thing as how they moved from this very deep controversy, really hating each other, and of course never talking with each other that goes along with that to a situation in which they really moved toward something that I think starts to approximate what we think about as adaptive management.

And in that way, I think we get some insights and this is the final slide, about what this box looks like, and what the kind of design features or the features of a process that would work in this kind of situation and I think many of the ones who are talking about are down here. The first is that the opportunities for engagement be democratic. By democratic in these cases I mean that the people who set the rules for the organization of the process where the people who are involved, it wasn't imposed upon them from the outside but they actually created the rules. This wasn't just local residents, it was local residents, it was experts from the government, it was experts from NGOs, it was a variety of people but they actually created the rules that they were going to have to live under and that they felt were responsive to the challenge that they face. That's what I mean by democratic opportunity.

Second that it created an opportunity to share sources of insight, experience, knowledge but also doubts. Doubt in these cases I think is a rare commodity and one we actually should price much more than we do. People are concerned about what's going on, about what might happen and these sources of doubt often are crowded out of these debates because we can only express conviction. This democratic opportunity that they created allowed us a space to actually to discuss, to engage the doubts people had and finally what they did is they started to reason, design, revise and eventually act together. Thank you very much.

Response Presentation / 応答発表

松浦 正浩 (東京大学公共政策大学院)
Masahiro Matsuura (The Graduate School of Public Policy, The University of Tokyo)

松浦： David 先生、ありがとうございました。次が、私と鎗目先生のほうからのプレゼンとなります。私からは、今のお話しにも出てきた Joint Fact-Finding というものを日本でも使ってみようというプロジェクトを 3 年間やってきましたので、それから得た知見のようなものをお話できればと思います。この話はいろいろなところでしているので、すでに聞いていたことがある方もいらっしゃるかもしれないですけれども、新しい話もいくつか盛り込んであります。

先ほど平川先生のプレゼンテーションのなかで、RISTEX という組織の話が出てきたと思いますが、そこのファンディングを受けまして、先週 2014 年 11 月 20 日まで 3 年間のプロジェクトを行って、私が研究代表を務めておりました。このプロジェクトは、先ほど言ったように Joint Fact-Finding という考え方を、日本の実際の政策形成に適用してみたらどうなるかを検討してみたという事例です。

「共同事実確認」と日本語で訳していますが、Joint Fact-Finding の考え方を、私はこういうふうに（図示）いつも考えています。つまりこういうステークホルダーたち、あるいは国民が何かで対立したときに、それぞれ異なる専門家が、それぞれに入れ知恵をするというのがこちらの図です。そうしたときに何が起こるかというと、advocacy science、「弁護科学」と呼んでいるんですが。結局、このステークホルダーはこの先生が正しい、もう一方のステークホルダーは別の先生が正しい、ということをこの場で議論する。またこのスペクテーターというか第三者みたいな人は、この人はこの人のことを信じて、また別の人はこっちの人のことを信じている。結局どちらを信じればいいのか、どちらの科学者を信じるのかということですね。つまり、科学が宗教みたいなものになってしまう、どの神様を信じるかみたいな話になってしまうという問題があるということです。それを解消するのが、Joint Fact-Finding だと私は考えています。つまり、ステークホルダーが議論するときに、その後ろに専門家がそれぞれつくのではなく、ステークホルダーの議論の場に、専門家のプールというものを別に設けて、その間で一元的なやり取りを繰り返すというのが、Joint Fact-Finding の考え方だということで、これを日本でやってみようという取り組みを進めてきたということです。

実際にアクションリサーチということで、私自身やってきたプロジェクトがこちらの報告です。日本の方は皆さんご存じでしょうが、対馬という日本の西端の方にある小さな島で、木質バイオマスを使って再生可能エネルギーを入れようという事例や、あるいは 3.11 の福島以後、食品中の放射性物質をどのぐらいまで許容するかという新たな基準値の設定課程を検証したり、人を集めて議論をしたりですとか。あるいは、これは岡山の日生の例ですが、小さな湾のようなところを、海洋空間計画ということで地域の人々がこれからどのように管理していくかということで、地元の中学生を集めたワークショップをやって、彼らが必要とするエビデンスとは何かを整理したりというようなこともやりました。

私と David と、その上の先生にドナルド・ショーンという人がいて、その人の書いた本で、“Reflective Practitioner”（『反省的実践家』）という本があります。その考え方は何かというと、実際にやってみて、やってみたことから知見を引き出して、その知見を機能的に整理していきましょうといったものの考え方です。つまり、何か仮説があってそれを検証するために実験をやるのではなくて、とりあえずやってみてそこから知見を引き出していくというのが、プラテクショナー、あるいは

プロフェッショナルの実際の思考回路なんだと。それをベースにして、今の経験を踏まえて、私たちが考える Joint Fact-Finding のあるべき姿ということで、5 つの条件を考えました。1 つ目がエビデンス。サイエンティフィック・エビデンスみたいなものは、議論の当事者、あるいはステークホルダーが取得するということですね。従来であれば、先ほど平川先生のプレゼンテーションのなかで、欠如モデルみたいな話がありましたけれども、専門家が人々にエビデンスを与えるといったフレームワークでものごとをとらえがちなんですが、そうではなく、エビデンスはステークホルダーが取りに行くものだと。そのフレームの転換が必要でしょうというのが 1 つ目です。

2 つ目が、エビデンスについての共通理解の形成ということです。これもいろいろなステークホルダーがいて、異なるエビデンスを持って争っているのであれば、まずそこの共通の理解、common understanding を作らなければならないということです。

3 つ目が、多様なディシプリンからエビデンスを収集するということです。ある社会問題が存在したときに、社会問題とそのまま綺麗にマッチする学会とか学協会のようなものというのは実際には存在しません。いろいろな学協会、ディシプリンからの知見を、ある社会問題のために統合しなければならないというのが 3 つ目です。

4 つ目、エビデンスの不確実性について意識しましょうということです。先ほどの David のプレゼンのなかで、ナレッジがオープンだという状況があるっていうお話がありましたけど、まさにそういうことです。ラトゥールのヤヌスの話がありましたけれども、つまり、'science in the making' のような状況の科学っていうものもあるんだよ。だからこそ、Uncertainty があったり、あるいはアクセスできない、そもそも知識が全く存在しない、void の状態だといったような状況があり得るということもちゃんと認識しておきましょうということです。

最後に、議論の当事者が誰なのかについて意識する。1 番目の裏返しのようなものですが、科学者がエビデンスを誰かよく分からない人に渡すのではなくて、議論の当事者というステークホルダーがいて、その人がエビデンスを取りに行くんだということを意識しましょうということです。このようなプロジェクトの話を、幸いにも国会の原子力問題調査委員会に呼ばれて、意見陳述というか、専門家証言をさせていただいたり、全国紙で新聞記事を載せてもらったりして、少しずつこうやって広めようとしてきたということです。

これを踏まえての反省がいくつかありますが、キーになるポイントをお話しします。1 番ポイントになるといいますか、面白いかなと思われるのが 4 つ目のポイントです。Joint Fact-Finding をやるということは、専門家を、David の言葉の中で "servant" という言葉が出てきたと思うんですが、専門家をステークホルダーの servant にするといったようなパラダイムというか考え方があったわけです。つまり、専門家が「これが情報です」と言って渡すのではなくて、専門家たちはあくまでステークホルダーに「どういう情報が必要ですか」と、メイドというか執事というか、「ご主人様、どういう情報が必要ですか」ということを科学者に言わせるというのが、ある意味共同事実確認のポイントであったわけです。実際にそれをやってみると、ステークホルダーとか議論の当事者の人たちっていうのは、意外と視野が狭かったりするんですね。先ほどの LRT と magnetic fields の論争の話の中でも、結局問題のフレーミング自体、ステークホルダーが間違ったフレーミングを持っていたと。その時に、もしメイドのような科学者だと、答えられないわけですね。議論の当事者たちに対して、「いや、それは間違っているよ」と言えるような、対等の立場にいないといけないわけです。

ですので、私自身は共同事実確認を、科学者をメイドか執事のような立場に置くというつもりでずっとやってきたんですが、実はそれではうまくいかないということがわかってきました。また逆に、例

えば科学者自身が､「これはあなたのフレーミングが間違っていますよ」とか､「あなたの視点はちょっと狭いですよ。未来はもっとこんなふうに変わる必要がありますよ」みたいな話を伝えていくような役割も果たさなければいけないんじゃないかなということが、このプロジェクトをやってみて分かったということです。

　他にもいくつか知見はあるんですけれども、こういったプロジェクトで 3 つの社会実験を行ってきて、今後どのようなかたちで日本で、様々な社会課題に広めていくかというのを、今後はこの STIG 等のプログラムを通じてでも考えていきたいなというふうに思っているところです。どうもありがとうございました。次は、鎗目先生の方からお願いします。

• Response Presentation / 応答発表

鎗目 雅 (東京大学公共政策大学院)

Masaru Yarime (The Graduate School of Public Policy, The University of Tokyo)

Masaru Yarime： Today, I actually invited some students and also working with my colleagues, so I think I should try to speak in English although I can speak Japanese much better than my English. Thank you very much for this opportunity. Currently I am working for the STIG program at the University of Tokyo and also this may adjoin the UCL new Department of Science, Technology and Engineering and Public Policy. And today we have the head of the department Dr. Jason Blackstock. He is going to talk about that program in more detail. But somehow I think this is a good opportunity to try to strengthen and expand the cooperation between similar programs in different places. I think we could try to utilize these kinds of opportunities fruitfully.

Somehow my talk is a bit different from the previous speakers in a sense that my work on these is more on innovation studies and economics and policy studies of technological change and innovation. I think the challenge is how to integrate these different kinds of, in a way, epistemic background together to address the complex issues in science, technology, and innovation. As you might know, some of the recent trends in science, technology and innovation policy, the first one is this innovation, how to encourage innovation because of the stagnation of growth since the oil crisis and then coming to the university industry collaboration triggered by the federal act in the US since 1980s and then the similar legislation policy introduced in Japan since 90s and also in other OECD countries. Particularly the emphasis is given to intellectual property rights and legal issues, and corresponding to that there are many changes in the legislation, regulations about university and also the status of university which now has become independent entity from the government. Basically how to encourage university-industry collaboration has become critical issues and still is a very important issue.

Then the second trends I identified is this societal term in a way, so these grand challenges, societal challenges, I think in Europe and also in the US this grand challenges is used and probably if you are a native speaker in English, the grand means something important, great, some kind of connotations. But in the case of Japan, we normally use these societal challenges, social challenges. As far as I understand, they are somehow trying to say something similar and then the background is that this increasing importance of societal issues which are not necessarily dealt with properly by private actors, so environmental issues, energy security, public health and poverty. Then these agenda has been addressed in many governments and also international organizations like OECD and other.

Just this is one example addressed by US National Academy of Engineering. They identified 14 grand challenges including environment, energy, health, server security and these kinds of issues. Also the UCL probably Jason will talk more about this one but the university as a whole tries to identify some key areas as grand challenges and then knowledge expertise, findings accumulated within the university should be integrated together to address some of the key societal challenges or grand challenges.

At different levels this agenda of how to deal with grand challenges and having impact has become very important and particularly in the context of UK, this research excellent framework which has been introduced recently explicitly mentioned that the reach and significance of impacts on the economy and society and culture. It has become very important criteria for evaluating university, so that this has been one of the backgrounds why the whole agenda of impacts utilizing science, technology and engineering into making impacts in society has become very important challenge. And this sustainability which includes all these kind of issues and then in this case also grand challenges include some of the more traditional, conventional components forecast observation but at the same time how to encourage innovation has become the key issue. Then in this case we need to integrate social science and natural, technological areas.

Perhaps this is just very simple solution but probably what we are trying to address is something going beyond the traditional dichotomy of basic research versus applied research. What we are trying to address is something called Use-Inspired Basic Research or Application Oriented Basic Research or Solution Oriented Basic Research. This is also applicable to sustainability science which I have been working.

And then coming to more into university, this is just one graph which shows that the relative importance of government laboratories have been somehow decreasing in the sense that university's role has been increasing, so this also invites some question about what should be the function, role of government laboratories in the background of this increasing potential of university research. So this is also the huge issue for many countries including this country and also the US where the military research has been so dominant in the past but then how to redefine this national laboratory is a big challenge.

Then just coming to the evolution of university missions and then what we see in recent years is this kind of emergence of entrepreneurial university which primarily focuses on economic commercial applications. That has been introduced in Japan by changing regulations, registrations about science, technology, basic plan, and also the university operation. But then there are some criticisms and concerns because of this primary or exclusive focus on commercial applications creates some problems. Probably what we could mention here is the two types of dilemmas as individual scientist and also systemic level at the innovation system.

Individual scientist means potential tradeoff between basic research and commercial industrial application which is somehow summarized as patents or papers. Then we could do a kind of sociological analysis of this, how the individual scientist can allocate their time and energy between the two. In the more systemic level or societal level, we need to consider kind of institutions which are appropriate or relevant for what could be called republic of science which is I think the Shibayama-san mentioned that more classical argument about the transparency, universality of these kinds of norms and concerning to science and at the same time we have this importance of enterprise of technology which is more commercial entity property oriented kind of activities.

Then coming to the third challenge, the third transformations means how to somehow address both at the same time research, education and societal contribution. Then that what we need kind of preliminary study started about 2 years ago or so trying to assemble some of the cases of how university stakeholder platform formed and operated to address innovation for sustainability. Some of the questions, this is still ongoing and we haven't yet found very significant answer yet but what kind of activities are important, what kind of incentives are important and what kind of outputs, impacts are made through this kind of activities for addressing societal concerns through these stakeholder platforms. So somehow we try to identify some of the key properties although this is very simplistic and somehow kind of exercising typology in these different kinds of activity. This is just for example, depending on the nature of universities, the nature of activities previously different and then some key examples which is undergoing in the case of University of Tokyo and then some of the functions we identified, the vision creation and also target identification and then scenario making and also at the same time data collection and individual technological development which are more conventional approaches and then impact assessment and legitimation in society. These kinds of activities somehow could be addressed by using this innovation platform and then some of the issues which I mention at the end of my talk.

Again that still there be tradeoffs between basic research and these grand challenges or societal challenges, particularly very pure scientific investigations and obviously that when you try to emphasize societal challenges the resources with somehow shifted from this conventional areas to these areas but then what are the impacts, implications of these societal turn in science, technology and innovation policy. Also integration in practice means that I think somehow today many speakers raised this risk assessment, risk management, and kind of joint fact finding. I think this is very, very important but somehow innovation also comes from rather a small scale incremental type of activities, so how these kind of activities can be linked to risk assessment, management type of argument, which are I think appropriate for rather big issues, GMO, nuclear, but at the same time innovations are happening at a daily level and incremental manner. Also methodologically speaking, today we have discussion about STS, framing, value issues, normative issues, and also sociology of science, I think Professor Shibayama examined behavior of scientist and also somehow close to my background which is industrial organization, innovation studies which is more about corporate strategy in the social structure, so market, the mechanisms and how these kind of different streams of intellectual traditions can be integrated methodologically.

Again the challenge is how the papers, patents and policy advice could be integrated ideally and how to deal with this the institutionally different spheres of public, science enterprises technology and community of practice.

So these are just questions I don't have answers but hopefully by increasing, deepening our collaboration internationally including University of Tokyo and then UCL which will be addressed by Jason in the next session, so I hope that this will be a very good opportunity to start these kinds of discussions. Thank you very much.

● Q&A / 質疑応答

松浦： ありがとうございました。まだ 5 分くらい質疑応答の時間あると思いますが、どなたかご質問ありますでしょうか。Rogers さん、先にお願いします。

Michael Rogers： Thank you. A very fascinating presentation by David and I'd like to ask a question about building consensus. It seems to me that in many policy areas you are faced with enormous inertia to change from the status quo and the only organization I know that has been successful in consistently seeking and obtaining consensus is Codex Alimentarius but it seems to me that many of the areas that you mentioned obtaining consensus requires remarkably effective chairman and I don't meet so many people who are able to do that.

David Laws： Two things that I hope to respond. One is that just to be clear that domain of consensus which is the question, what do we do here and it is not broadly what do we do and I think that matters because that's a little more practical domain. There is a kind of scope for negotiation really in working that out, but the other thing that – I guess the implication will be – so how do you get there. That is a feature of kind of practice that in which the key features of the people who lead that. They work for the parties so they are not hired by – they may be paid by the government but they don't work for the government. They work for the group of actors as a whole and at their behest. The rules, as I said, are that they come forward with that so the people, by getting access to that, they also start to become responsible to each other and for the outcomes. So usually it's the parties that produce the consensus with the help of the person leading. But that person leading is really trying to help them develop something that's informed because they don't want advice that's just something that they can agree upon but will really stand up, and stand up to a broad social scrutiny.

That scrutiny is brought into play because if you have to go back to your group and I have to go back to my group, we have to do that along the way; otherwise we reach an agreement and then we go back and they say, "Well, we are not going along with that." So I think it's partly the organizational setup and then the chairman or the – it is not really chairman in that case but someone facilitating, mediating, doing something more like that is really working to try to help that group build up through a sequence what that is and then the methods for that are what we can discuss those they become a little bit of discussion technique. Does that address? But it has to be given specific meaning. What this shows is now what consensus means in general but what this group said consensus was going to mean in addressing the problem that they faced. They wrote that and then had to live by the commitments they made which included provisions for revising this, who could revise the rules, how can you parties enter, all those kinds of things. Those were the rules they made and so you get down to the details of the institutional design.

Michael Rogers： This is a question for Masa. The panel took up stakeholder consensual risk governance and by implication effects on innovation. So all of David's examples were local, right?

David Laws： Yeah.

Michael Rogers： Right, all of them were local and the question here is that if you take lessons from David's discussion and then turn to national issues where there are concerns of a risk and how you address the risk will affect innovation. What lessons do you take form David's presentation on local to the management of risk, seeking if not consensus, at least a little more understanding at the national levels? And it's a question to both Masaru and Masa.

Masahiro Matsuura： Maybe I should respond in English because that will be easier. You are asking how we can extract lesson or interpolate lessons from the local practice to the national level. Right. Well, many of the cases I have been dealing with is more or less in a local small islands or community, fishermen community but if you – one of the major differences is at the local level we can easily identify stakeholders or key leaders that we have to define. And that's going to be in the negotiation mode. They try to strike a deal so that they can live together as a community, right. But at the national level, community is so dispersed and sometimes it's hard to identify who the stakeholders are. In some cases, like the debate about gun control, we often use the case of this gun control in the US, so some people believe that people are allowed to have guns and some people say, "No, we shouldn't have a gun." It's not much matter of negotiation, it's more about what the society should be like and it's not much a matter of negotiation but it's more about matter of deliberation and what the citizen ought to be, rather than "you being this, I being this, let's make a trade." So at the national scale of the level may be negotiation framework doesn't work and maybe more of the deliberative framework, maybe not just bringing in representative but rather picking up randomly sampled population of the individuals. So maybe I think that the difference in representation which actually David has written a chapter about representation in The Consensus Building Handbook, maybe that one.

Masaru Yarime： Thank you very much for very, very important question and to be honest I don't have answer at this moment but probably at the level of very small-scale regional initiatives by university then it might be possible to try to bring all the stakeholders involved and then try to put them together at the same physical place or opportunities and then to have kind of discussion or negotiation but if you go up the scale at higher, the city level, national level, international level obviously that it's impossible to bring all the stakeholders onboard and then having a direct discussion with them so somehow you need to have some kind of representatives and obviously there should be some political implication of who should be in, who should be out and how to pick up the right stakeholders. But in my presentation actually I didn't talk anything about the latter half of my prepared slide and which is about phosphorus management and in this case it's based on material for analysis which is national at the same time global. Then by using this kind of some common understanding of how materials flow through different stakeholders and then to try to identify who are the main important stakeholders, own the material flow analysis so that you could pick up some of the major ones and then to try to bring in at the national level.

In the case of phosphorus, we created a national platform by inviting some of the major players from different sectors, the agriculture, fertilizer industry, governments, and also the NGOs and also trying to bring link to the international global level platform which is emerging by linking Japanese, European, American platforms. In this case, I used this platform which is not so clearly defined in my talk but somehow some kind of arena where the major stakeholders can bring in, at least to know each other to share some of the knowledge, and in this case some of the basic data information about material flows and some impacts. This kind of information could be a basis for creating a platform and then bringing in some other major representatives come together. Although it takes time to have the honest and also frank discussion among them but I think this is just one of the examples of analyzing the platform and also implementing the platform, in a sense that a lot of universities such as also now doing, combining together this analysis as a researcher and also practitioner by joining in this kind of initiatives at the same time. So this is kind of one example which the university could be engaged in this societal challenges.

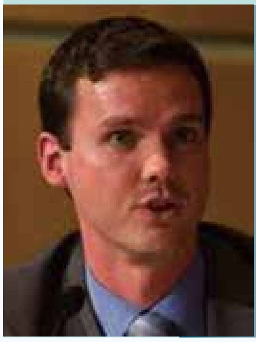
松浦：　最後に David のコメントで、このセッションは締めたいと思います。

David Laws：　Just two sentences, because it's an important question. One is I think, one design consideration could take as it was that if adaptation involves reframing and these cases involved that then what features of the case lead to that and there I would say it was the diversity. The actors, they didn't share perspectives, they didn't share the assumptions and a set of institutional rules that require them to confront those differences and that led them sometime to come to surprising results not one win, the other lose, but it's something new emerging. The second issue that your question raises is also then what might the institutional design question of how local and superlocal or higher level might be related in some kind of more articulated design that doesn't assign a problem to one level but actually where problems move across levels and that could be a key feature.

松浦：　他に挙手いただいた方もあるんですけれども、時間が結構押してしまいましたので、続きの

ディスカッションは、最後のパネルディスカッションのところでもう少しできればと思いますし、そこの最後で皆さんから質問を受けられるようにしたいと思います。最後のセッションとして、教育関係のセッションで、最初は Blackstock 先生から UCL のお話をしていただければと思います。

• Keynote Speech 4 / 基調講演4



ジェイソン・ブラックストック（ユニヴァーシティカレッジロンドン）

Jason J. Blackstock (Department for Science, Technology, Engineering and Public Policy, University College London)

"Understanding and Strengthening Science, Technology, and Engineering Knowledge within Public Decision-Making Processes"

「公的意思決定過程において科学・技術・工学の知見を理解し強化する方法」

Jason Blackstock： *Konichiwa.* First, let me begin by saying *arigato gozaimasu* to Yarime-san for the invitation and to Matsuura-san and Shibayama-san and of course Shiroyama-sensei for the invitation and the opportunity. Over the past couple of days, I have had the pleasure and the opportunity to get to understand a bit more about the STIG program and as Professor Shiroyama had mentioned the STIG program is now 2-3 years old which makes it almost twice as old as the program that I will be talking about at University College London, the Department of Science, Technology, Engineering and Public Policy.

Much of what I will talk about today, I have actually been editing my talk quite a bit over the last couple of days as I learned more about the program, the STIG program and also due to other meetings that Masaru was kind enough to organize about the context within Japan to try and draw out the most important aspect. What I am going to talking about is the central mission that our departments at UCL is attempting to accomplish and some of the mechanisms that we are trying to build in order address many of the things that have been discussed today. The innovations going on at the University of Tokyo in this space are very related to the sorts of programs that we are building.

Our core mission in the department is summarized here and I will just read it out briefly, to support and improve how science, technology and engineering knowledge is mobilized in support of public decision making around the world. I will talk in a couple of moments specifically about what we mean by knowledge mobilization and why we believe that’s an important aspect. But there are three pillars to the work that we are building, education program, research program and a policy institute that I will talk a little bit more about and because the design of the policy institute goes very much to the heart of how we begin to build bridges from the academic community and the research that we do in this environment and all of our science, technology and engineering knowledge and the public decision making environment, the policy environments. Now, these are all just to draw a bit more of a connection to the STIG program now so that we can talk later about the international collaborations that are possible. The STIG program, I just drew these figures from the STIG website but at the core of STIG is this concept of the education, research programs being interconnected, they are very much the same as ours, but over the past couple of years at the University of Tokyo there is also a program which I came to know over the past couple of days PARI, the Policy Alternatives Research Institute that has very strong connections with the policy community in trying to link between academic knowledge. And that's very closely related to the policy institute that we are trying to build within our program.

Now, before I start talking in detail about these programs I want to talk a little bit about our motivation and how we are thinking about the interface between STE and public policy and why we think about it the way we do. We have been talking today both about innovation systems and the importance of science, technology, and engineering in innovation in the R&D drive, but also about the public sector and public policy implications of a lot of science and engineering and both of those are very much at the heart of how we think about this interface, what we are trying to build at the department. So, to begin with for the rationale well we have talked quite a bit about innovation and the opportunities of innovation to deal with science and technology problems. We cannot forget that when the governments are paying for so much of the R&D, they are doing so because they expect there will be a benefit to society in terms of economic growth and prosperity.

Now, this is just a simple slide to illustrate that that since 2008 in the financial crisis, after the financial crisis when governments were slashing budgets across the board one thing they did not slash but rather increased investment in across most of the OECD countries was investment in research and development with the expectation that this would help reverse the trend within the economy that had come about due to the economic crisis. You can see that from 2008 to 2011 the grid in blue, there is increases almost across the board for all countries in the investment with the rationale that the more investment in R&D, the more economic growth will be returned at the end. Now, in the title of our department we do not have the name, the word, innovation that is something that is within the STIG program but it's not explicitly something that we put front in the center but that doesn't mean it's not there.

One of the important rationales that we have is a belief that underpinning a successful innovation ecosystem needs to be the reliable mobilization of STE knowledge into both legislation and regulation environment to enable the environment in which innovation can take place. The examples earlier on by Professor Oye illustrated quite well the value for – an adaptive governance approach of having good mechanisms that bring in technical knowledge from the examples that he raised, biotechnology and pharma, the importance of having good relationships with government so there can be learning mechanisms. Without strong relationships between the STE knowledge foundation and the regulatory environment, there cannot the sort of enabling ecosystem that can support the adaptive governance and adaptive planning that Professor Oye was outlining. So our belief is what we are not focused particularly on for example policy for R&D budgets, we are very much focused on enabling environments in what is necessary in terms of those knowledge system to support the innovation ecosystem.

Now, of course there are all of the other challenges, many of which we have talked about from infrastructure, to energy technologies to communication technologies where governments are heavily reliant on their ability to get knowledge from the Science, Technology and Engineering, the STE communities in order to understand future trends. Thanks to Yarime-san, we had a meeting today with the Science, Technology and Innovation Council Member at the cabinet office, Professor Harayama and we spoke about the value and importance of future's foresight and horizon scanning around these sorts of technology, across the whole array of technological arenas, because of the importance of these changes that the changes in technologies for governance process is going forward. Now, this is equally true when we start talking about the international context. I am just going to draw a few examples that relates to work that Yarime-san and myself do in the sustainable development or sustainability arena.

In just 2015, this coming year, there are three crucially important frameworks, international frameworks being negotiated or re-negotiated ranging from the setting of the sustainable development goals, building off the Millennium Development Goals, the Hyogo Framework for action on resilience and planning for disasters and particularly natural disasters and preparation and of course the UN convention on climate change.

Now, all of these represent the sort of brand societal challenges that Masaru had mentioned and the second motivation and rationale for how we are structuring our programs is based on the fact that STE knowledge mobilization enables our societies to tackle this grand challenge. Many of the conversations earlier on that we had from David and from Michael and from Ken, all dealt with issues of credibility, legitimacy and salience. Now, I don't have time in the talk to go into that framework in great detail but it's a framework that colleagues at Harvard such as Bill Clark have developed to think about how we engage citizen perspectives, the importance of having conversations that encourage the legitimacy of the knowledge, as well as the salience of the knowledge to make sure that it is both engaged with the concerns of society, but also relevant to the issues upfront. This is very much at the heart of the sorts of programs that we are attempting to build.

Now, the other piece of background information which is quite important is if this is our framework the one thing that I should say I well, these are principles that are guiding the way in which we are shaping our programs, they are also hypotheses. When Vannevar Bush in the 1940s gave his speech and wrote the paper, "Science, The Endless Frontier," he stated that investment in scientific and technological and engineering research will create wonderful value for society, but if you read that in detail, I do this with my students every year, you ask them how does he say it's going to happen and he actually he doesn't say how it's going to happen, he just says it will, trust us, we will invest and it will happen. And of course, we have a belief that strong investment in the infrastructure, the social infrastructure, the institutional infrastructure and skills training enables the mobilization of scientific knowledge within decision making, public decision making, will support both our ability to tackle grand challenges and innovation ecosystems. Now the question is how? What are mechanisms? What are the sorts of operational processes that we can use to effectively mobilize knowledge? We heard some great examples earlier on about specific mechanisms. We had some presentation in particular by Hirakawa-san, talking about different mechanisms for public engagement for example, but all of these mechanisms or attempting to address how we build, how we most effectively use our science, technology and engineering knowledge within society. And the hypothesis underpinning these is that if we build these mechanisms more effectively we will produce better innovation and we will tackle the grand challenges. So part of the research program, these principles, these motivations also define the core of our research programs within the department which I will come to in a little bit.

Now, alongside the creation of our department, or actually predating or motivating the creation in our department is the fact that there has been quite an evolution in the landscape in the institutional frameworks for the interface of science and public policy over the past two decades. Particularly in recent years, we have seen the development, particularly at the national level but also more recently at the international level of science advisors. We earlier heard about Anne Glover, the creation of Anne Glover's post a couple of years ago in Europe is the European Chief Science Advisor, and the unfortunate disillusion of that post now that the new president of the EU Commission has changed and has changed their mind.

Now, in Auckland, New Zealand, in August of this year, Sir Peter Gluckman, the Chief Science Advisor convened a major conference called "Science Advice to Governments." Now, this pooled together 62 different countries, Chief Scientific Advisors or people playing similar sorts of roles from around the world, both developing and developed countries to discuss their practices, their mechanisms for doing it. That is actually the first time that that network of Chief Scientific Advisors has come together at that scale. At present, the OECD is running a study looking at how these networks work and actually professor Dr. Arimoto-san and Dr. Sato-san at GRIPS are part of that important study, mapping out the institutions that different countries have and the frameworks that they have. And more recently Ban Ki-moon assembled for the first time last year the Science Advisory Panel to the Secretary General of United Nation.

Now, the reason I go through these examples is even in the United Kingdom where the science advisory system is often thought of as being advanced, we can often forget that this science advisory system up until the middle of the 1990s consisted primarily of one government chief science advisor and a relatively small office of support. It was only after cases of BSE and foot-and-mouth and the government changed – realizing that evidence informed policy making is a very important foundation for improving the way they dealt with a whole range of issues that they began the reaffirmation inside the UK of the structure that they use. Today, almost every government department in the UK has its own departmental chief science advisor. That means there is now a network of science advisors across the entirety of government but these science advisors are relatively new in their post, most of the time these are individuals with strong scientific backgrounds who are put into the post but without necessarily any experience in government or public policy. And there have been quite a few examples of individuals coming into that post and within 1 or 2 weeks saying something publicly that the minister had to take into the back office and say don't do that again. Partly because we do not have a large number of scientists and engineers with significant experience in the public policy environment, particularly not at the senior levels these days. The reason I go through and illustrate this is to say this is a rapidly evolving context. We don't have a lot of knowledge or understanding of what the best frameworks for these are.

Now, let me just give another couple examples before moving on. The second examples that I'll give are ones that where these are focused very much on advisors, there are other systems that are focused more on knowledge synthesis or evidence synthesis to provide a broad array of evidence to help support decision makers. It's not an advisor that stands beside or behind the Prime Minister and gives advice but is rather a broad array of institutions designed to summarize the evidence and the knowledge and put it forward. The IPCC is one everyone will know about and I won't talk much about it but we often forget now that the IPCC is only 20 years old and at 20 years there is only now one other attempt to replicate that IPBES which is focused on the ecosystem services and biodiversity, and in that evolution from IPCC to the creation of this new entity, IPBES, they have started to think about new mechanisms for stakeholder engagement for ensuring there is engagement of local communities and the co-production of knowledge. So new mechanisms are being introduced now in part because the IPCC is a fairly rigid process, while it was created 20 years ago there has not been a very significant evolution of the structure of how it works whereas there are a lot of questions about how we could do this better? Are there opportunities to design it better? There is, more recently in the UK, I'll just use a national example, something called "What Works Centers" and this comes out of the concept of making evidence useful. These are a set of centers that have been set up across healthcare, education policy and a range of other social policies, policing and crime, for example, with the objective of being able to synthesize the information and provide advice to practitioners and to policy makers about what the evidence says is the most effective course of action.

Now, these are experiments, we don't have a good framework that says if you set this up like the IPCC it will definitely work because as we know the IPCC has been very effective at summarizing the knowledge around climate change but we haven't solved the problem. There are big gaps between the ability to summarize knowledge and the ability to mobilize it into the public decisions to support better public decision making.

The last thing I'll just say on this to set the context is the fact that we've already talked a little bit about city and local government, or city in local context and this should actually say city, local or state in the context of the US because I just will go back to Ken's example for a moment when he was talking about the – or responding to the conversation about Ebola and he was talking about the fact that actually there has been a travesty of some cities or states setting policies about how to deal with healthcare workers coming back into the United States from Africa which has been a disincentive for them to go out. One question would be that right now those city and local governments are relying on national organizations like the CDC to provide them advice, but there is one CDC and the CDC is understandably quite focused on trying to deal with the Ebola situation itself. They don't have time to pick up the phone for every city official who wants to call and talk about the Ebola situation. There is not that level of trust that is built necessarily when you look at a science advisory system and you have a trusted science advisor standing beside the decision maker. So one big question that we are looking at within our department is what would these sorts of institutions look like at the city and local level from mobilizing advice.

Now, this is the context that has evolved over the last 10, 15, 20 years in many cases, and it leads to some of the fundamental questions that we are trying to deal with in STIG, and particularly when thinking about building capacity for effective decision making we think about it, breaking it down into three separates things, much of which we have actually had the conversation about already. First is the institutional structures. On the previous slide I was showing two different models of one science advice, one evidence synthesis and actually there are a range of other models. And I did not do justice to any of the public engagement activities or the other type of adaptive governance activities, there are a whole range of potential frameworks out there, but they are poorly brought together, synthesized and examined comparatively to find out which institutional frameworks and which practices would work better in which context. There is both the institutional level of how do you structure science advisory systems or evidence synthesis systems but also what are the practices that make them more effective or not. During the break Michael had mentioned to David that in some of these context that David was talking about, it sounds like you need a strong chairman in order to be able to make the sort of negotiations between different parties work, you need some sort of a broker in order to be able to facilitate that and that's an open question, I don't – we don't – but there is a question of whether or not we can build up an understanding of these practices to know when they will be more effective and why because policy context around the world would like to have it. But of course in order to run the institutions or design the institutions and implement the practices we also need huge amount of skills. Going back to the chief scientific advisor example, we don't have skills training for science advisors who are plugged out of a laboratory and suddenly put in a government department which operates just a little bit differently. When you start doing experiments on bureaucrats they are not necessarily very happy with you, understandably so. And of course as we focus on trying to understand institution practices and skills, this is for both the science, tech and engineering and public policy communities. These are two very distinct communities with their own drivers, with their own backgrounds and we need to look at this from both sides.

STEaPP and actually STIG and PARI in the context of University of Tokyo are experiments on the academic side but equally there are experiments like the chief scientific advisor networks going on the policy side and we need to be aware of it and understand how they map together, both of them together.

Now, in the interest of time, I am going to go through just very quickly some of the things that we have been doing within STEaPP to begin to address this, to begin to map this out.

The aims are illustrated by our mission to educate current and future generations of both scientists and engineers and policy makers at how to interface , to improve our understanding of the landscape of this interaction through research that is coproduced with policy communities. We haven't talked a lot about this today but this idea of having a strong interaction between policy communities and research communities at the early stages of research design is very important. This connects very well again with the sort of adaptive planning approach that Professor Oye was outlining, this idea that you need early engagement between policy communities and scientific communities so that you can identify where there are opportunities to address some of the issues upfront and early on.

And finally in the policy institute, our goal is to develop and test models on how well this works. We don't want to just study the practices and the skills, we want to set up a living laboratory that interfaces between the policy communities and academia, much like PARI so that we can run the experiments and understand better how these models work in different environment. One key issue that Masaru had identified though is there are challenges with the cultures and incentives that exist within both public policy decision making and within academia. As an academic I have to publish papers, if I don't publish papers I am not going to be relevant and I am not going to be relevant to my community, but those papers are judged by my peers of scientists, they are not judged by policymakers, whereas from a policy context the ability to address the issues day-in, day-out that are coming so fast and furious is the key driving force and the tensions that exist there manifest throughout all of these aims in these goals and all of the programs that we are trying to build. This could itself be a symposium that we could talk through and they well be worth doing that to try and understand how the cultures and incentives misalign at times and what we can do with building the institutions between them.

Within our education programs, this is an array of our education programs and I'll skip through these relatively quickly and not talk about them in any detail, but we have a core focus on experiential learning and the focus on experiential learning is based on the idea that you can't learn to do this interface from reading a textbook or from having a lecture. You can only learn about this interface, you can only learn about policy communities by having the experience, you can only learn about trying to engage and mobilize science, technology and engineering knowledge by actually engaging at that interface. So things like our Masters of Public Administration program which is brand new this year, it is an MPA in science, engineering and public policy. The students have as part of it one-third of their time at UCL is actually spent working with a real world policy client, this is the World Bank or the department of energy and climate change so that the students have the experience trying to broker between academic knowledge that they are able to get from within the classroom and from within their advisors and the policy environment itself. Part of that is to build up the experience of the next generation who will therefore have the ability to move back and forth and run some of the engagement processes or the dialogues that are necessary so that they develop the skill sets, but part of it is also because students can become are often more able to willing to break down some of the incentive barriers or some of the cultural barriers between the two environments in order to effectively mobilize knowledge. The students themselves can be very valuable vehicles of change and we do this across not only the MPA program, the graduate program and this is just the details of the graduate program I am happy to talk about that in more detail. We are also launching a doctoral program in order to do very similar things. We have a Ph.D. program which is for sort of future academics, we are also launching a Doctorate of Public Administration which is for people who are practicing in policy environments to come and spend half of their time, not all of their time but half of their time within the academic context to be able to get a doctorate of practice effectively at mobilizing this sort of knowledge of this interface.

And we're also doing it at the undergraduate level. We run a program which is entitled "how to change the world" that was my dean's idea to call it something that ambitious, but in this program we have over 500 students for a two-week intense program where a whole range of real world organizations present challenge problems to the undergraduates and they work in small designed teams of five or six people for a two-week period to come up with innovative ideas to address those challenges. And from the first year alone when we ran this, we had a range of these organizations saying can I do this again next year and would you mind sending some of those student groups to us to present the ideas, because the students even at this undergraduate level can be very effective mobilizers of the knowledge into a policy context where they are facing challenge.

I'll skip through the research because essentially the research builds very much off of this framework of institutions practices and skills across both communities and just briefly say that the goal that are range of research groups emerging such as science advice to find broadly risk and innovation leadership, etcetera. And of course Masaru had already mentioned the fact that at UCL we do have these topical grand challenges, human well-being, global health and within the department we are attempting to ensure that we have a metric structure where when we begin to look at these practices and these institutional frameworks and skills we look at them across a range of different topical arena not just local, national and international but also across sustainability, urbanization, development, humanitarian response so that we begin to develop a map, a comparative map of where – in which context do these practices become more effective. Ken's questions earlier about how do you take engagement practices at the local level and scale them to the national level are exactly the sorts of questions that we want to ask for a whole range of processes and equally that sort of the inverse question of how do you take a national level CSA process and scale it down to a local level. But of course the answer may be different if you are talking about sustainability versus development, whether you are talking about a developed country context or developing country. So having that comparative framework is quite important.

And the final thing in terms of STEaPP to talk about is the policy institute. I am not going to talk in detail about what we're doing here but when I explain this, when I was originally developing the framework for the department, I went to my dean and he is a dean of engineering, he is a computer scientist by background and an engineer and he was saying, "Well, what is this thing? I understand education, I understand research but tell me what a policy institute is and tell me how are you going to staff it?" And I responded to him by saying, "Well, in engineering you have big laboratories, right, you've got big workshops and laboratories and you staff them with technicians, you staff them with technicians because oftentimes if you take a professor in there, the professor doesn't have time to maintain the equipment and you need that technical expertise to be able to help with mobilizing that infrastructure in order to deliver the value" and he said, "Ah, yes I understand that" and I said, "Well, take another example. When we look at the interface between university and business and private sector we build things like business development and technology transfer offices that have become very effective in the last 30 years at building relationships between private sector and university." He says, "Yes, I understand that as well." And the question that I posed to him is "Where is the equivalent on the public sector side?" And at the heart of the policy institute became this idea that we need a team of policy officers, non-academics who aren't motivated by or managed or driven having to publish papers all the time and people who have significant experience both in policy and in the academic environment in order to act as the knowledge brokers, in order to act as the interface, the go between , just like chief scientific advisors in the government have become a bit of an envoy out to the science community to help bring knowledge in, this sort of role and again this is similar in my understanding to what PARI has emerged into, it becomes an interface of the university reaching out with its knowledge to the policy environments to support them.

Now, there are lots of questions about what should our programs look like across, executive and professional education, policy consultancy, etcetera but these are questions that we want to address in an international context. So the final point that I will make connecting to what Yarime-san had said is I believe there is a need for an international academic network, there is already the beginning of emergence of things like the international CSA network, chief science advisor network and other international conversations like the IPCC but if we can begin to build networks between places like STIG and PARI and STEaPP and others in other parts of the world, we can begin doing more of a comparative mapping of understanding the institutions practices and skills that are more effective in different environment. We also can look at how we are trying to education both the scientists and engineers of the future and also current generation and the same on the policy side and compare best practices and look at the opportunities to compare curriculum and compare examples and compare case studies, symposiums like this or wonderful opportunity and I am hoping we can do more in collaboration.

And finally there is the sharing of best practices between these sorts of policy institutes, things like PARI, things like the STEaPP policy institute and hopefully 15, 20 years from now the interface between academia, between universities and their policy environments are as well developed as the business development and technology transfer has become over the last 30 years. There will always be more we can do and learn but the more we can share the best practices, the better. And finally we set up the department last year on August 1st, 2013 and there were three of us at that time, we have now grown to be – this is not even all of us anymore because it's out of date by 2 months now, but the team has grown quite quickly and I have the distinct honor of working with such tremendously brilliant people and their support has been invaluable. So with that I will say thank you very much for being here. Thank you.

松浦：　ありがとうございました。では、最後に代表の城山先生のほうから、東京大学で行っている教育プログラムのお話をさせていただきます。

● Response Presentation / 応答発表

城山 英明（東京大学公共政策大学院）

Hideaki Shiroyama(The Graduate School of Public Policy, the University of Tokyo)

城山： それでは、最後に私の方からお話しさせていただきます。今、Blackstock さんに UCL のプログラムの内容と、それからそのベースとなる考え方のようなことをお話いただきましたが、今度は我々の STIG の教育プログラムの概略と、成り立ちの経緯や考え方の特徴のようなことをお話させていただき、先ほどお話いただいたように、交流可能等かということを考える材料にできればなあというふうに思っています。

最初は、プログラムの中身の説明をかなり書いていたんですが、少しお話をうかがっていると、中身の細かいことというよりは、むしろ考え方ですとかどういった経緯でいろんなことをやり出したのかっていうことを、少しお話したほうがいいかなあと思いましたので、お配りしたものとは少しスライドを足して変えています。

もともと、UCL のプログラムは、まさに去年始まって、すでに先ほどお話したように、すごく大きな話になっているということです。一方我々のプログラムは、かなりインクリメンタルなというか、徐々にこういうことをやってきたというところがあります。もともとのきっかけは、2004 年に東大で GraSPP、公共政策大学院を、経済学部と法学部でジョイントベンチャーのような形で始めたわけです。これはある意味では経済と法律という限定した分野ですけれども、学際的に、かつ実務の人を巻き込んで来ようと。実際に実務家の方に教員になってもらったり、実務の人を巻き込むプロジェクトをいろいろ始めたというのがそもそもの経緯です。

ある意味では、2004 年にそのようなかたちで始まったんですけれども、その後いろいろなプロジェクトをやり始めます。例えば、民間企業の寄付金による、エネルギーと地球環境についてのプロジェクト、SEPP（Sustainability of Energy/ Environment and Public Policy）というプロジェクトがあります。その後、I2TA という、日本でテクノロジーアセスメントのようなものがどういうかたちであり得るのか、どういう手法が使えるのか、あるいはどういうかたちで制度化が可能なのかというようなプログラムも行いました。

これは 2008 年ですけれども、海洋アライアンスというプログラムを始めました。これは、むしろ工学系、農学系、理学系の先生方と公共政策大学院で、法律の人と政治系の人が組んで、部局横断型教育プログラムを作るということを始めました。

2010 年には、これは小規模なんですけれども、JAXA、日本の宇宙航空研究機構の協力を得て、「宇宙開発と公共政策」という授業を始めました。その後、例えばヘルステクノロジーアセスメントに関するプロジェクトなども行っています。要は、もともと法学と経済の話で、学際的かつ実務を巻き込むということをやっていたのが、理科系の話を巻き込むような話をインクルメンタルにやっていったという経緯なんです。ある意味ではその延長上で、STIG プログラムの発足としては 2012 年、そして今年で 3 年目になりますが、科学技術とイノベーション政策に関わる包括的な研究教育プログラムを行っているというのが、大きな流れであります。

そのなかで、先ほどちょっと触れていただきましたけれども、東大に PARI、政策ビジョン研究センター（UTokyo Policy Alternatives Research Institute）があります。日本語と英語の名称がずいぶん違うんですが、これはこのセンター設立時の東大総長が、日本語の名前を気に入っていたの

でこうなりました。それで英語名は、自分たちの目指すことにしようといって、Policy Alternatives Research Institute とした。つまり、1 つのビジョンを押しつけるというのではなく、政策の選択肢を議論して、それを社会に問うていきましょうという志として、こういうものを全学機構として 2013 年にパーマネントベースで作りました。

私自身は今、公共政策大学院の院長をやっていますが、その前 3 年ぐらいはディレクターをやっていて。ディレクターという立場もありますが、私個人としては、ここに科学技術ガバナンスのグループとか、複合リスク・ガバナンスの研究を行っています。これらは中身はそれぞれかなり重なってくるところがあります。こういった、教育の部局でやっていた話と、大学の中で教育というよりは、むしろ社会発信でやってきたことを並行して行ってきたというのが経緯かなというふうに思います。

（図示）字がたくさんあってなかなか分かりづらいと思うんですが、我々の STIG のプログラムもその 1 つです。我々のプログラムはここにありますね。実は、このプログラムは複数の拠点大学が連携して実施しているプログラムであります。GRIPS（政策研究大学院大学）が中心拠点で、それ以外に経済、経営的な側面の拠点校としては一橋大学。あるいは、九州大学はアジア地域のリージョナル・イノベーションを主にやっています。あと、メディカルを中心に、メディカルと ELSI、倫理や法的な問題、あるいはコミュニケーション、ここはまさに平川先生がからんでいるところですが、大阪大学と京都大学と、これら 5 つぐらいのグループでやっているわけです。

もともとのアイデアはというと、先ほど Blackstock さんのお話のなかで、リーマンショックの後、R&D のインベストメントが各国で増えているというお話がありました。ある意味ではこれも同じようなところがあって、増えていったときにそれをどうやって正当化するのかと。ある種のジャスティフィケーションをしないとなかなかそれを維持できないという、政策当局的な意識というのが背景としてあったというところがあります。

より短期的には、当時日本は民主党政権だったわけですが、ある種の行政改革といいますか、事業仕分けの中で、科学技術政策というのはお金がかかって成果がないだろう、あるいはなんでこんなに予算を使わなきゃいけないんだっていうことが取りざたされました。例えば、スーパーコンピューターのプロジェクトが話題になったり。それで、ちゃんと R&D 投資をするエビデンスがほしいというのが、直接的な動機となって始まったところがあるだろうと思います。そういう意味では、きちんと評価ができるようなデータを作るということが 1 つですが、それだけでなく、単にエビデンスを作ればいいというだけではなくて、エビデンスを作るということと、政策形成のプロセスをどういうふうに運営していくのか。異なるコミュニティのインタラクションをどうするのかということも大事なので。データのエビデンスの話とプロセスの話を両方見るということが、プロジェクト全体としては謳われたわけです。ただ、短期的にはエビデンスをちゃんと作れと。そうしないと、仕事してないじゃないかと、そういう批判は常に受けることになります。先ほど松浦先生が紹介された RISTEX のプロジェクトも、このリサーチファンディングです。それからデータは政府系のいろいろな研究所が中心になっていますが、基礎的研究や人材育成が、先ほど申し上げた 5 つの拠点によってなされてきたというのが、このプログラムの大枠であります。

そういうなかで、STIG の基本理念ですけれども、分野横断的、インターディシプリンな教育プログラムです。ポイントはプロセスとエビデンスを両方見るということで、そこは先ほどのお話をうかがっていると、すごく近いなという印象を受けました。エビデンスを作るというのは、1 つの焦点だったんです。例えば経済評価とか、あるいは実際にどういう成果ができたのかというのを、ビブリオメトリクスできちんと分析するというような。そういうエビデンスを作るというのが、1 つの焦点であっ

たのは確かです。ただ、たまたまこの場合には、公共政策と工学系が一緒になってやったということもあって、エビデンスだけではなく、プロセスの問題をきちんと見ましょうというのが、1 つの特色になっています。ですから STIG には、Governance というキーワードをプログラムタイトルに入れています。あるいは、エビデンスがプロセスでどう使われるかという、このインタラクションをちゃんと見ようということになっています。

これは全体の構造ですけれども、公共政策と工学系研究科が中心になって、他に例えば経済学、法学、政治学、医学部、それから情報学環ですね。駒場にある総合文化研究科にも入っていただいていますし、先ほどの政策ビジョン研究センター、PARI などとも連携しています。学位を出すわけではないですけれども、全学でいわゆる修了証、サーティフィケイトを出すプログラムとして実施しています。

細かいことはここでは触れませんが、カリキュラム的にもプロセスの話とエビデンスをきちんと作るのと、両方習得するような仕組みになっています。先ほどのエキスペリエンシャルともつながると思うんですが、共通のコアになる科目というのはケーススタディで、異なる分野をバックグラウンドにもつ学生が一緒になって、かつ、実務の現場の人にも来てもらって、ある種のグループワークをやるという授業を必修科目にしています。

もう 1 つの特徴は、工学系の学科、医学系の学科等を巻き込んでいるので、フィールドスペシフィッククリサーチ、分野別研究科目と書いていますが、例えばパブリックヘルス、あるいは情報関係や海洋関係、宇宙など、そういう各分野については、むしろ理科系のいろいろな人たちを巻き込んで展開していることです。必ずしも社会科学系でそこまで個別に専門化している人はいないので、理科系を巻き込むことでこういう授業展開が可能になっているのが、1 つの特徴かなと思います。

現在は、比較的いろいろな学生を対象にオープンに、とりあえず履修登録をしてくださいというかたちで進めています。初年度は 92 人の学生に登録してもらって、今年は 77 人が登録し、トータルの登録者が 153 人います。授業出ている学生にどんどん登録するよう勧めたので、若干インフレ気味のところはあるんですが、そのなかで、特に興味のある人には継続的に関わってもらうというようなかたちにしています。

通常は修了に必要な単位取得に 2 年かかることを想定しているんですが、1 年目の 2013 年度に 6 名が修了しました。この 6 人は卒業後就職をして、文部科学省や鉄道会社、シンクタンクと、それなりに関係のあるような進路に進んでいます。今後、できれば毎年 15 人ぐらいを目標に、サーティフィケイトをとる学生を育てていきたいなと思っています。

実務の現場とのつながりという意味で言うと、「ポリシープラットフォームセミナー」と題して、毎回省庁の現場の人や海外の研究者に来ていただき、実務とのネットワーク、あるいは海外とのネットワークをいろいろなかたちで作っていく取組みも行っています。過去 2 年ぐらいの間に 29 回実施しましたから、毎月 1 度以上はやっているということになろうかと思います。

もう 1 つは、先ほどお話したように 5 つの拠点大学で実施していますので、毎年夏には全国の拠点から学生と教員が集まって、リトリート合宿をしています。最初の年は筑波で、この夏には兵庫県の淡路島で、来年度は我々東京大学が企画することになっていますが、名古屋での開催を予定しています。いろいろな大学、異なるバックグラウンドの人が来るということのメリットと、それから、実際の現場に行くという目的もあります。名古屋では三菱重工やトヨタのご協力も得て、そういった現場を見学したり、素材にして議論するようなことをやりたいなと思っています。

それから、国際的なネットワークです。これはいろいろな形態があり得ると思うので、まさにこ

こはいろいろ考えたいわけですが。現在進めているもので、去年から始めて今年も計画しているのは、Rathenau Instituut というオランダのテクノロジーアセスメントの機関と、ドイツのカールスルーエ工科大学の研究機関と一緒になって、根拠に基づく政策フェロー (Fellowship for Evidence-based Policy) があります。つまり、政策の実務をやっている人たちが、まさにエビデンスをどう扱うかや、ポリティクスとエビデンスの相互作用など、具体的なケースをベースに議論するという場です。昨年の第一回は東京大学で開催し 30 人ぐらいが参加しましたが、今回は先ほどロジャースさんにも触れていただきましたが、2 月にベルギーのブリュッセルで開催を予定しています。

以上が STIG の成り立ち、あるいは実施している内容の経緯になります。さらに付け加えさせていただくと、STIG というのは修士、博士、いずれでも履修できるプログラムですが、もう 1 つ今動いているのは、博士レベルでの分野横断的教育プログラムで、実務に関わるようなことを習得するというプロジェクトを、これも去年から始めています。考え方としては、先ほどの鎗目さんのプレゼンにかなり近いんですけれども、大学という場で、テクノロジー、サイエンスの話とポリシーインスティテューションの話をちゃんと組み合わせて、ソリューションをプロポーズするようなトレーニングをしたほうがいいだろうと。特に社会科学系もありますが技術系、あるいは科学技術系の人のトレーニングとして、こういうことを埋め込んだ学位プログラムをちゃんと作りたいというのが背景にあります。いろいろな専門分野を基礎にしつつ、さらに水平展開力といいますか、ある程度俯瞰的にそういったものを見たりとか、あるいは全体をインティグレートする。あるいは、実際にプラクティカルにアクションにつなげるということも含めてプログラムを組もうとしています。これは学位プログラムですが、最後には学位をそれぞれ出すんですが、プロセスとしては毎年学生 25 人ぐらいを募集、部局横断で運営しますので、いろいろな工夫をしています。例えば、実際にプロジェクトを企画するというのをやっていて。なるべく現場に入っていくプロジェクトを企画して、2 カ月ぐらいは海外に行って研究するようなことを、博士論文を書く場合に求めるということをやったり。またセカンダリーアドバイザーをつけるなどの工夫を積極的に取り入れてやっています。

分野としては医療、エネルギー、航空宇宙。さらにレジリエンスやリスク、こういった分野を専攻している学生を集めています。これは、STIG とほぼ重なるようですが若干ずれていて。より幅広いということもありますが、こういったいろいろな部局をベースにやっているということです。そういう意味でいうと、修了証のプロジェクトとしてやってきたんだけれども、先ほどもちょっとお話のあった博士レベルの人材育成をしています。ただ、現時点で博士課程は絶対的に理系学生が多いので、このプログラムも公共政策が幹事部局をやってはいますが、学生の 7 ～ 8 割は理系で、2 割ぐらい社会科学系の学生が混ざっているという感じです。ちょっと長くなりましたが、以上で私からのご報告とさせていただきます。ありがとうございました。

● Q&A / 質疑応答

松浦：　あと、1 問くらい質問とかコメントがあれば受け付けますけど。

参加者：　ありがとうございます。どちらかというと IPCC に興味があった単なる一般市民で、こんな時間を使うのは申し訳ないんですが、1 つだけ質問させてください。私が今日うかがった範囲で理解した範囲では、Joint Fact-Finding というのは、利害関係者間で共通認識した議論の前提のようなものであって、どちらかというと裁判所の事実認定とかそういうものに近いのかなあという、私なりの理解としてはそんなふうに理解いたしました。

質問ですが、科学エビデンスが十分でない場合に、どうやって Joint Fact-Finding を、議論の前提を見つけ出したらいいのかというのが 1 つ目の質問です。2 つ目の質問は、科学エビデンスが十分でない場合に見つけ出した Joint Fact-Finding が、これは科学的なエビデンスとは違った、議論の前提としての Joint Fact-Finding なんだということが区別して利害関係者に提示されるのかどうか心配になっています。区別されないと、なんとなく一般市民としてはそれが混同されてすり替えられてしまったりすると、なんだか騙されたような気がして、科学の信頼を失ってしまうのではないかという不安を抱いております。

具体的な例としまして、先月起こった御嶽山の水蒸気爆発があると思うんです。科学的には、マグマ噴火は予測できるけれども水蒸気爆発は予測できないというのが、現在の科学技術のレベルです。分かっていることは、水蒸気爆発の前には火山性微動が起きるけども、火山性微動が起きたからといって、必ず水蒸気爆発が起こるとは限らないと。こういったなかで、全国の火山の温泉保養地の観光地の警戒レベルを決めなくてはならないとします。そうすると、微動が起きたからといって警戒レベルを上げると、全国の観光地の温泉街が干上がってしまう。そんな問題が起きた場合、どうやって Joint Fact-Finding を決めて、なおかつこれは議論の前提であって、本当は科学エビデンスとしては前回 1 回ぐらいしか水蒸気爆発したことないんで、ほとんどエビデンスがないですよと、そういうことを正直に言ってもらえるかどうか、そのへんをお伺いしたいんですが。

松浦：　はい。分かりました。この前のセッションの話についてのご質問ですね。

David Laws：　Thank you. I'll try to address maybe Dr. Matsuura. I think there are two important things, one was an important piece that Dr. Matsuura identified in his presentation and I think it captured the kind of state-of-the-art which is that this is a process of interaction between stakeholders of various kinds including people from the world of science. Previously they were viewed as servants but that for reasons here outlined quite well I think that doesn't work either but then the idea is that – and remember this developed out of situations where there was some need to act, something had to be done, right, and that the thinking is that that is best informed by an understanding of what is known and also what is not known. And that people act in light of that and being willing to share that uncertainty, doubt in that kind of diverse group is the idea so it's not that it only can be applied when knowledge is certain but exploring that in a kind of diverse setting with diverse actors who might challenge one another's assumptions and who share and need to act is what defines joint fact-finding. It's not to hide uncertainties, nor is it to overburden us, but to understand them in relationship to some situation that creates a need to act.

松浦： 私のほうから付け加えるとすると、Andrew Stirling という人が Risk Matirx というのを書いていて。結局それが何を言わんとしているかというと、従来のように科学者に基本的に任せると、問題が、何が起きるかを狭く定義してしまって、しかも確率がある程度特定されているという条件でリスク分析をして評価しましょうという方向に動いてしまいます。そうすると、水蒸気爆発とか火山性微動みたいな分からない部分の話がどんどん捨象され捨てられていく、見えないことになってしまう。Joint Fact-Finding は、できる限りそこまで含めて整理しようと。分からないことはここです、分かっているのはここですと。科学者だけに依頼すると分かっていることだけ出てきて、分からないことは情報として出てこないので、そこを明らかにしようと。それが今回、David なり私なり、Oye 先生の話もそこに近い部分あったと思うんですが、やらんとしていることかなと思います。

• Wrap-up discussion / 総合討論

松浦：　最後はパネルディスカッションをやりたいと思いますので、発表された先生方、前にお願いします。まだ時間には余裕がありますので、最後にもう 1 回質問を受けるかたちにしたいと思います。パネルディスカッションといいますか、総括討論ということになりますけれども、基本的に今やってきた質疑応答の流れみたいなかたちでやっていきたいと思います。まずは、順番に皆さんから今回の 1 日を受けてのコメント、あるいは誰かに対する質問というのがあれば発言いただきたいと思います。

In other areas who had fights. There was a huge fights over particulate matter, PM2.5 and whether and how a Harvard study should serve as a basis for setting a tough standard. And industry didn't like it. The Harvard guys said we're truthful. People were... the nasty fight. In this instance they turned to a third party organization that both sides of the controversy agreed to fund, the Health Effects Institute which did an evaluation, which was ultimately accepted. The last example. This is actually one that I mentioned in my presentation, where there are very intense fights over the effects of synthetic biology on environment. The parties to the conflict, NGOs, civil society, the leaders of the movement actually kind of opposing, the firms that were doing the work, the academics that were doing the work, and the environmental scientists and EPA did not agree on what the policy should be. But they agreed on what they needed to know more about and they again sought public funding with open access to the results. So, you look at these three examples and what I find that they have in common. This really resonates with many of the comments referred today is that the open acknowledgement of uncertainty, the open acknowledgement of what is not known is often a critical first step towards constructive engagement with issues, but it requires a degree of honesty which is hard to come by in public policy but is not without hope.

松浦：　今のポイントに関して、Uncertainty を認めるという話に関して、どなたか発言されたい方いらっしゃいますか。

Michael Rogers：　Uncertainty is a very loaded word. I come from a physics background originally and I got very deeply involved with the evolution of the European Unions' precautionary approach which is based on uncertainty. Yet there is always uncertainty, so there has to be some sort of balance here and it seems to me that many of the essential problems we face are caused by a misunderstanding of what uncertainty means. For example, most of my friends and colleagues in the nuclear business will tell you there is no uncertainty in disposal of radioactive waste. It's a simple technology which has been around for about 20 years which we could deal with tomorrow if there wasn't an enormous misunderstanding they would say about uncertainty. So I think the real problem comes down to how do we move forward from this impasse between public understanding, public trust and this predication of regulations based on some sort of uncertainty. It's easy to say but it's not getting us very far.

Michael Rogers：　One rejoinder, I completely accept what you say. It is absolutely a major problem and how we move forward is really not so obvious but the other problem that there has been an enormous misunderstanding between hazard and harm. For example, in European Union jurisdiction, and pressure from the Denmark, to actually label nickel-based compounds as being essentially harmful whereas in fact most nickel-based compounds are products which cannot ever reach the human consumer and so they are trying to base regulations and public understanding on the basis of uncertainty in hazard rather than uncertainty in the risk seems to be another real complication in this field.

松浦：　デイビッドさんお願いします。

David Laws：　I think it's also worth noting in what Dr. Oye said about how understanding accumulates in these areas. If you take for instance the understanding of let's say environmental health diseases, much of those – I won't say most because that's always a controversial claim but many important cases developed out of case orientations that were originally outliers and were marginalized. It was only when those cases became identified and then they led to a broader exploration of what the issues were, what the system was, that we got an understanding of kind of etiology of these environmental diseases. So it wasn't a top-down understanding. It emerged from case specifics and often were the procedures in place marginalized the very symptoms that later became the core of the new understanding.

松浦：　ジェイソンさん。

Jason Blackstock：　*Arigato.* Just building off of Ken and Michael's points, I think one of the things that has struck me with the diversity of cases that we looked at today but also thinking more broadly, of a range of them is there is – and Ken you already sort of alluded to this that even the solution of focusing on the uncertainty in the science will work in some cases but not others. In other words, there is no one-size-fits-all mechanism or framework to deploy and I think one of the things that I, you know, from my focus on climate change for example. Climate change is an area where it's not a debate about the uncertainty though I imagine Ken will have a reason but I mean to some

extent in that one it is very much, you know, just like GMOs. There are other value systems that are engaged. There are other issues that are engaged in that context. One of the stories that I always used to illustrate that is in the early part of the 1990s, or even late '80s and early '90s, when climate was becoming an issue, the problem of climate change was presented hand-in-hand with a solution and the solution was a global carbon tax and that was based on previous experiment with sulfur dioxide and other systems that have been used. But in that phrase global carbon tax are two words that the Republicans hate, global and tax. They have come to my head at that time: carbon was neutral but my hypothesis is, had the solution presented at that time been local carbon entrepreneurship actually the Republicans may well have found that a perfectly acceptable framework. And so it was not the science of climate change or the issues of the uncertainty about science that the political situation revolved around. It became an attack on the science based on the fact that the proposed solution was in fact an anathema or a threat to the political values. This is where it's a situation where the types of mechanism. So we have seen recently things like the proposal of Roger Pielke, Jr., the model of The Honest Broker. If those of you who have not read his book, he suggests four stereotypes of different ways of that scientists can behave, and the honest broker is the scientist who presents only the facts and steps back and is not engaged, of course that has not worked very well in climate at all. In fact it seems to be a straw man that fails routinely, precisely for many of the reasons that David and Michael and Ken have raised in their presentations that just presenting the facts and stepping back does not address whose facts, what issues are taken into account from the local perspective. And so overall in my mind this push is very much in the direction of can we create not just research that looks at these individual mechanisms but actually starts to do the comparisons across these cases and look for those more general, databases of here is mechanisms and here is cases they have been effective and how so we can begin to do that comparison and I would hypothesize that that might be a very interesting international collaborative project for the sort of network we may be able to begin building.

David Laws： Very briefly, but I would just highlight that. Resolving the controversy at the policy level is not resolving the controversy that you get agreement that there is climate change. We need to do something and then you start to act. So you plan then to raise the issue in the Netherlands, the big inland sea wall to deal with the projected climate change and all of a sudden local controversy breaks out. The uncertainty comes right back into play because why do you need to this here, why do you need to do so much, why does it need to be so big, why do you need to do it now and that just gets recreated. So it's not the end of policy controversies, not the end of controversies.

松浦: 今までゲストの皆さんにうかがいましたけれども、どなたか。城山先生から順番にいきましょう。

Hideaki Shiroyama： The point between evidence and reframing issue which was repeatedly referred seems to be very interesting. So the issue of the evidence is not 行詰め just evidence itself. How to frame the evidence, whose evidence he mentioned or, you know, from the fourth perspective. So the issue of uncertainly also relating to that perhaps, you know, uncertainty is not just about evidence itself, the uncertainty about from whose perspective, you know. There can be many potential from which perspectives and evidence can be build, so the interaction between the issue of evidence and reframing issue seems to be very interesting. In the overall discussion today, first session rather focusing on the evidence and how the regulation will be reviewed in the face of the new evidence. That kind of framing is basically made, but in the latter part, especially the David's part and you more emphasized the framing issue rather than the evidence issue itself. So those seems to be a little bit different, but actually those two sessions can be interacted to each other that can be the potential area for the research I think, that's the impression I had.

David Laws： This is extremely important point. It's what I written in my note so if I got to raise an issue. But first of all reframing or framing is characterized policy controversies in that way as being precisely those situations in which turning to the facts usually tends to escalate rather than resolve the dispute right. So the idea that you are going to bring in evidence and resolve a framing controversy is unlikely. But also if you think about and whether you are talking in the policy level or much more local level, a kind of practice perspective. People who work in these settings I think what you see is that if we are talking about adaptation and reframing, we are talking about learning, right. But learning then – then we have to confirm what learning is, what's involved in it, and it gets much more complicated I think because you could say is that learning involves changes in behavior, right. But then you have to look at what the behavior – the behavioral expression of knowledge it involves and then that's people having stakes on one part but that's maybe the easy part. The other part is habits or professional practice, the context of institutional processes, organizational routines and remaking that so learning then becomes not a new insight, an epiphany that leads me to something but really a remaking and a remaking in a social context. So it's a much more complex process and then how evidence and uncertainty enter into that I think is something that bears the kind of research that we've been talking about where there is very close tie between research and policy, but also between those two and the practice world in which this gets done. And policy and practice then can usefully be disentangled from one another to precisely raise those kind of issues.

松浦： ありがとうございます。話題を変えてもいいかな。じゃあ、鎗目先生。

Masaru Yarime： Well, just trying to change a little bit about the issue we are discussing. The international cooperation mentioned by Jason, and this year I visited China for four times and just a few weeks ago I was invited to attend trilateral Science, Technology and Innovation Policy Seminar which was organized by Chinese Academy of Science and also

NISTEP in Japan and also KISTEP STEPI in Korea. We made out the presentations and somehow the Japanese presentation in a way referred to the social dimension in public engagement and stakeholders roles and also the risk assessment and also engagement of the psychology [ph] for the studies and then to some extent Korea has also similar tendency to refer to the social dimension but then in the case of China, at least as far as I had impression that they are interested in benchmarking the US and then how to catch up with US, publication, patents, innovation and that was the main concern and when we talk about public engagement with these, the people in China, well it's not that easy to have a kind of common understanding or common interpretation or somewhere the common ground and I was also invited to give a seminar at the Sichuan Administration Institute which is operated by the communist party, so all these students are local officials of the communist party in different cities within the Sichuan province.

I talked privately with some of the people and then they say that their function is to just try to interpret and translate what the central government says and then they just try to follow what they say and implementation at the local level. So, in this case the public engagement at this moment at least is not kind of priority. So in this kind of situation I guess in the case of Jason, you have many students from different countries, in Middle-East and Netherlands how we could discuss this public engagement and the consensus building, joint fact finding in these kinds of environment? This is a huge question and I don't have any answer to that but I think when we talk about the issues like climate change what China will do will have a huge impact and what increasingly China developed technologies and then we are using it, in this case the developers or scientists, engineers and not necessarily sitting next to you, in this kind of case how we could have kind of dialogue and discussion then, just want to pose this question to someone.

松浦： そろそろ時間も迫ってきましたが、平川先生にまだご発言いただいていなかったので、エンゲージメントのお話しですとか、デモクラティック・ガバナンスみたいな話も今ありましたので、ちょっとまとめみたいな感じになってしまいますがよろしくお願いします。

Hideyuki Hirakawa： I would like to raise question about or make a point about the necessity to classify and make a typology of the problem based on which we need to classify or systematize the response to the risk governance or some other governance issues. For example, the International Risk Governance Council has made some typology of this problem from the simple, complex and uncertain and ambiguous. Based on this kind of typology of the problem, we can make a typology or systematize the response to the crisis of risk issues. So, for example, today I talked about public engagement and necessity and importance of public engagement but public engagement is not necessarily best way or better ways to solve the problems.

Public engagement itself can raise the problem so we should find a way to find when the public engagement is necessary or available and a good solution to the problems and who can do it, who should do it and where and how and on what issues in which kind of framing? So we have to systematize the response in terms of the public engagement based on the classification of the problems. That is further our challenge in relation to the public engagement activities, developments.

松浦： ありがとうございました。ちょっと時間も押してきてしまったので、私の方でいくつか、今出てきたキーワードだけでまとめさせていただきます。

1 つは、controversy ということで、対立があるような状況というのがあったということです。そのなかで、David のようなコンセンサスモデルもあれば、パブリックエンゲージメントのようなものもあって、最後に平川先生おっしゃっていただいたように、そういうのが必ずやらなくてはいけないかというとそうでもなくて、適切なガバナンスというもののを考えなくてはいけないよねという結論は、皆さんのコンセンサスとしてあるのかなというふうに思います。

2 つ目として、先ほどの質問のなかにもあったんですが、分からないこと、不確実性、Uncertainty があることを認めるということ自体が一つ、このガバナンスのなかでやらなくてはいけない大きなことであると。意外とそこをみんな認めたがらないけれども、それを認めるというのが 1 つ大きなステップになるというお話があったと思います。

また、Blackstock さんからあった話だと思うんですけれども、結局、科学という話をするときと、ポリティカル、政治との関わりというものがやはりあると。ある場合には政治が優先してしまうし、ある場合には科学を優先して、そこをどうやってうまくバランスをとるか、つなぐかという話が出てくるということ。あと、もう 1 つ、科学とは何かというバウンダリーワークをどうやってやるかという話も、今出てきたかなというふうに思います。

あと 1 つ、コンプリートなプロポーザルとして、多くのケースが出てきたんだから、それを整理するっていうだけでも、まず必要だよねっていうお話をいただいたかと思います。それが最終的に使い分け、場の使い分けという平川先生の結論にもつながる部分かなというふうに思います。

質問を受け付けるというふうに申し上げたんですけれども、時間がなくなってしまい申し訳ありません。まだ皆さんここに少し残っていると思いますので、終了後に個別に問いかけていただくようにしていただければと思います。今日は長い間、どうもありがとうございました。まずは、先生方に拍手をよろしくお願いします。今後もこのように開かれた議論の場を、毎年できる限り設けていきたいと思いますので、皆様お付き合いいただければと思います。本日は、どうもありがとうございました。

Appendices / 資料編

• Keynote Speech 1: Kenneth Oye

ADAPTIVE RISK MANAGEMENT IN BIOTECHNOLOGY
APPLICATIONS TO SYNTHETIC BIOLOGY AND PHARMACEUTICALS

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Political Science and Engineering Systems
Massachusetts Institute of Technology

Outline

Permissive, Precautionary and Adaptive Approaches
Exemplary Cases . . . and Cautionary Tales
Current Risk Governance in Biotechnology
- Synthetic Biology
- Pharmaceuticals

Future Convergence of Pharmaceuticals and Synthetic Biology?

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MIT CBI Center for Biomedical Innovation
SynBERC Synthetic Biology Engineering Research Center

APPROACHES TO RISK GOVERNANCE UNDER UNCERTAINTY

Permissive
* Allow innovation unless environment, health, security are clearly compromised
After-the-fact reaction if crisis materializes; backlash may limit innovation
Examples: Post-Fukushima nuclear shutdown, US stasis on gene therapy

Precautionary
* Limit innovation unless environment, health and security are clearly protected
Diversion of innovation to less regulated areas may heighten risks
Examples: EU on GMOs, US on stem cell research, German genetic data protection

Planned Adaptive
* Prepare: Fund research to inform priors on benefits and risks
* Discriminate: Foster initial applications with most favorable priors
* Observe: Harvest and process information from initial experience
* Adapt: Learn from experience and update/correct practices

Exemplary Cases	Cautionary Tales
FAA-NTSB air safety	NASA shuttle
EU TSE policy	USDA BSE policy
EPA PM2.5	NIH FDA Transfats

PERMISSIVE: AFTER-THE-FACT REACTION TO HARMS	
DDT "Silent Spring"	EPA banned chlorinated pesticides & herbicide
Challenger + Columbia	NASA fixed booster, did not engage in dynamic testing
Gene therapy	FDA restricted gene therapy after permissive testing
Trans fats heart disease	1957-1991 research, 2006-2013 FDA label and ban
Fukushima	Disaster, Japan shut nuclear plants

PRECAUTION: ACT ON WARNING TO REDUCE RISK IN ADVANCE OF HARMS	
Y2K	US imposed standards and invested in infrastructure
Carcinogenicity	EPA "Delany Clause" ban on many potential carcinogens
GMO release	EU limits GMO field release
Pathogenic DNA elements	HHS DNA Screening Guidance (voluntary) + IGSC
Iran nuclear weapon	US-Israel attack Iran with Stuxnet and assassinations

11:59:59 31 DECEMBER 1999
12:00:00 01 JANUARY 2000

APPROACHES TO RISK GOVERNANCE UNDER UNCERTAINTY

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EPA PM2.5	NIH FDA Transfats

DISTINCTION BETWEEN REACTION AND PLANNED ADAPTATION

Netherlands 1953

Government diagnosed and fixed flaws in dikes and flood gates and created ongoing adaptive review.

Kobe 1995

Government diagnosed specific flaws in seismic building codes and created ongoing adaptive review.

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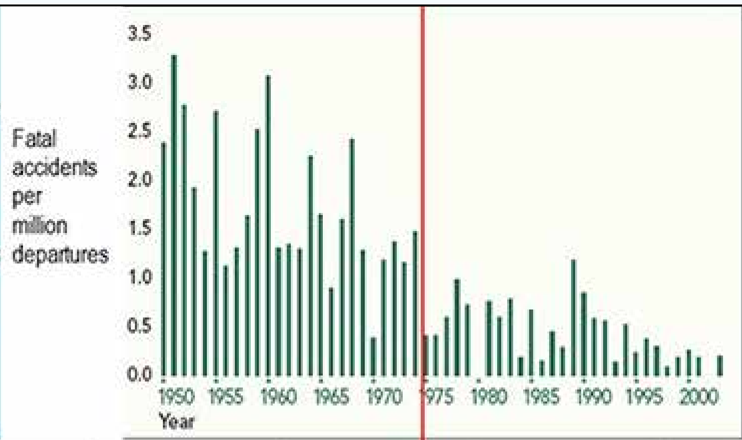
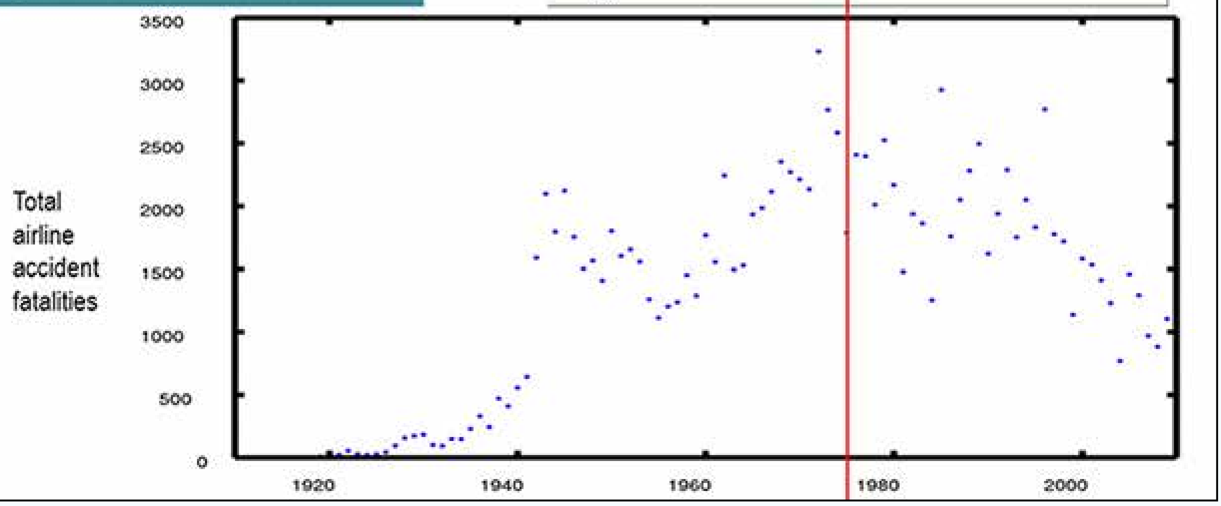
SynBERC Synthetic Biology Engineering Research Center

COMMERCIAL AVIATION
1975 US LEGISLATIVE REFORM
"No Federal agency can properly perform such functions unless it is totally separate."
FAA certifies, NTSB investigates
Examine accidents + near misses
NTSB recommends
FAA/makers/airlines usually act
- Why was reform demanded?
- Did the reform work?





SHUTTLE – FIXED O-RING, DID NOT FIX NASA

Old Story - Richard Feynman on O ring failure

New Story - NAS on NASA design process

1986 Challenger disaster

1986 Rogers Commission / Feynman

1988 NAS advised NASA to adopt dynamic testing and experimentation process to inform adaptive risk management system

1989 NASA ignored NAS, chose static tests of safety without adaptive elements

2003 Columbia disaster

- Why did NASA reject NAS proposal?
- Was adaptive experimental approach needed?

Collected Reports of the Panel on Technical Evaluation of NASA's Redesign of the Space Shuttle Solid Rocket Booster

of the

Committee on NASA Scientific and Technological Program Reviews

Commission on Engineering and Technical Systems

National Academy Press
Washington, D.C. 1988

9

EU TSE ROADMAP – STRUCTURED SENSING AND POLICY FEEDBACK

We have come to the stage that amendments of certain measures could be envisaged without endangering the health of the consumer or the policy of eradicating BSE, provided that the positive trend continues and scientific conditions are in place. Indeed different indicators already suggest a favourable trend in the BSE epidemic and a clear improvement of the situation in recent years due to the risk reducing measures in place. Furthermore, inspection reports indicate that implementation of BSE requirements in the Member States has improved. The main indicators are presented in Charts 1 -3 of Annex I.

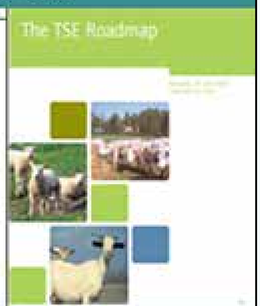


CHART 1: EU BSE CASES 2001 TO 2004

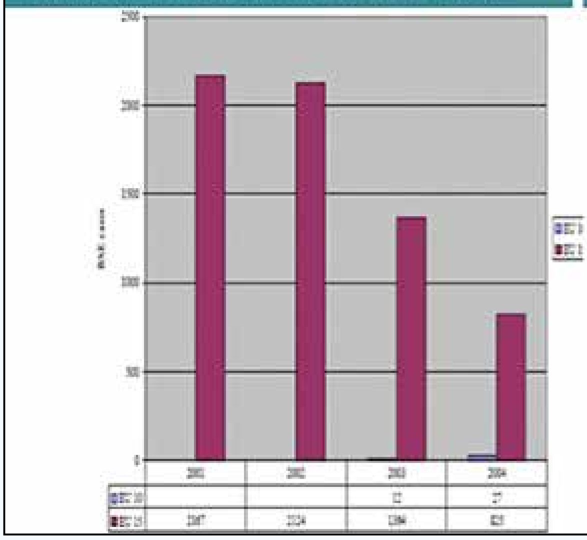
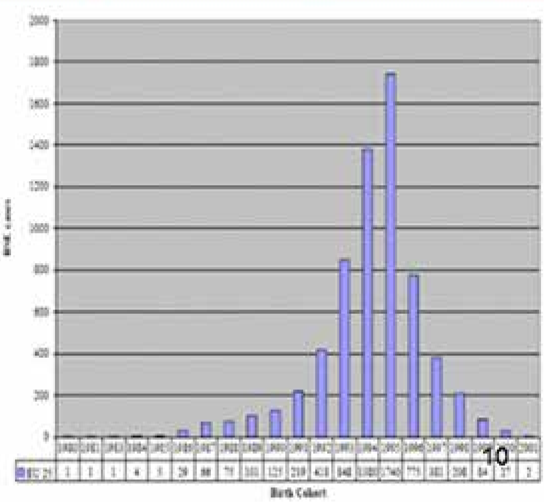


CHART 2: EU BSE CASES BY BIRTH COHORTS



10

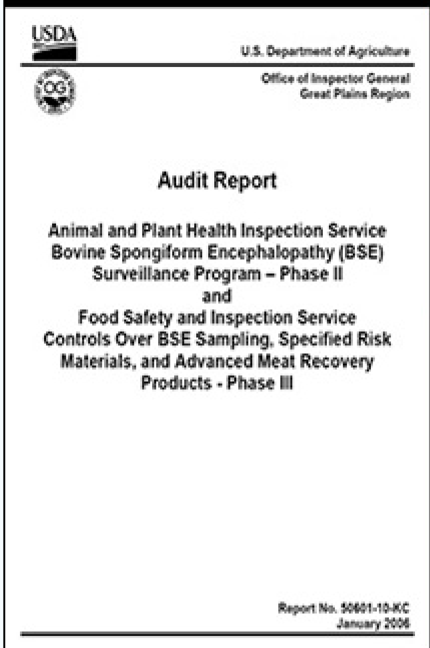
US BSE SURVEILLANCE AND TESTING – WEAK SENSING

BSE TESTING	US	JAPAN
PERCENT TESTED	.05 percent	100.00 percent
TYPE TESTED	sample of downers	all cattle prefectures < 20 mo national > 20 mo
SCREENING TEST	BioRad rapid reaction	BioRad rapid reaction
OLD CONFIRM TEST	IHc	IHC + Western Blot
NEW CONFIRM TEST	IHC + Western Blot	IHC + Western Blot
BSE CASES	2 cases	20 cases

*IHC = ImmunoHistoChemistry

11

US BSE SURVEILLANCE AND TESTING – WEAK SENSING


USDA
U.S. Department of Agriculture
Office of Inspector General
Great Plains Region

Audit Report

Animal and Plant Health Inspection Service
Bovine Spongiform Encephalopathy (BSE)
Surveillance Program – Phase II
and
Food Safety and Inspection Service
Controls Over BSE Sampling, Specified Risk
Materials, and Advanced Meat Recovery
Products - Phase III

Report No. 50601-10-KC
January 2006

[APHIS officials] justified their decision to not do additional testing because the IHC test is internationally recognized as the gold standard of testing. Also, they believed that conducting additional tests would undermine confidence in USDA testing protocols. p iii-iv

The additional tests recommended by NVSL scientists, but not approved by APHIS Headquarters officials, were the IHC using other antibodies (IHC testing using different antibodies ultimately produced positive results); IHC testing of additional regions of the brain (the cerebellum tested positive); regular and enriched (OIE-like) Western blots (the obex and cerebellum tested positive); and variable rapid tests (the obex and cerebellum tested positive with two different rapid tests). p 33.

12

ELEMENTARY PRINCIPLES FOR GOVERNING EMERGING RISKS

PROSPECTIVELY PLANNED ADAPTATION

- Both phenomena being regulated and effects of regulatory policies are not well understood upfront. Understandings change with observations on use.
- Policies should be proactive and adaptive, engaging with priors on risks/benefits and updating as understandings of risks and benefits evolve.

OBSERVING/SENSING/REVEALING

- Parties differ in their interest in harvesting and sharing information needed to evaluate benefits/risks.
- Policies should create incentives and cut disincentives to reveal information needed for risk management (research funding, liability and IP law).

CREDIBLE KNOWLEDGE ASSESSMENT

- Conflicts of interest, organizational inertia and prior beliefs typically bias observation and assessment.
- Policies should provide for credible and legitimate assessment of scientific and technical information under complexity, uncertainty and controversy.

13

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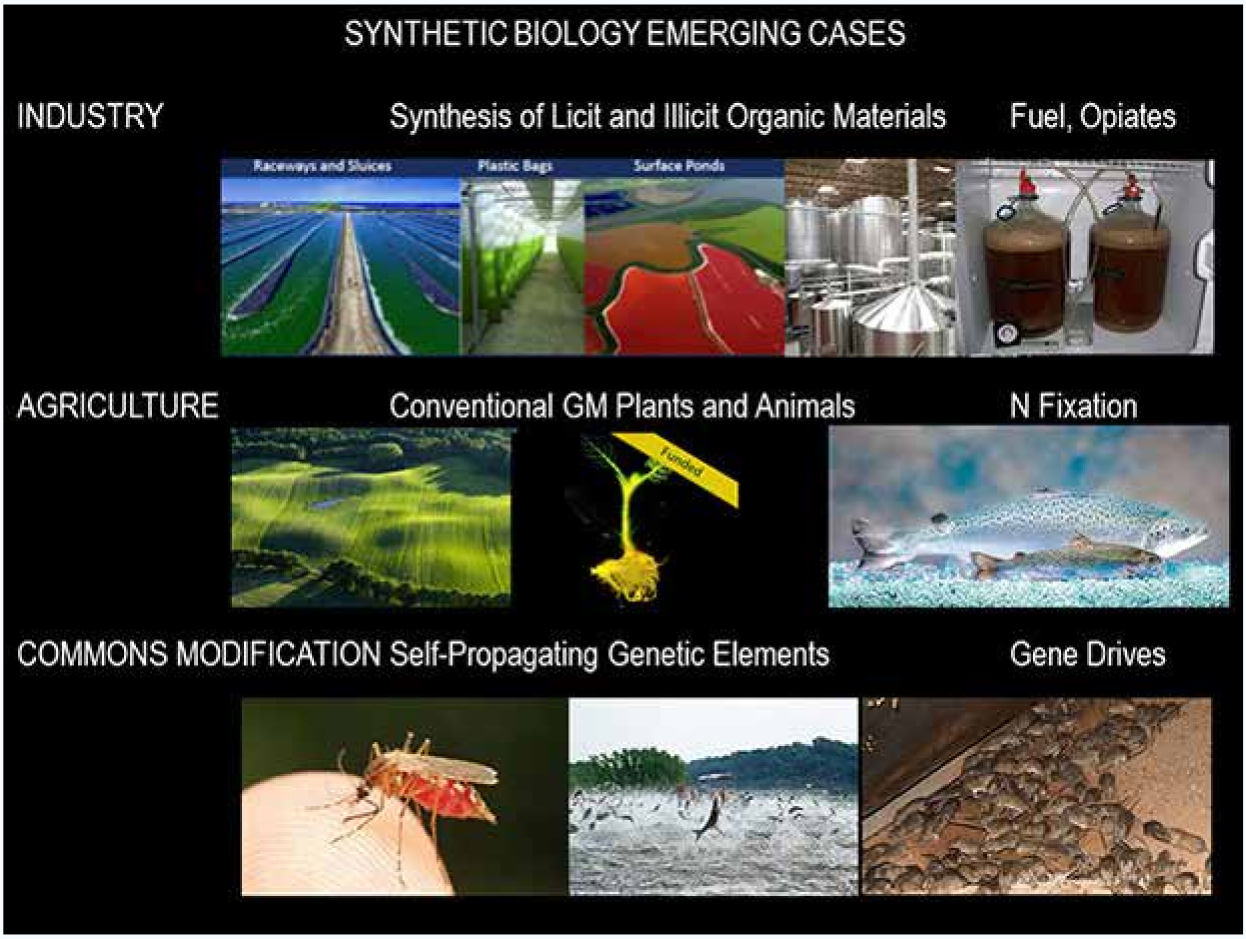
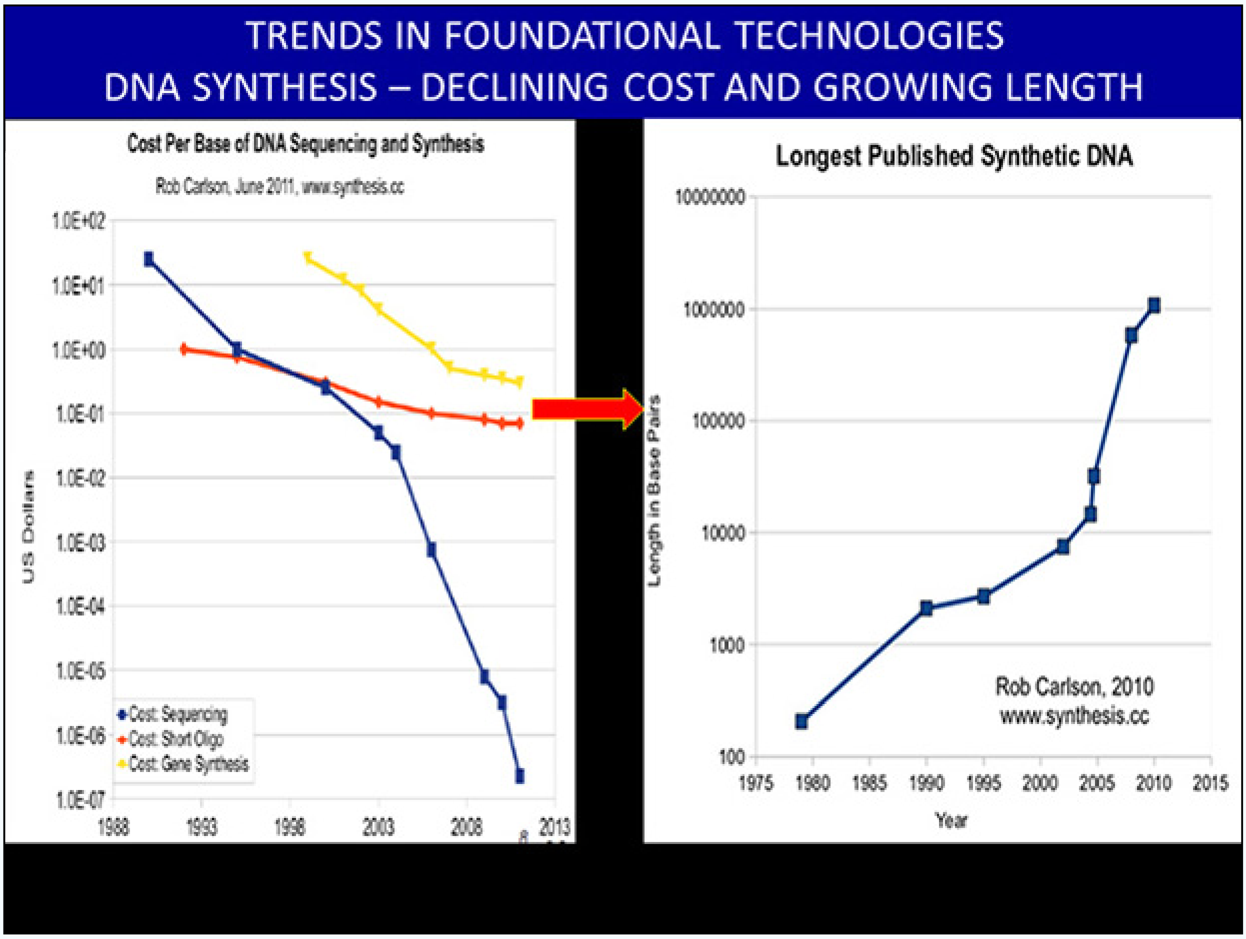
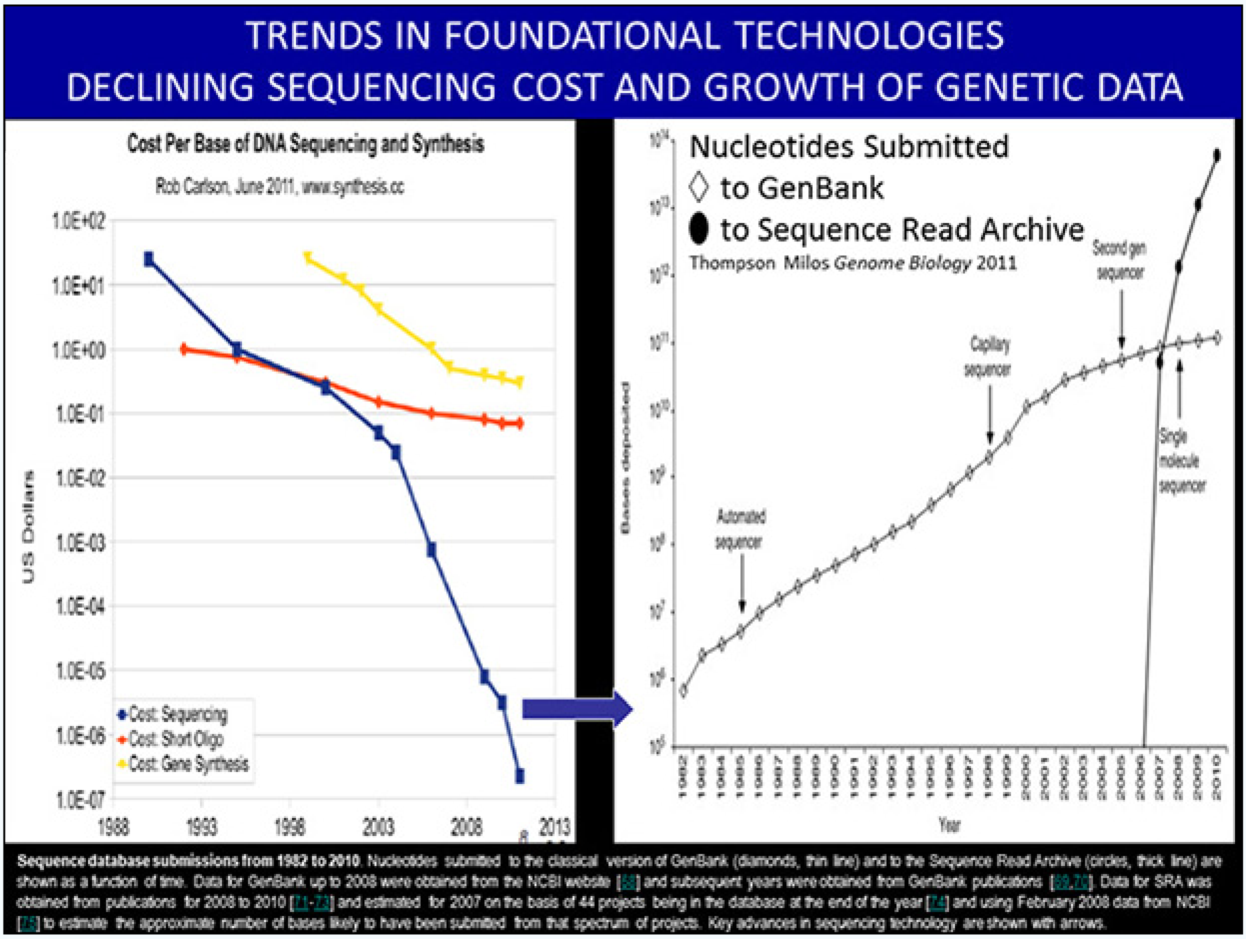
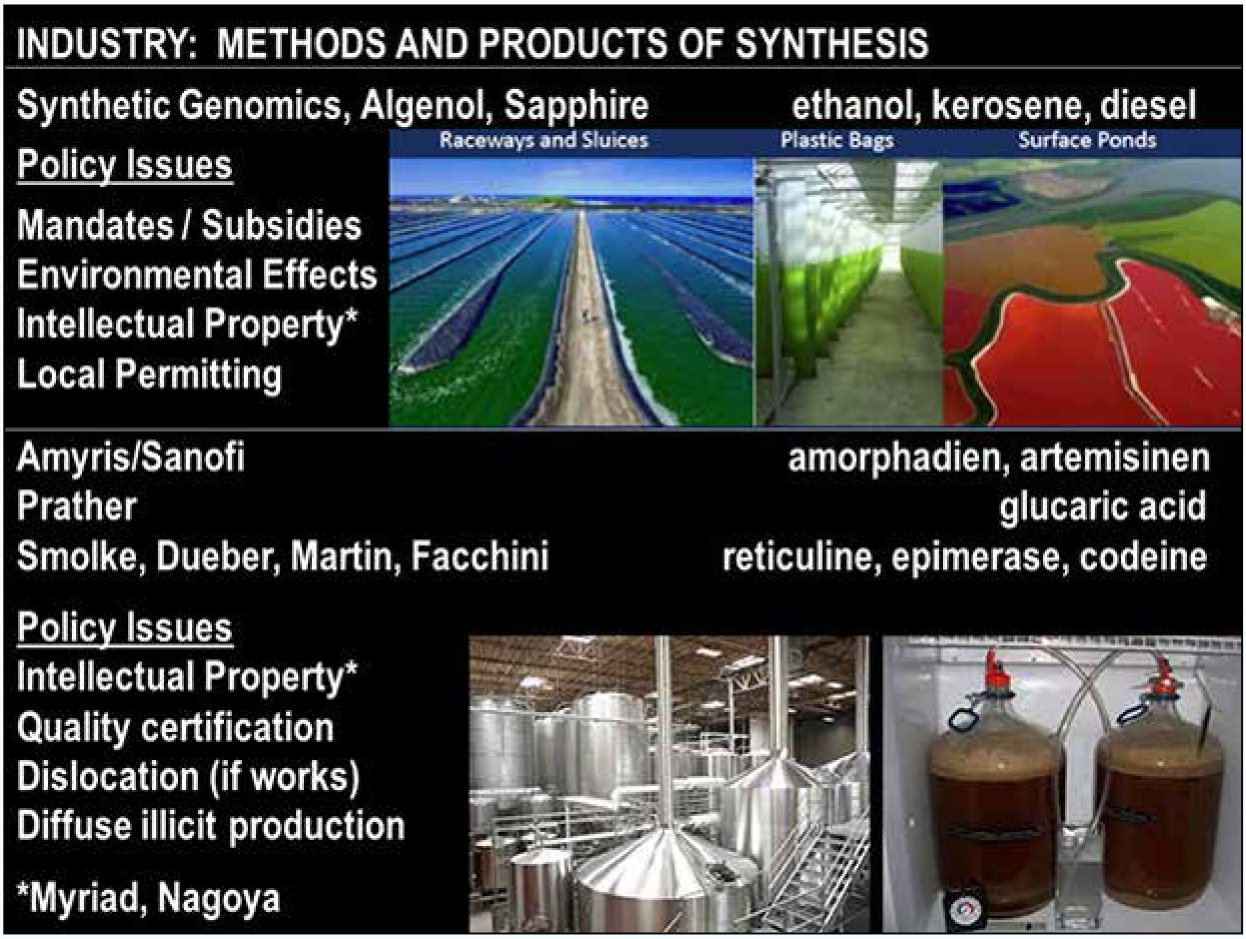


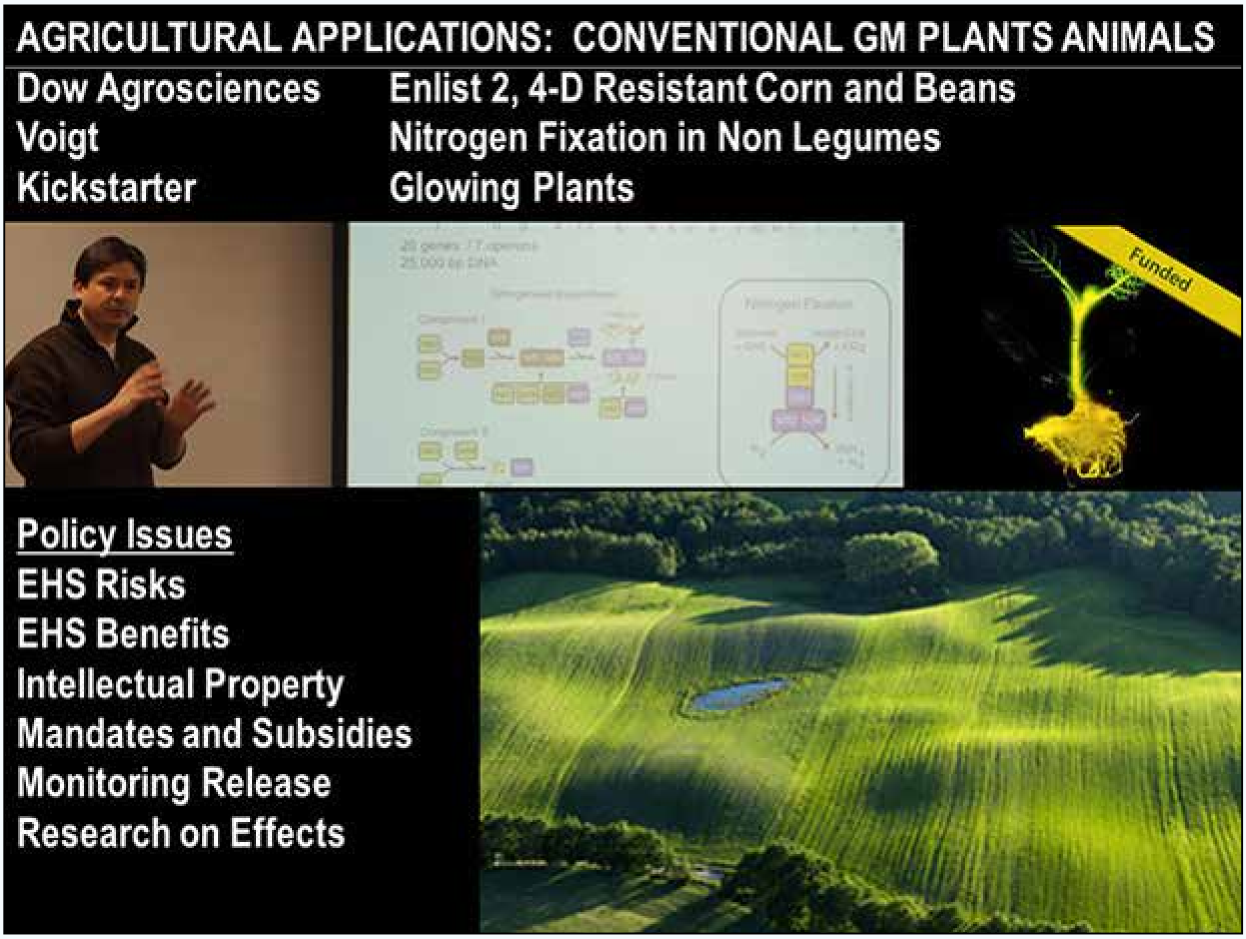
SYNTHETIC BIOLOGY EMERGING CASES
INDUSTRY
Synthesis of Licit and Illicit Organic Materials
Fuel, Opiates
Raceways and Sluices
Plastic Bags
Surface Ponds
AGRICULTURE
Conventional GM Plants and Animals
N Fixation
COMMONS MODIFICATION Self-Propagating Genetic Elements
Gene Drives



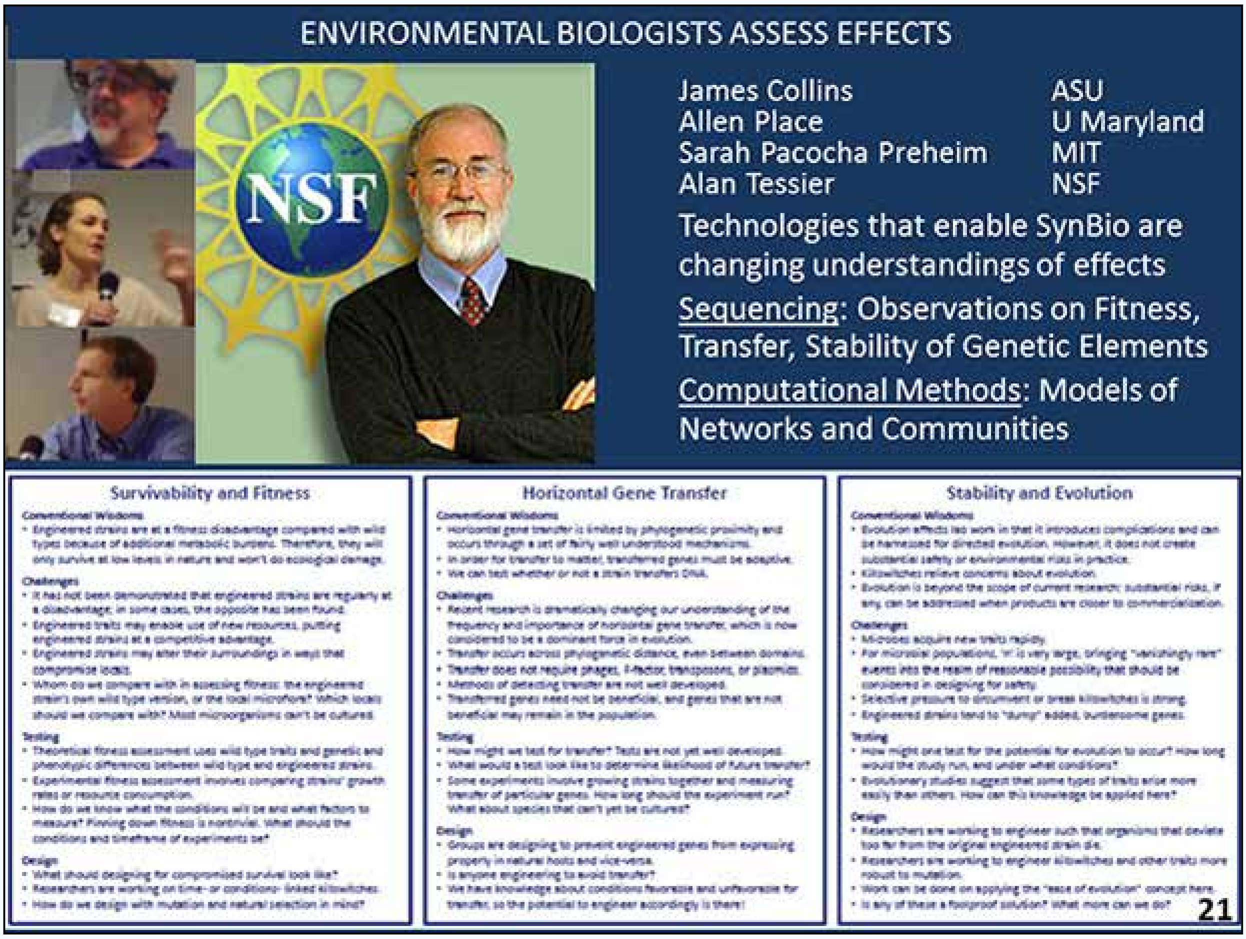
TRENDS IN FOUNDATIONAL TECHNOLOGIES
DNA SYNTHESIS – DECLINING COST AND GROWING LENGTH
Cost Per Base of DNA Sequencing and Synthesis
Rob Carlson, June 2011, www.synthesis.cc
US Dollars
Cost: Sequencing
Cost: Short Oligo
Cost: Gene Synthesis
Longest Published Synthetic DNA
Length in Base Pairs
Rob Carlson, 2010
www.synthesis.cc
Year

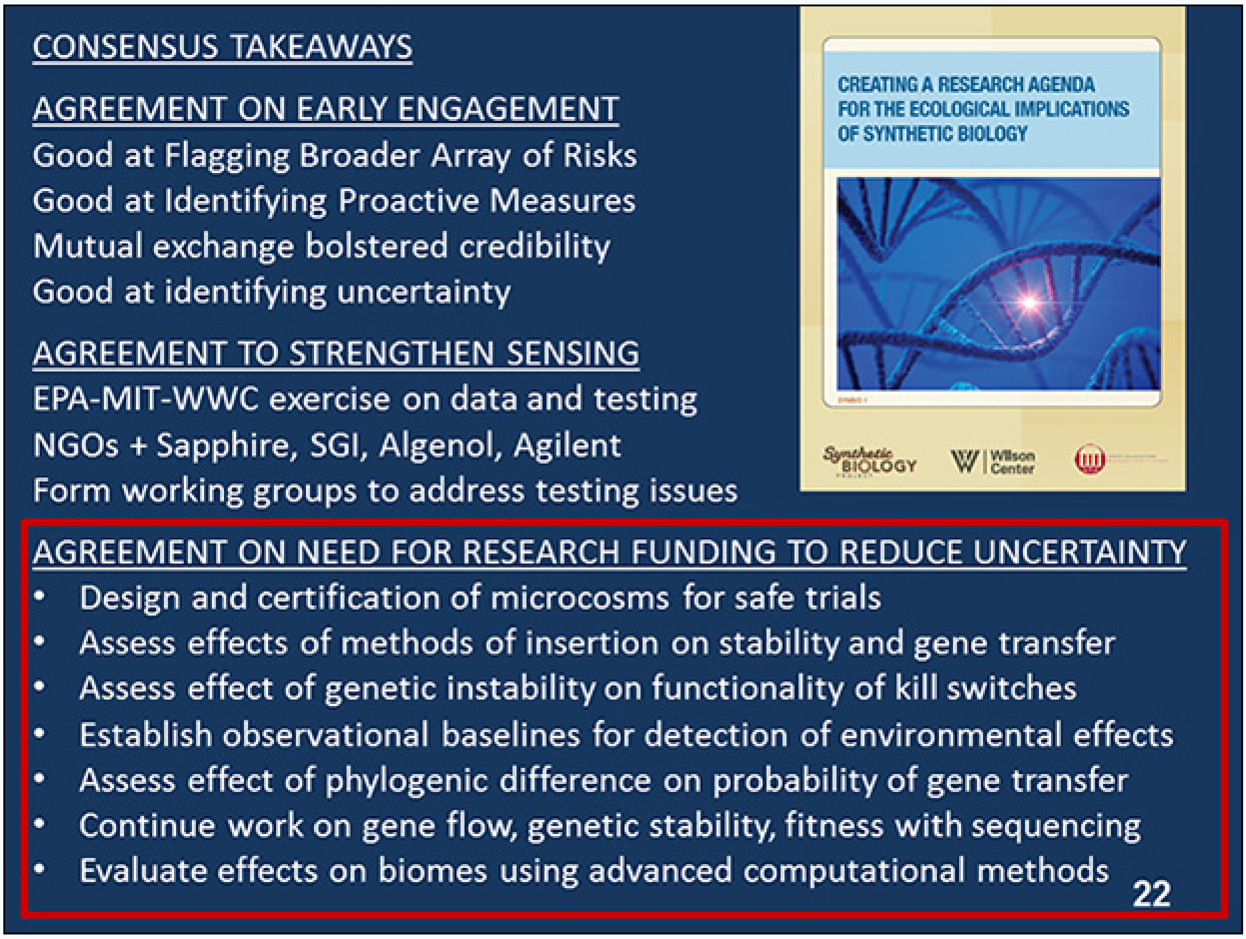

TRENDS IN FOUNDATIONAL TECHNOLOGIES
DECLINING SEQUENCING COST AND GROWTH OF GENETIC DATA
Cost Per Base of DNA Sequencing and Synthesis
Rob Carlson, June 2011, www.synthesis.cc
US Dollars
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1988
1993
1998
2003
2008
2013
Cost: Sequencing
Cost: Short Oligo
Cost: Gene Synthesis
Nucleotides Submitted
to GenBank
to Sequence Read Archive
Thompson Milos Genome Biology 2011
Bases deposited
Automated sequencer
Capillary sequencer
Second gen sequencer
Single molecule sequencer
Year
Sequence database submissions from 1982 to 2010. Nucleotides submitted to the classical version of GenBank (diamonds, thin line) and to the Sequence Read Archive (circles, thick line) are shown as a function of time. Data for GenBank up to 2008 were obtained from the NCBI website [68] and subsequent years were obtained from GenBank publications [69,70]. Data for SRA was obtained from publications for 2008 to 2010 [71-73] and estimated for 2007 on the basis of 44 projects being in the database at the end of the year [74] and using February 2008 data from NCBI [75] to estimate the approximate number of bases likely to have been submitted from that spectrum of projects. Key advances in sequencing technology are shown with arrows.


INDUSTRY: METHODS AND PRODUCTS OF SYNTHESIS
Synthetic Genomics, Algenol, Sapphire
ethanol, kerosene, diesel
Policy Issues
Mandates / Subsidies
Environmental Effects
Intellectual Property*
Local Permitting
Raceways and Sluices
Plastic Bags
Surface Ponds
Amyris/Sanofi
amorphadien, artemisinen
Prather
glucaric acid
Smolke, Dueber, Martin, Facchini
reticuline, epimerase, codeine
Policy Issues
Intellectual Property*
Quality certification
Dislocation (if works)
Diffuse illicit production
*Myriad, Nagoya

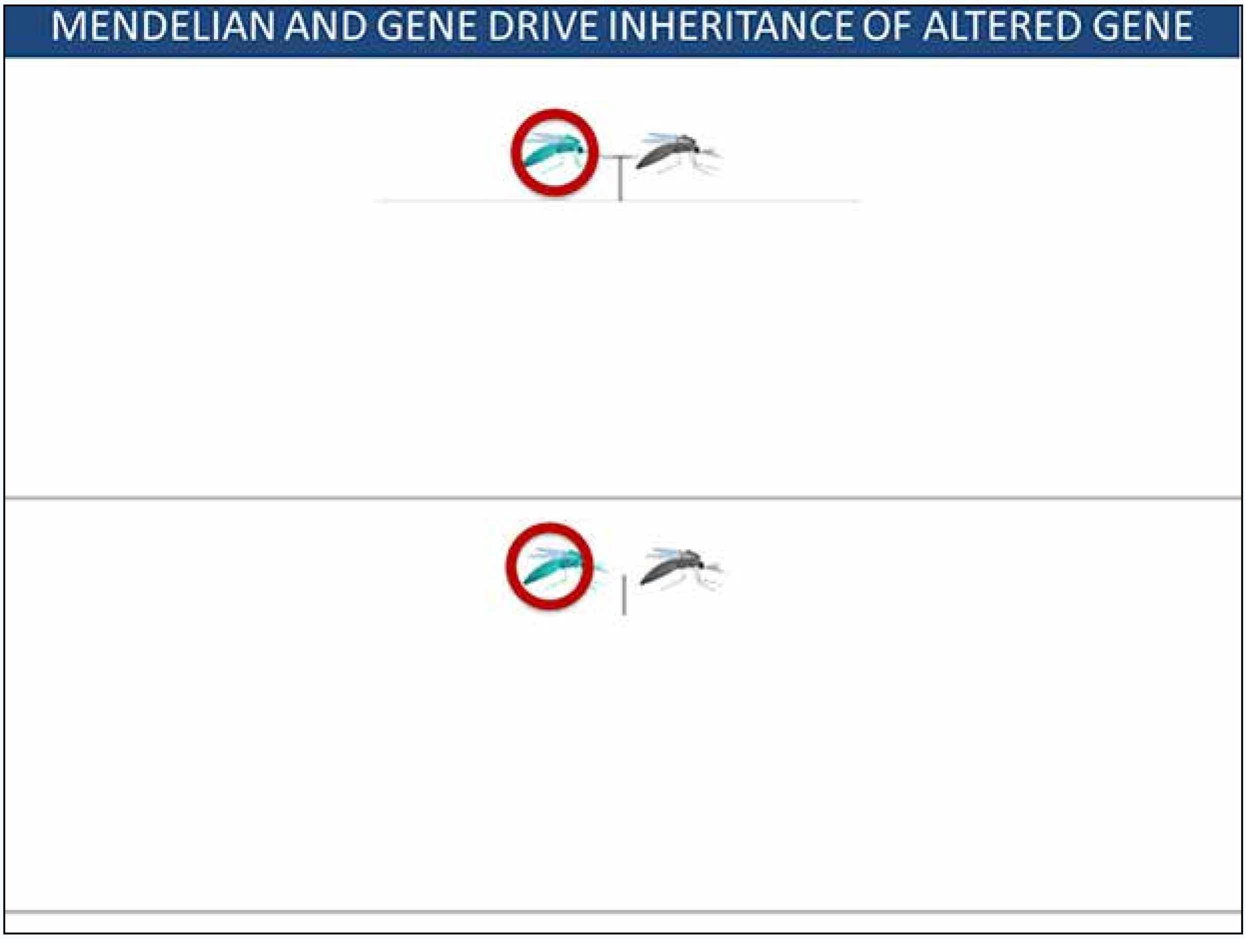

AGRICULTURAL APPLICATIONS: CONVENTIONAL GM PLANTS ANIMALS
Dow Agrosciences
Enlist 2, 4-D Resistant Corn and Beans
Voigt
Nitrogen Fixation in Non Legumes
Kickstarter
Glowing Plants
Funded
Policy Issues
EHS Risks
EHS Benefits
Intellectual Property
Mandates and Subsidies
Monitoring Release
Research on Effects


DECEMBER 2012: ALGAE BIOFUELS
SYNTHETIC GENOMICS
ALGENOL BIOFUELS
Sapphire Energy
Agilent Technologies
d Testing Methods for Assessing the Safety
ntal Introduction of Synthetically Designed
20

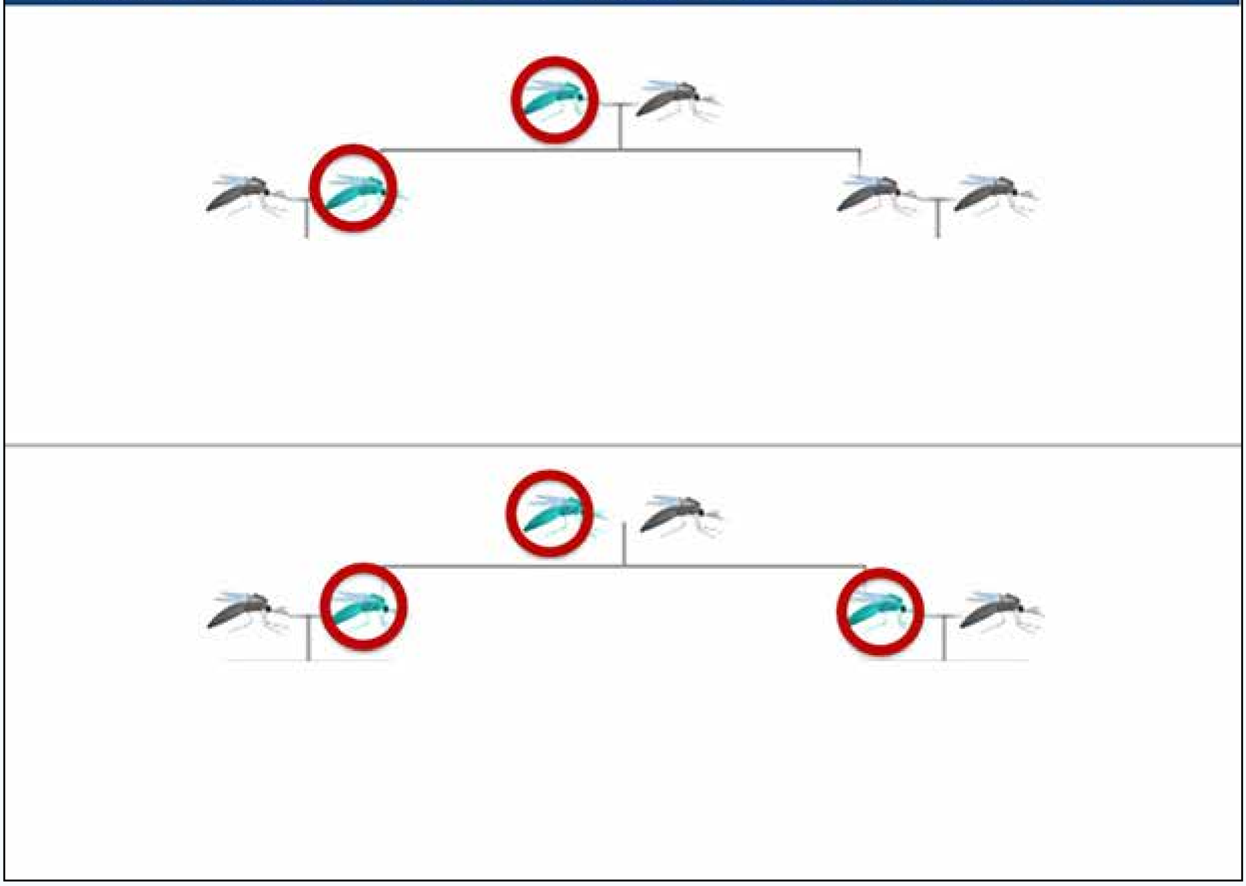

ENVIRONMENTAL BIOLOGISTS ASSESS EFFECTS
NSF
James Collins ASU
Allen Place U Maryland
Sarah Pacocha Preheim MIT
Alan Tessier NSF
Technologies that enable SynBio are changing understandings of effects
Sequencing: Observations on Fitness, Transfer, Stability of Genetic Elements
Computational Methods: Models of Networks and Communities
Survivability and Fitness
Horizontal Gene Transfer
Stability and Evolution
21


CONSENSUS TAKEAWAYS
AGREEMENT ON EARLY ENGAGEMENT
Good at Flagging Broader Array of Risks
Good at Identifying Proactive Measures
Mutual exchange bolstered credibility
Good at identifying uncertainty
AGREEMENT TO STRENGTHEN SENSING
EPA-MIT-WWC exercise on data and testing
NGOs + Sapphire, SGI, Algenol, Agilent
Form working groups to address testing issues
CREATING A RESEARCH AGENDA FOR THE ECOLOGICAL IMPLICATIONS OF SYNTHETIC BIOLOGY
Synthetic BIOLOGY
Wilson Center
AGREEMENT ON NEED FOR RESEARCH FUNDING TO REDUCE UNCERTAINTY
• Design and certification of microcosms for safe trials
• Assess effects of methods of insertion on stability and gene transfer
• Assess effect of genetic instability on functionality of kill switches
• Establish observational baselines for detection of environmental effects
• Assess effect of phylogenic difference on probability of gene transfer
• Continue work on gene flow, genetic stability, fitness with sequencing
• Evaluate effects on biomes using advanced computational methods
22

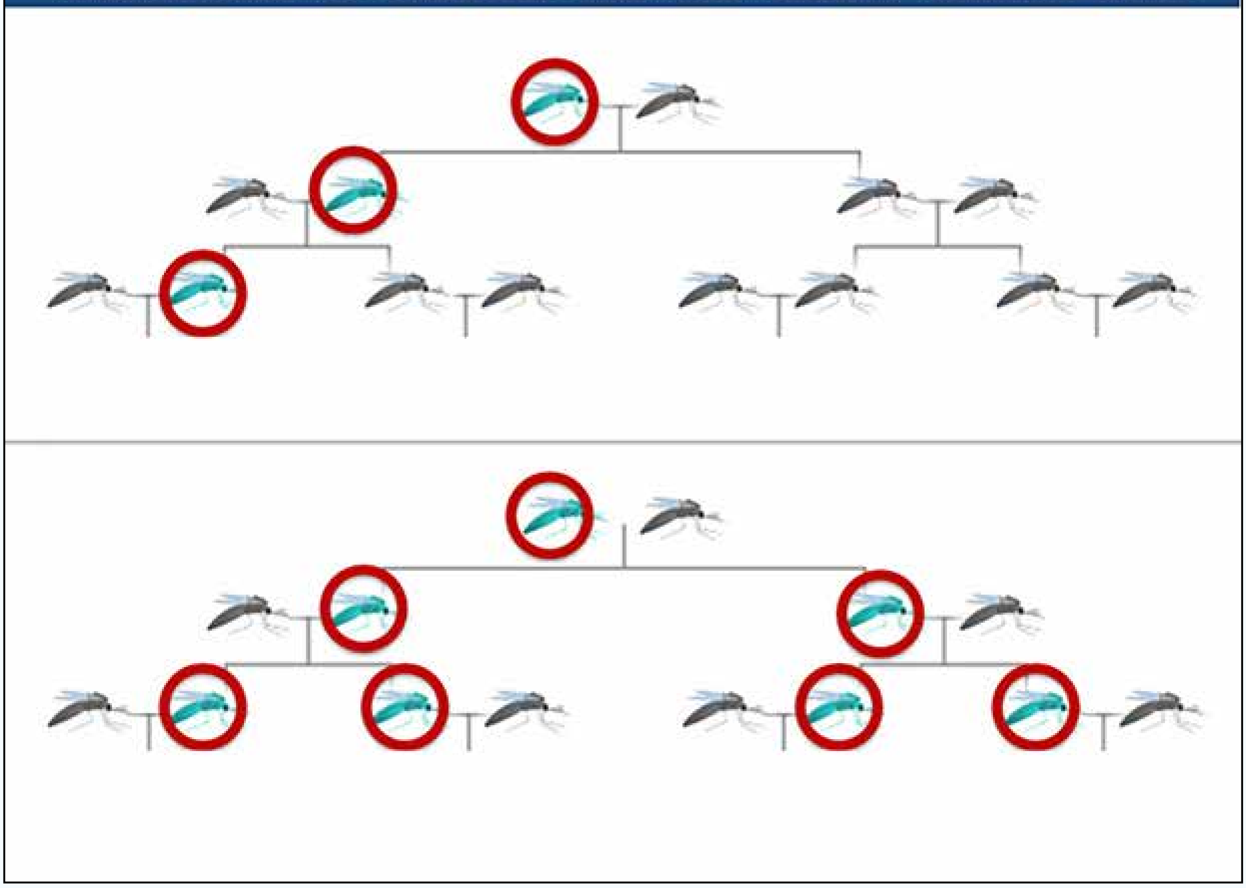

COMMONS MODIFICATION: SELF PROPAGATING GENETIC ELEMENTS
Policy Issues
EHS Risks
Security Risks
EHS Benefits
Intellectual Property
Mandates and Subsidies
Monitoring Release
Research on Effects


MENDELIAN AND GENE DRIVE INHERITANCE OF ALTERED GENE

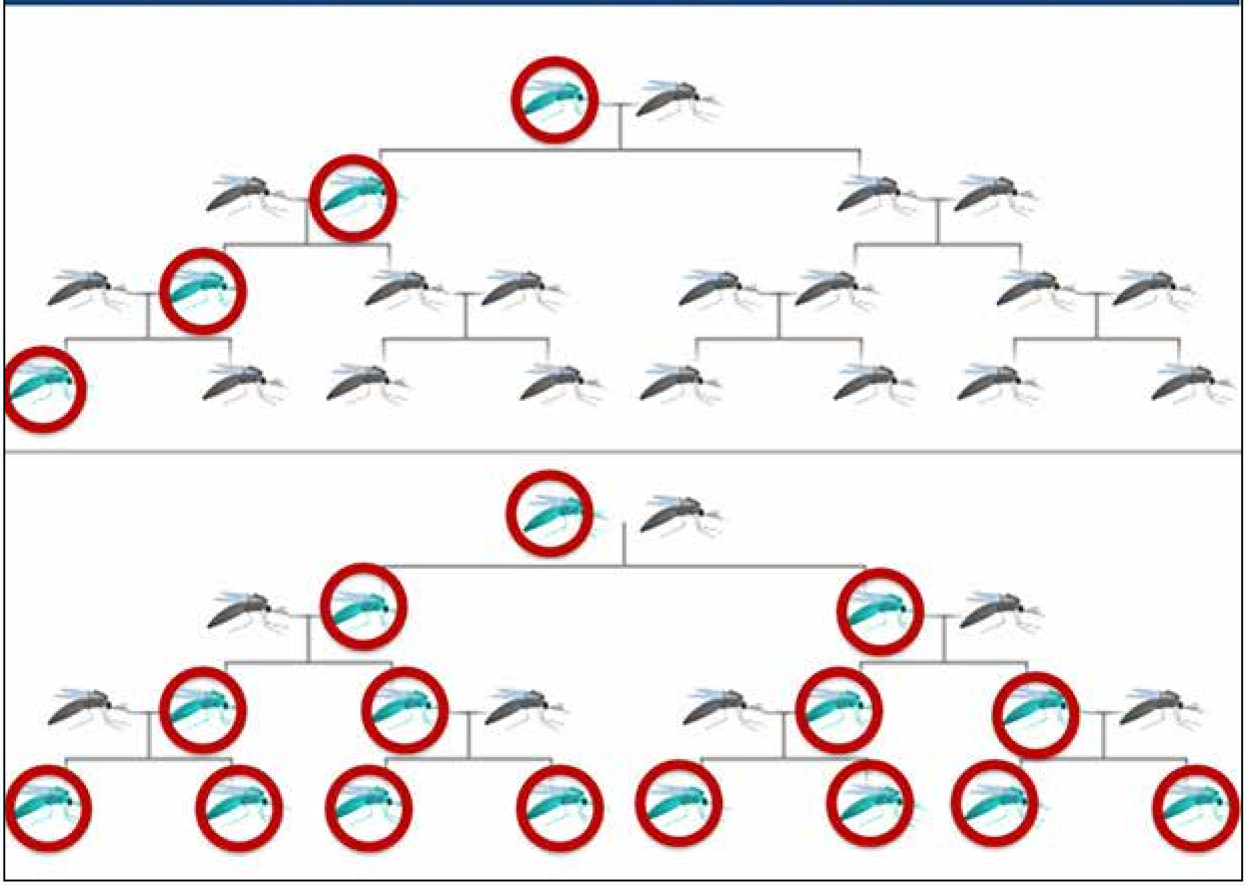
MENDELIAN AND GENE DRIVE INHERITANCE OF ALTERED GENE



MENDELIAN AND GENE DRIVE INHERITANCE OF ALTERED GENE



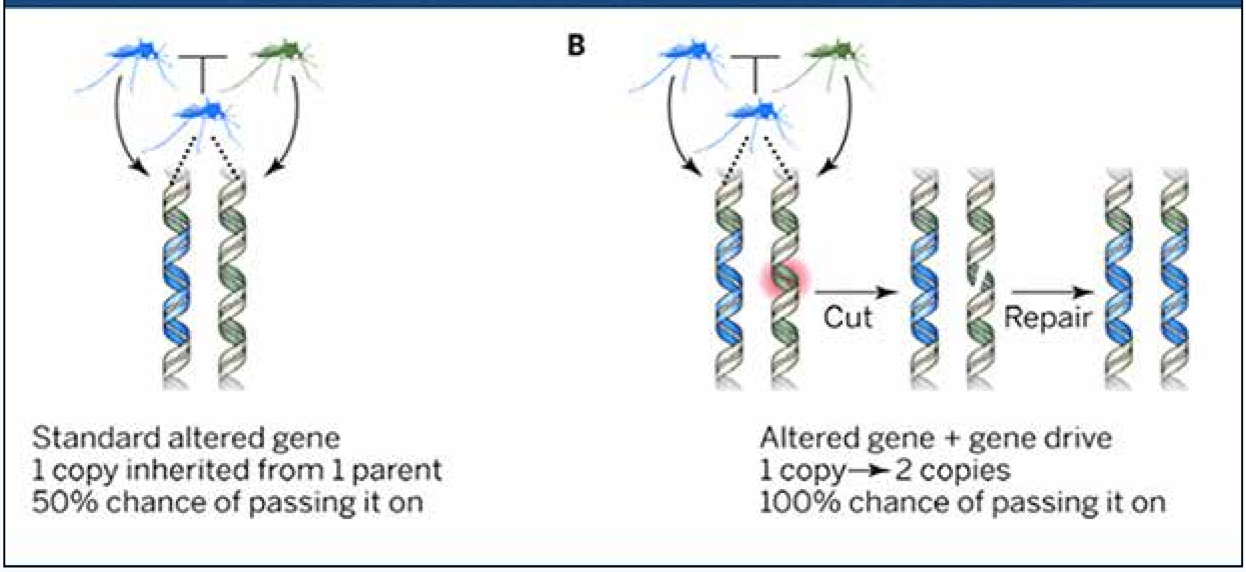
MENDELIAN AND GENE DRIVE INHERITANCE OF ALTERED GENE

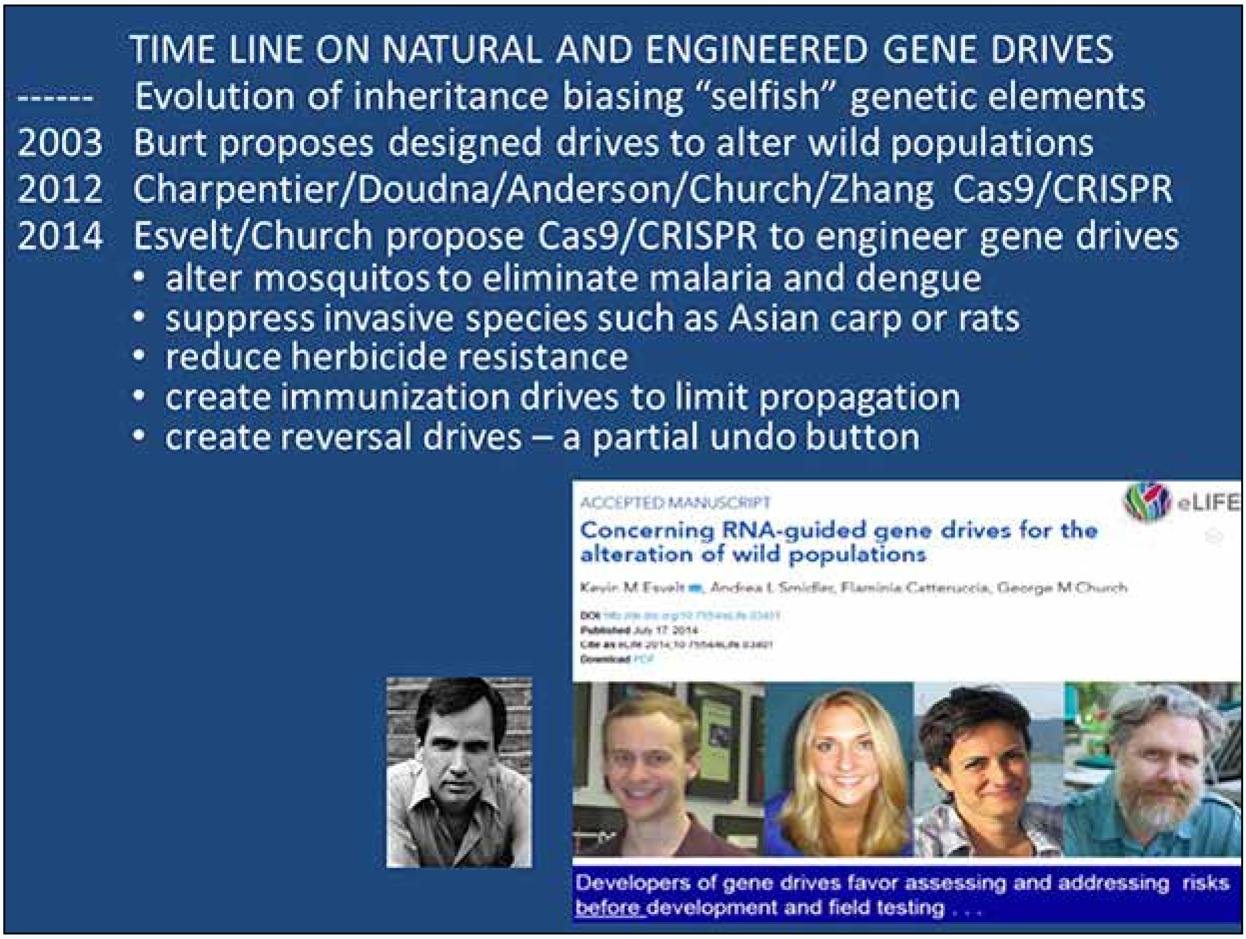


HOW GENE DRIVES BIAS INHERITANCE

A Altered genes (blue) and wild type (grey) ~ 50 % odds

B Altered gene with gene drive and wild type ~ 100 % odds
Gene drives cut homologous chromosomes lacking alteration and cause cell to copy altered gene and the gene drive





Sciencexpress Policy Forum

Regulating gene drives

Kenneth A. Oye,[1,2*†] Kevin Esvelt,[3*] Evan Appleton,[4] Flaminia Catteruccia,[5,6] George Church,[3] Todd Kuiken,[7] Shlomiya Bar-Yam Lightfoot,[2] Julie McNamara,[2] Andrea Smidler,[3,8] James P. Collins[9]

[1]Political Science Department, Massachusetts Institute of Technology. [2]Engineering Systems Division, Massachusetts Institute of Technology. [3]Wyss Institute, Harvard University. [4]Bioinformatics, Boston University. [5]Harvard School of Public Health. [6]University of Perugia, Italy. [7]Woodrow Wilson International Center for Scholars. [8]Harvard Medical School. [9]School of Life Sciences, Arizona State University.

*Principal contributors to this piece.

†Corresponding author. oye@mit.edu

Regulatory gaps must be filled before gene drives could be used in the wild

Genes in sexually reproducing organisms normally have, on average, a 50% chance of being inherited, but some genes have a higher chance of being inherited. These genes can increase in relative frequency in a pop-

nome engineering that uses the CRISPR nuclease Cas9 to cut sequences specified by guide RNA molecules (5, 6). This technique is in widespread use and has already engineered the genomes of more than a dozen species. Cas9 may enable "RNA-guided gene drives" to edit nearly any gene in sexually reproducing populations (1).

To reduce potential negative effects in advance of construction and testing, Esvelt et al. have proposed several novel types of drives (1). Precision drives could exclusively affect particular species or subpopulations by targeting sequences unique to those groups. Immunizing drives could block the spread of unwanted gene drives by preemptively altering target sequences. Reversal drives could overwrite unwanted changes introduced by an initial drive or by conventional genome engineering, even restoring the original sequence. However, ecological effects would not necessarily be re-

ENVIRONMENTAL ISSUES

Mutation of gene drives inevitable, will alter effects
Lateral gene transfer may reduce discrimination
Immunization and reversal may not be effective
Diseases borne by vectors will evolve
Environmental effects will vary by species and alteration

SECURITY ISSUES

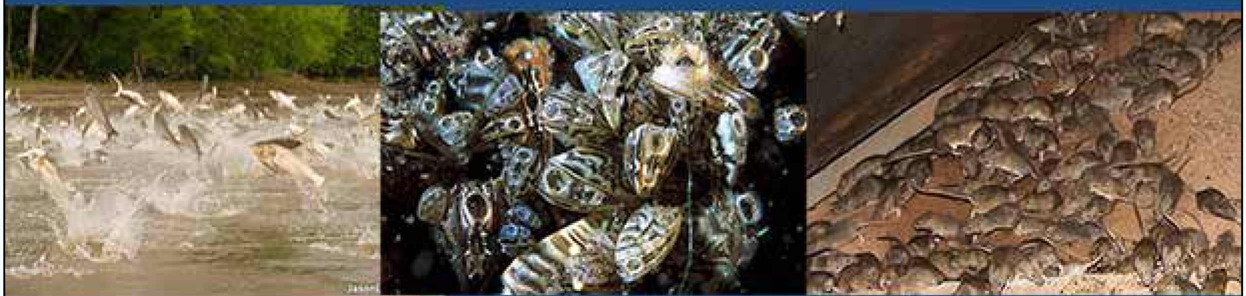
Gain-of-function enabling ability to host diseases
Suppression of crops and livestock in traditional agriculture
Suppression of pollinators and other keystone species
Immunization drives may protect self and allies from effects
Reversal drives may be withheld for economic or political gain
Security implications uncertain - note ingenuity and creativity

2009 FDA GUIDANCE*

Regulation of Genetically Engineered Animals
Containing Heritable rDNA Constructs

An rDNA construct in a genetically engineered animal and is intended to affect animal structure or function meets the definition of an animal drug . . .

Developers demonstrate that construct and new products expressed from construct are safe for the animal



>> Fit with suppression of Asian carp, zebra mussels or mice?

INTERNATIONAL ENVIRONMENT

Transborder movements inevitable, effects complex

CARTAGENA

- Article 17 "Unintentional Transboundary Movements and Emergency Measures" notify if released organism likely to have significant adverse effects on biodiversity or health.
- Other provisions treat movement of organisms as trade issue, with controls through ordinary border measures.

NAGOYA-KUALA LUMPUR SUPPLEMENT

- Article 27 - Parties to adopt process to define rules on liability and redress for damage from trans-border movements
- October 2014 Seoul . . . .?

INTERNATIONAL SECURITY

1925 GENEVA PROTOCOL

- Prohibits "bacteriological methods of warfare"
- Extends (by analogy) to viral agents . . . and more?

UN BIOLOGICAL WEAPONS CONVENTION

- Article 1 "general purpose criterion" bans development, production, or stockpiling of agents that have no justification for prophylactic, protective, and other peaceful purposes.
- National measures and Australia Group Guidelines rely on lists of organisms and toxins

USES OF LEAD TIME

Science nerds: Assess environmental and security effects, flag sources of uncertainty, direct research at uncertainty

- Effect of genetic instability of drives on environment
- Effect of lateral gene flow on diffusion of alterations
- Improve test methods - mesocosms and microcosms

Technology geeks: Modify organisms and uses to minimize risks by designing, testing and incorporating safety features

- Develop and test immunization drives
- Develop and test reversal drives
- Develop and test precision over generations

Policy wonks: Identify and address gaps in policy, fund research, foster informed public debate . . . .

- Functional approach -- not just lists of pathogens
- Red teaming / white hat hacking to flag misuses
- Public debate over benefit/risk in advance of release

SOME REACTIONS AND EXTENSIONS

SOME REACTIONS AND EXTENSIONS

OMG

Friends of the Earth

SOME REACTIONS AND EXTENSIONS

OMG

Don’t tell the muggles
They will panic

SOME REACTIONS AND EXTENSIONS

OMG

Don’t tell the muggles
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Don’t let Voldemort know.
Classify all information needed to create gene drives

SOME REACTIONS AND EXTENSIONS

OMG

Don’t tell the muggles
They will panic

Don’t let Voldemort know.
Classify all information needed to create gene drives

Malaria is nature’s way of controlling human population
Don’t eradicate malaria

90.9wbur “Kelly from Millbury” RADIO BOSTON

SOME REACTIONS AND EXTENSIONS

OMG

Don't tell the muggles
They will panic

Don't let Voldemort know.
Classify all information needed to create gene drives

Malaria is nature's way of controlling human population
Don't eradicate malaria

Gene drives will affect the global commons
We need global discussion of values and decision processes

ADAPTIVE RISK MANAGEMENT IN BIOTECHNOLOGY
APPLICATIONS TO SYNTHETIC BIOLOGY AND PHARMACEUTICALS

Public Symposium of Science, Technology, Innovation Governance Program
University of Tokyo
28 November 2014

Kenneth A. Oye
Political Science and Engineering Systems
Massachusetts Institute of Technology

Outline

Permissive, Precautionary and Adaptive Approaches
Exemplary Cases . . . and Cautionary Tales
Current Risk Governance in Biotechnology
- Synthetic Biology
- Pharmaceuticals

Future Convergence of Pharmaceuticals and Synthetic Biology?

The speaker gratefully acknowledges support from NSF Synthetic Biology Engineering Research Center, NSF Cellular and Molecular Biology, and MIT Center for Biomedical Innovation .

PoET MIT's Program on Emerging Technologies: Assessing Implications and Improving Responses
MIT CBI Center for Biomedical Innovation
SynBERC Synthetic Biology Engineering Research Center

TRADITIONAL DRUG DEVELOPMENT AND LICENSING

SPONSOR BUILDS CASE FOR SUPERIOR EFFICACY AND SAFETY

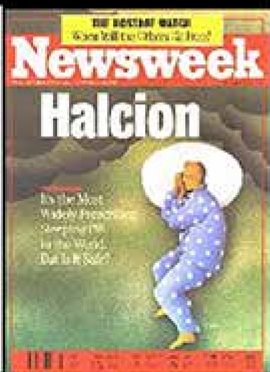
- Pre-IND Models / in Vitro Studies / Animal Studies
- Early Trials Small N human using mixed research designs
- Late Stage Large N human using confounder cleansed RCT

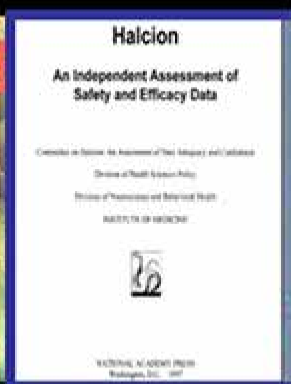
DRUG REGULATORS AND "MAGIC MOMENT"

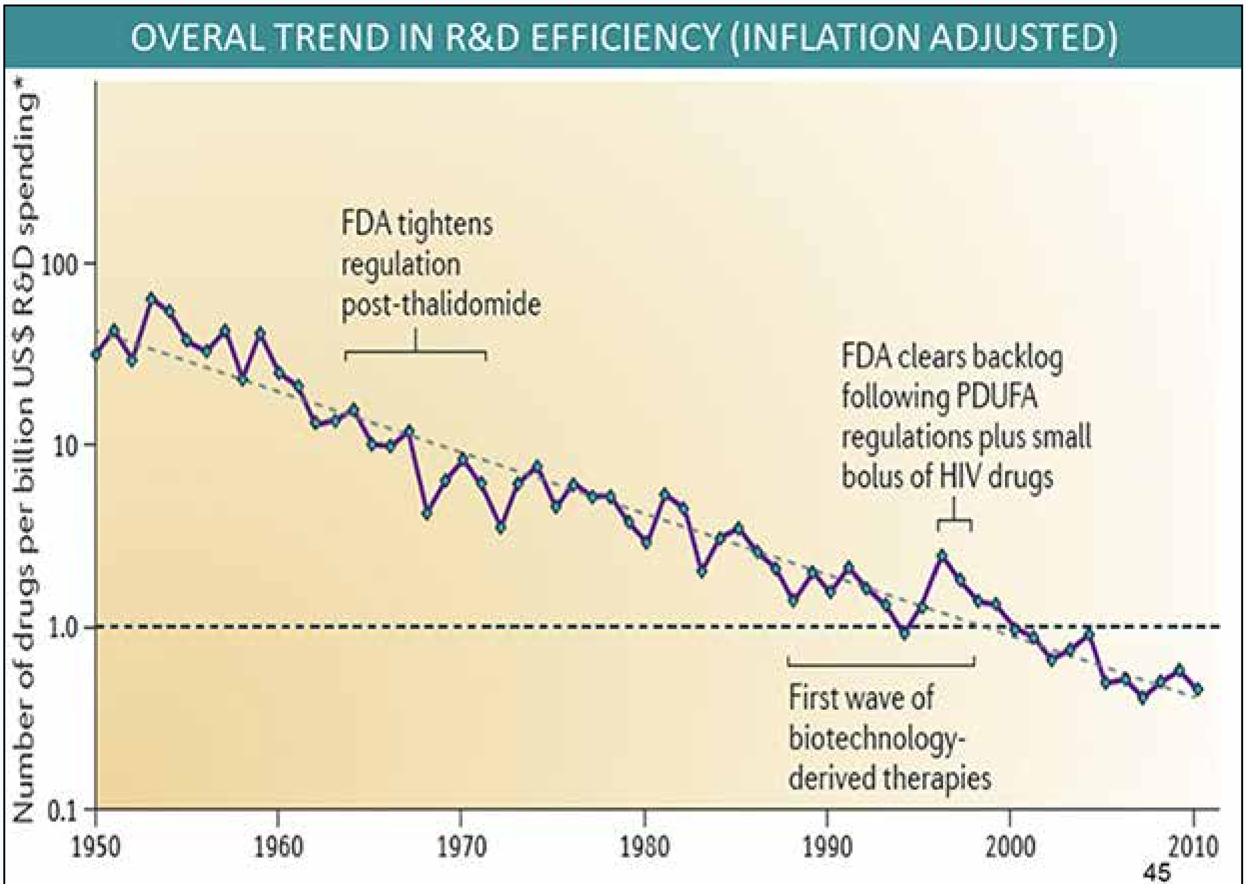
- Approve if dossier supports claims of superior efficacy / safety
- Most approvals without limits and controls on provider
- If known risks, add risk mitigation programs with registry

Crises Prompt Piecemeal Reforms

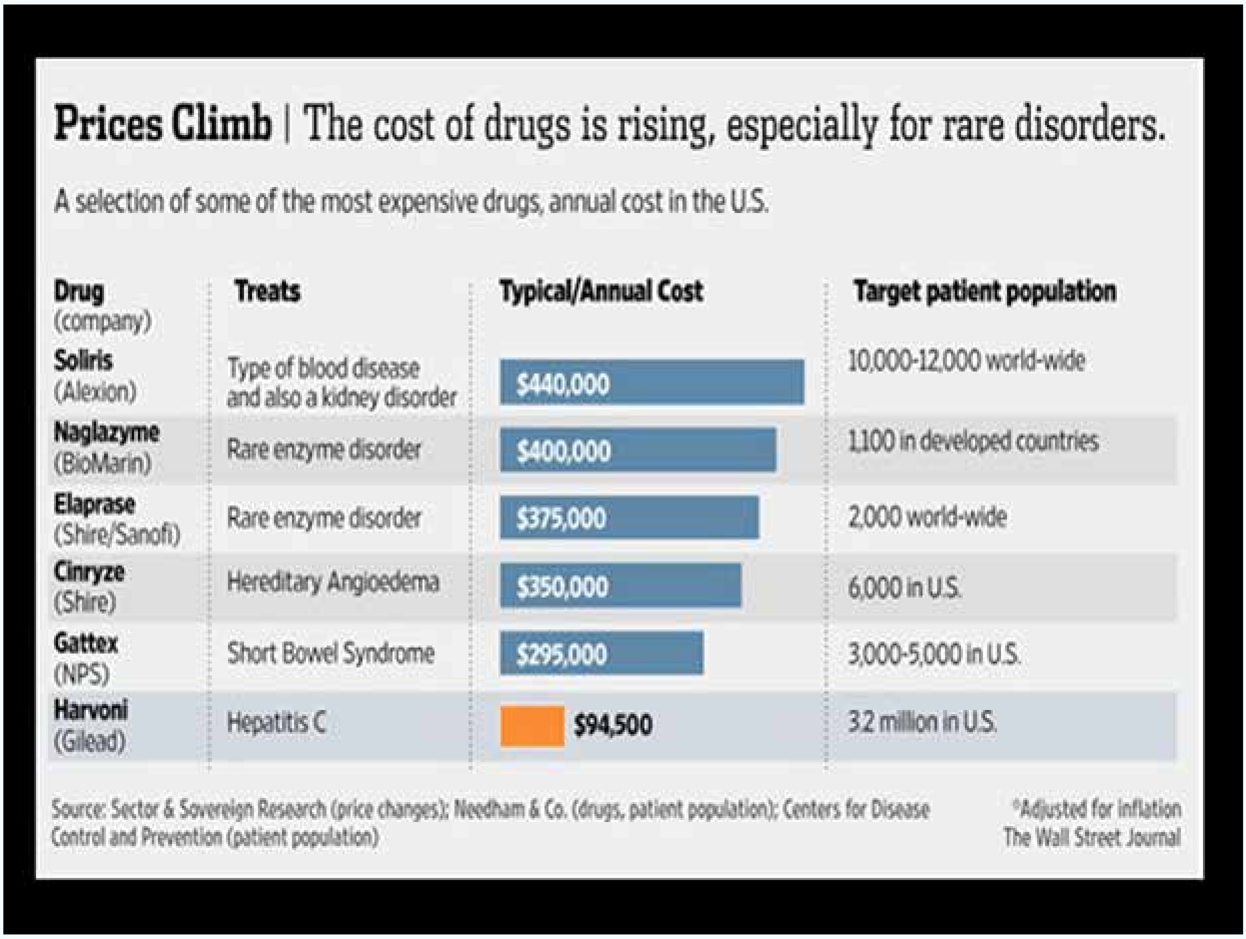
Thalidomide	>	safety data, surveillance
HIV AZT	>	earlier access / AA and CMA
Halcion, Accutane, Vioxx	>	surveillance, REMS/RMS
Gilead	>	▲ reform pricing, IPR, licensing?
Declining R&D efficiency	>	▲ reform pricing, IPR, licensing?





Scannell et al, *Nature Review Drug Discovery*, March 2012.



Prices Climb | The cost of drugs is rising, especially for rare disorders.

A selection of some of the most expensive drugs, annual cost in the U.S.

Drug (company)	**Treats**	**Typical/Annual Cost**	**Target patient population**
Soliris (Alexion)	Type of blood disease and also a kidney disorder	$440,000	10,000-12,000 world-wide
Naglazyme (BioMarin)	Rare enzyme disorder	$400,000	1,100 in developed countries
Elaprase (Shire/Sanofi)	Rare enzyme disorder	$375,000	2,000 world-wide
Cinryze (Shire)	Hereditary Angioedema	$350,000	6,000 in U.S.
Gattex (NPS)	Short Bowel Syndrome	$295,000	3,000-5,000 in U.S.
Harvoni (Gilead)	Hepatitis C	$94,500	3.2 million in U.S.

Source: Sector & Sovereign Research (price changes); Needham & Co. (drugs, patient population); Centers for Disease Control and Prevention (patient population)

*Adjusted for inflation
The Wall Street Journal

CURRENT PROBLEMS AND RESPONSES

LONGSTANDING PROBLEMS

- Patient demand for earlier access to break through therapeutics
- Confounder cleansed RCT bad predictor of safety/effectiveness
- Patients unnecessarily exposed to risks during early use

NEW PROBLEMS

- Indications splintering into smaller genetically defined sub-groups
- Increasing difficulty finding enough subjects for RCTs
- Limited competition among sponsors in smaller niches

CURRENT INITIATIVES

- Adaptive licensing: earlier + conditions/ observations + feedback
- Data sharing & analysis: front end RCTs / on market registries+EHRs
- Testing Technology: organoids partially displace human and animals

STATE OF THE ART

nature publishing group

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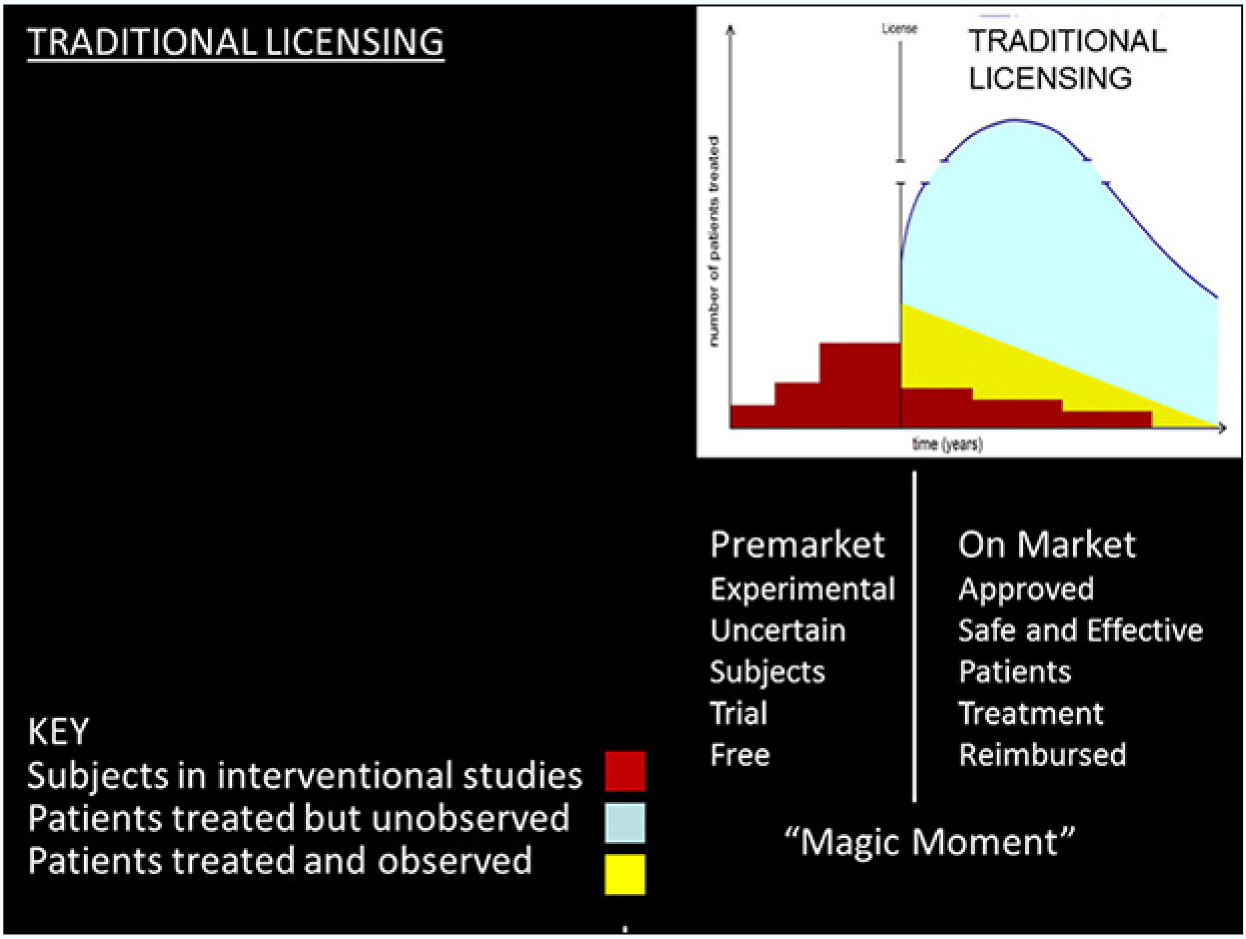
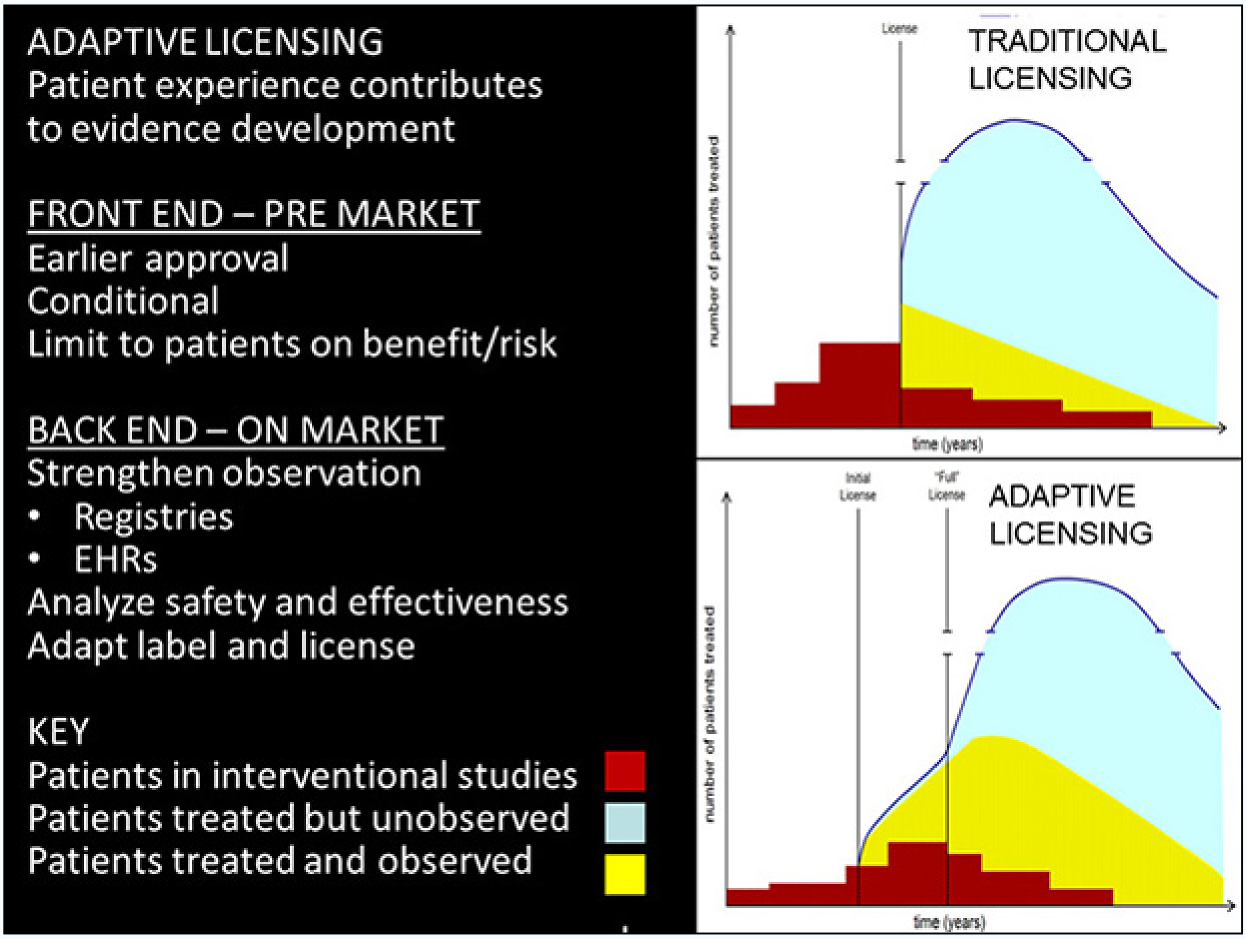
See COMMENTARY page 378

Adaptive Licensing: Taking the Next Step in the Evolution of Drug Approval

H-G Eichler[1,2], K Oye[2,3,4], LG Baird[2], E Abadie[5], J Brown[6], CL Drum[2], J Ferguson[7], S Garner[8,9], P Honig[10], M Hukkelhoven[11], JCW Lim[12], R Lim[13], MM Lumpkin[14], G Neil[15], B O'Rourke[16], E Pezalla[17], D Shoda[18], V Seyfert-Margolis[14], EV Sigal[19], J Sobotka[20], D Tan[12], TF Unger[18] and G Hirsch[2]

Traditional drug licensing approaches are based on binary decisions. At the moment of licensing, an experimental therapy is presumptively transformed into a fully vetted, safe, efficacious therapy. By contrast, adaptive licensing (AL) approaches are based on stepwise learning under conditions of acknowledged uncertainty, with iterative phases of data gathering and regulatory evaluation. This approach allows approval to align more closely with patient needs for timely access to new technologies and for data to inform medical decisions. The concept of AL embraces a range of perspectives. Some see AL as an evolutionary step, extending elements that are now in place. Others envision a transformative framework that may require legislative action before implementation. This article summarizes recent AL proposals; discusses how proposals might be translated into practice, with illustrations in different therapeutic areas; and identifies unresolved issues to inform decisions on the design and implementation of AL.


TRADITIONAL LICENSING
License
TRADITIONAL LICENSING
number of patients treated
time (years)
Premarket
Experimental
Uncertain
Subjects
Trial
Free
On Market
Approved
Safe and Effective
Patients
Treatment
Reimbursed
"Magic Moment"
KEY
Subjects in interventional studies
Patients treated but unobserved
Patients treated and observed


ADAPTIVE LICENSING
Patient experience contributes to evidence development
FRONT END – PRE MARKET
Earlier approval
Conditional
Limit to patients on benefit/risk
BACK END – ON MARKET
Strengthen observation
• Registries
• EHRs
Analyze safety and effectiveness
Adapt label and license
KEY
Patients in interventional studies
Patients treated but unobserved
Patients treated and observed
License
TRADITIONAL LICENSING
number of patients treated
time (years)
Initial License
"Full" License
ADAPTIVE LICENSING
number of patients treated
time (years)

FROM PREDICTION TO OBSERVATION AND MONITORING
Credit: Eichler OECD presentation 2014

Year	Drug > Adverse Effect	Detection Threshold
1950-60s	Thalidomide > phocomelia	10000 cases
2005	Natalizumab > PML	3 cases
2009	Pandemrix > narcolepsy	6 cases

Note: phocomelia — low background / high visibility event
Note: MI in diabetics — high background / low visibility events

nature publishing group
Open
PERSPECTIVES

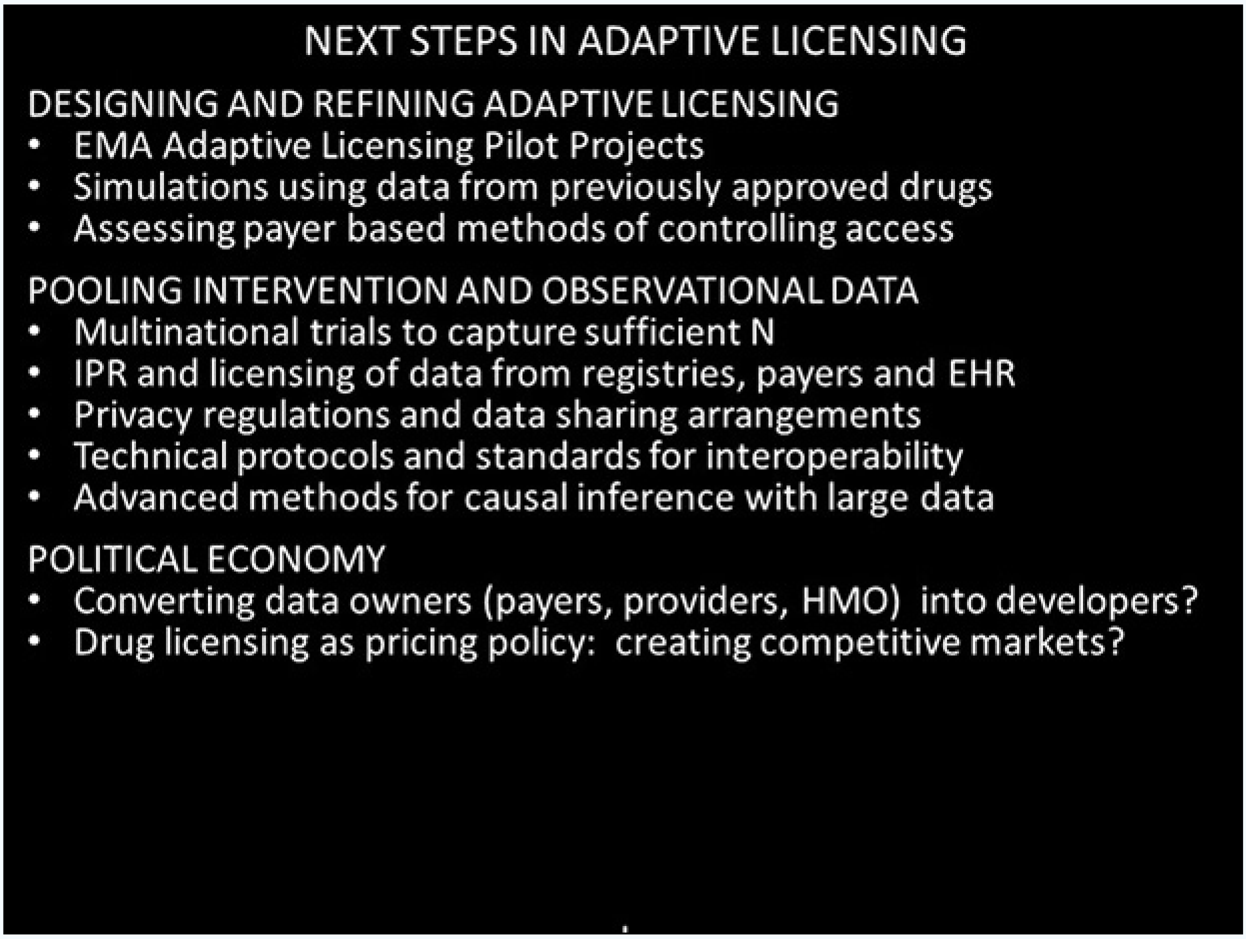
Legal Foundations of Adaptive Licensing
3 April 2012
European Medicines Agency, Canary Wharf, London, UK

Legal Foundations of Adaptive Licensing

K Oye[1], LG Baird[1], A Chia[2], S Hocking[3], PB Hutt[4], D Lee[5], L Norwalk[6] and V Salvatore[7]

In April 2012, MIT's Center for Biomedical Innovation and the European Medicines Agency (EMA) cosponsored a workshop on legal foundations of adaptive pharmaceuticals licensing. Past and present attorneys from the US Food and Drug Administration (FDA), the EMA, and Health Sciences Agency Singapore (HSA) found that existing statutes provided authority for adaptive licensing (AL). By contrast, an attorney from Health Canada identified gaps in authority. Reimbursement during initial phases of adaptive approaches to licensing was deemed consistent with existing statutes in all jurisdictions.


NATIONAL AND REGIONAL STEPS TOWARD ADAPTIVE LICENSING
Health Canada
Progressive Licensing Exercise (not approved) 2008
Parliament enacts afety reform / adaptive licensing 2014
European Medicines Agency
Pharmacovigilance legislation 2010
EFPIA planning IMI project on AL/MAPPs 2013
EMA/EUnetHTA drafting 3 year post market data plan 2013
EMA AL Pilots 2014
US IOM PCAST AND FDA
PCAST report recommends exploring SMU and AL 2013
Breakthrough product designation established 2012
• 64 requests for designation in year 1, 24 granted 2013
• 2 FDA-CMS parallel review pilot projects 2013
JAPAN PMDA
Conditional time limited approval regenerative medicine 2014
Forerunner Review Assignment 2014
Call for fostering International Trials and Data Sharing 2014
THE FUTURE OF DRUG SAFETY
Road map to 2015
Pmda


NEXT STEPS IN ADAPTIVE LICENSING
DESIGNING AND REFINING ADAPTIVE LICENSING
• EMA Adaptive Licensing Pilot Projects
• Simulations using data from previously approved drugs
• Assessing payer based methods of controlling access
POOLING INTERVENTION AND OBSERVATIONAL DATA
• Multinational trials to capture sufficient N
• IPR and licensing of data from registries, payers and EHR
• Privacy regulations and data sharing arrangements
• Technical protocols and standards for interoperability
• Advanced methods for causal inference with large data
POLITICAL ECONOMY
• Converting data owners (payers, providers, HMO) into developers?
• Drug licensing as pricing policy: creating competitive markets?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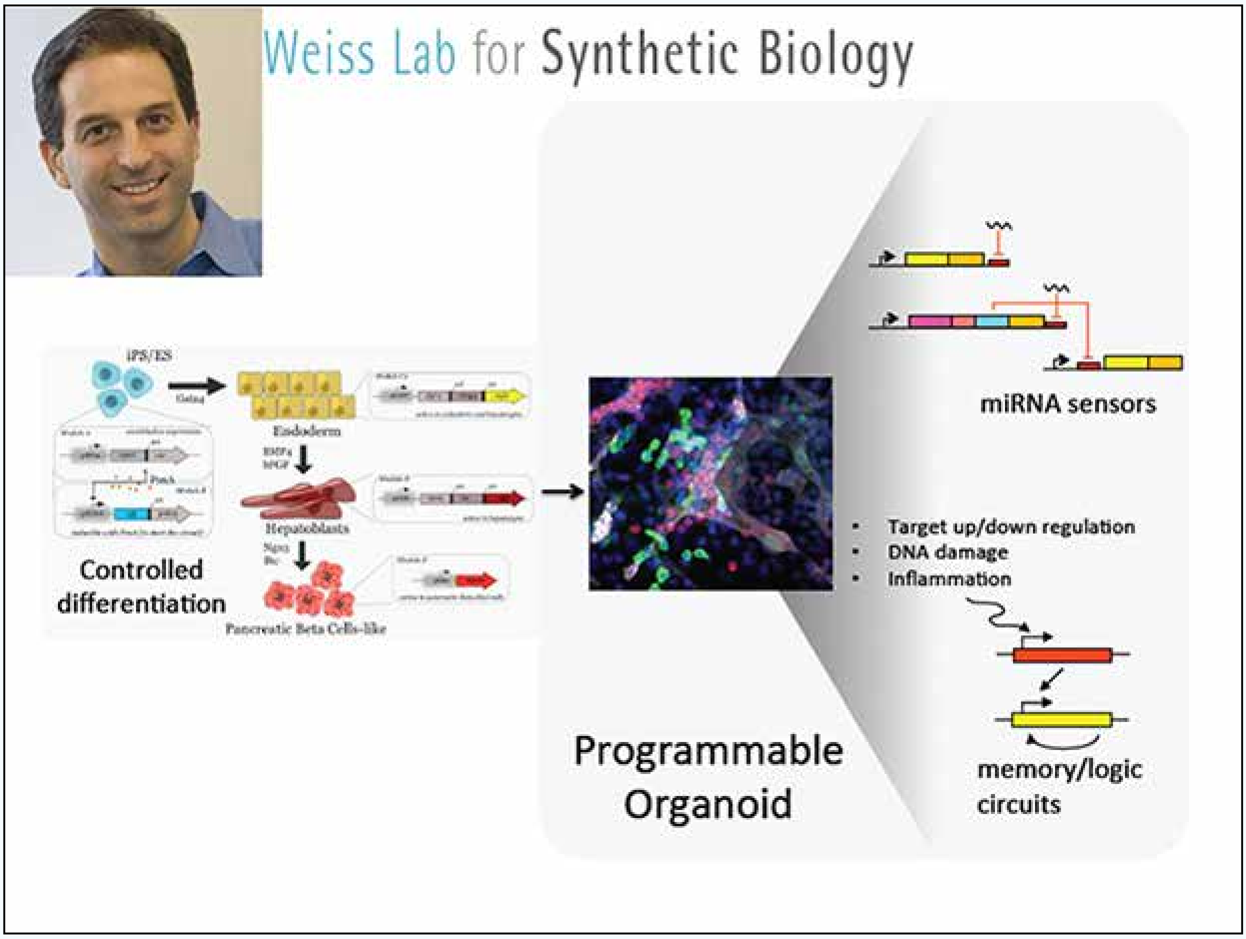
• Synthetic Biology
• Pharmaceuticals
Future Convergence of Pharmaceuticals and Synthetic Biology?
The speaker gratefully acknowledges support from NSF Synthetic Biology Engineering Research Center, NSF Cellular and Molecular Biology, and MIT Center for Biomedical Innovation .
PoET MIT's Program on Emerging Technologies: Assessing Implications and Improving Responses
MIT CBI Center for Biomedical Innovation
SynBERC Synthetic Biology Engineering Research Center


Weiss Lab for Synthetic Biology
iPS/ES
Endoderm
Hepatoblasts
Pancreatic Beta Cells-like
Controlled differentiation
miRNA sensors
Target up/down regulation
DNA damage
Inflammation
memory/logic circuits
Programmable Organoid

IDENTIFYING AND ADDRESSING BARRIERS TO COMMERCIALIZATION
PRACTICES WORK SUPPORTING PROGRAMMABLE ORGANOID TESTBED

GOALS

- Identify regulatory, IP, economic factors affecting commercial viability.
- Feedback from practices work to improve commercial viability of organoid design.
- Feedback from practices and testbed work to inform recommendations on policy design.

WORKPLAN

Fall 2014	Initial research on opportunities and barriers
Winter 2015	Focus group with investors, customers, regulators
Spring 2015	Follow up research with feedback to testbed and policy

SOME ISSUES TO BE INVESTIGATED

- Sponsor and regulatory acceptance for early stage use in IND applications
- Sponsor and regulatory acceptance for late stage use in development and licensing of ultra orphans and personalized drugs where recruitment of human subjects difficult/impossible
- Intellectual property rights issues associated with parts and methods used in testbed

BOTTOM LINE: Commercialization requires investor, customer and regulatory acceptance

BIOVENTURES INVESTORS
FLAGSHIP VENTURES
Fidelity INVESTMENTS

gsk GlaxoSmithKline
NOVARTIS
Bristol-Myers Squibb
AMGEN
Johnson & Johnson

FDA
Health Canada Santé Canada
EUROPEAN MEDICINES AGENCY

International Genetically Engineered Machine Competition (iGEM) as testbed

2004	5 teams with 70 participants from US universities
2007	54 teams from 19 nations - Beijing wins
2010	130 teams – Slovenia wins
2014	230 teams – with East Asia, South Asia, Africa

Universitas Indonesia November 2014: *E.coli* detects quorum sensing signal molecule fCAI-1 of *v cholerae*, activates motility gene CheZ, degrades biofilm by secreting α-amylase, nuclease, and substilisin to break down matrix and secretes peptide 1018 to kill.

华大基因
BGI

Decode life

Explore the future

Experience brilliant life

Partnerships and Acquisitions

Complete Genomics, Biogenode SA

Davis, Baltimore , Philadelphia, London

Regulatory Differences and Strategies?

Security - Australia Group Guidelines

Environment – GMO Testing & Field Release

Privacy - Genetic Data Protection Regulations

CONVERGENCE SYNTHETIC BIOLOGY & PHARMACEUTICALS?

Pharmaceuticals: blockbusters to orphans to ultraorphans to personalized

- Economic reasons – exclusivity extensions / underexplored areas
- Scientific and medical reasons – advances in sequencing and genetics
- Political - stronger organizations of rare diseases

Synthetic Biology and Bio-Informatics: faster/cheaper/precise

- Sequencing: exponential expansion of genetic information at low cost
- Bioinformatics: DNA + electronic records > genetic bases of diseases
- Synthetic Biology: faster/cheaper genetic engineering
  > clinical implications for gene therapies, biologicals, precision guided drugs
  > development implications include organoids as testing tools

Emerging Risk Governance Policy Challenges

- Large N clinical trials ⇔ Smaller target patient pools
- Approval of single asset ⇔ Multiple assets variations on themes
- End-to-End adaptive and discriminating safety management
- Efficacy-to-Effectiveness demonstration to satisfy payer demands

Emerging Risk Governance Technical Challenges

- Develop and certify organoids for use in early and late stage testing
- Integrate heterogeneous medical data sources
- Detect signals and patterns in heterogeneous noisy observational data
- Simulate proposed policies using dossiers and EHRs of approved drugs

ACKNOWLEDGEMENTS

MIT SynBio Policy Group: (R) Robert Reardon, Ralph Turlington, Allen Lin, Scott Mohr, Jeanne Guillemin, Kirk Bansak. (F) Kenneth Oye, Shlomiya Bar-Yam, Sarah Jane Vaughan. (N) Evan Appleton, Kelly Drinkwater, Julie McNamara, Gautam Mukunda, Ala'a A Siam

Sponsors
Paula Olsiewski Sloan
Theresa Good NSF
Keith Roper NSF
Mark Segal EPA

SynBERC Synthetic Biology Engineering Research Center

Woodrow Wilson International Center for Scholars

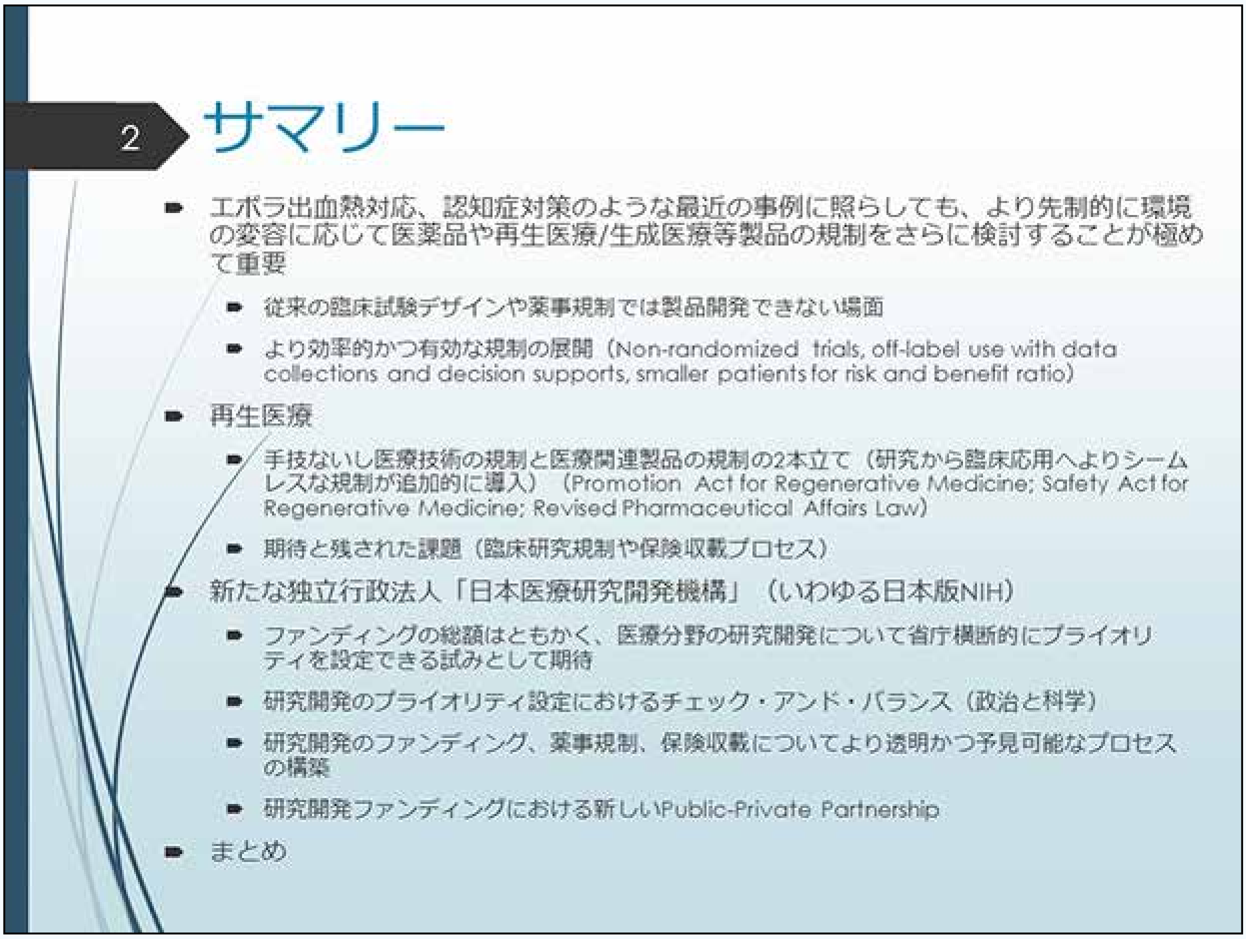
Pharmaceuticals Partners
Gigi Hirsch, Lynn Baird, Magda Papadaki MIT
Hans-Georg Eichler EMA
Mac Lumpkin Gates Foundation
Sarah Garner NICE-CASME
Robyn Lim Health Canada
Thomas Unger, Pfizer

Synthetic Biology Partners

David Rejeski	Woodrow Wilson Center
Todd Kuiken	Woodrow Wilson Center
Randy Rettberg	iGEM
Piers Millett	UN BWC
Genya Dana	US Department of State
George Church	Harvard University
Peter Carr	MIT Lincoln Laboratories
Dan Ducat	Michigan State University
Patrick Boyle	Ginko Bioworks
Toby Richardson	SGI-DNA
Kirsten Jacobsen	Public Health Canada

61

• Response Presentation: Chiaki Sato



3 再生医療と再生医療等製品の規制
- さまざまな可能性を秘めたトライアル

- 再生医療の規制
  - 再生医療等安全性確保法（臨床研究・自由診療） - 手技ないし医療技術、リスク分類あり

  ※法の対象範囲の問題: See, e.g., The U.S. v. Regenerative Sciences, LLC, 741 F.3d 1314 (D.C. Cir. 2014)
  - 医薬品医療機器等法（再生医療等製品） - 製品
- 医薬品医療機器等法に基づくいわゆる「条件・期限付き承認」
  - 有効性については、一定数の限られた症例から、従来より短期間で有効性を推定
  - 安全性については、急性期の副作用等は短期間で評価を行うことが可能とされる
  - 人の細胞を用いることから、個人差を反映すると品質が不均一となるため、有効性を確認するためデータの収集・評価に長時間を要する
- 再生医療分野にかかわらず、個別化医療で議論されているのは、まさに上記のようなこと
- 対象患者群が少なく、アンメットメディカルニーズの高い分野への応用がありうるか

Resource: See, e.g., 厚生労働省「再生医療等の安全性の確保等に関する法律について」available at www.mhlw.go.jp/file/06-Seisakujouhou-10800000-Iseikyoku/0000066162.pdf; 荒木裕人「厚生労働省における 再生医療に関する取組について」（2013年2月21日）; Deborah Armstrong, et al., The Role of Non-Randomized Trials for the Evaluation of Oncology Drugs, Issue Brief for Conference on Clinical Cancer Research, November 2014

4 新たな独立行政法人「日本医療研究開発機構」の展望
- 長期的視点で改革を続けられるかが鍵

- ファンディングの総額はともかく、医療分野の研究開発について省庁横断的にプライオリティを設定できる試みとして期待
- 健康・医療戦略推進法のもとで、研究開発のプライオリティ設定におけるチェック・アンド・バランスが適切に働くか（政治と科学）
  - 健康・医療戦略（閣議決定）、医療分野研究開発推進計画（本部決定）、そして日本医療研究開発機構における業務運営の基本方針（本部決定）という流れで、科学者が果たしうる、ないし果たすべき役割
- 研究開発のファンディング、薬事規制、保険収載についてより透明かつ予見可能なプロセスの構築
  - See,e.g., National Medical Device Postmarket Surveillance System Planning Board
- 研究開発ファンディングにおける新しいPublic-Private Partnershipの必要性
  - 医薬品については、See,e.g., the U.S. NIH's Funding Opportunities to Repurpose Drug Candidates from Industry

5

まとめ
-終わりのない改革がこれからも続く

- 再生医療および再生医療等製品の規制は、これが終局的な形というわけではない
  - 新しい可能性を他の医療技術や医療関連製品に切り開く試み
  - 他方、技術水準の変容や新しい知見によって異なる規制が必要になるかもしれない
  - 米国と欧州の規制の動向に留意して、絶え間ない改革を覚悟できるかどうか
  - 臨床研究についての適切な法規制は、その第一歩となりうる
- 新たな独立行政法人「日本医療研究開発機構」の成否については、相当な期間を経てはじめて議論できる
  - 法的課題としては、健康・医療戦略本部を中心とした体制で研究開発のプライオリティ設定におけるチェック・アンド・バランスを確立すること
  - トランスレーショナル・リサーチやサイエンスでいきなり成果を上げるのは、歴史的にみても極めて難しそう
  - 他方、枯渇しつつある医薬品のシーズなどへの対応について、新しいPPPの在り方を検討する必要がある

6

Thank you so much for your attention!

chiakist@pp.u-tokyo.ac.jp
CSato@brookings.edu

Weakening Scientific Integrity

- Case Study of BioScience in Japan -

Sotaro SHIBAYAMA
& Yasunori BABA

UTokyo Sch Eng / RCAST

STIG International Symposium 2014
Making the Most of Science and Innovation through Better Governance
Nov 28 2014

Deviation from Honesty is a Major Risk

- Decentralized governance of academic science (Merton 1974)
  - Driven by scientific publications
  - Scrutinized (usually) based on voluntary services of peer
- Premise of scientific honesty
  - Core value to sustain the decentralized system
    - Singapore Statement, etc.
  - Too costly to uncover deliberate lies
- Dishonest publications
  e.g., Fabrication, falsification, plagiarism, etc.
  - Damage various stakeholders
    - Academia: compromise subsequent studies (Azoulay et al. 2012)
    - Users of scientific knowledge: e.g., biased clinical research (Dwan, 2008)
    - Sponsors: undermine the reputation of organizations and countries

2

Goal of this study

- Understanding the mechanism behind dishonesty is essential for "better governance" of science.
- Limitation of previous studies
  - Difficult to measure (desirability bias)
  - Too rare incidents to do any analysis
- This study
  - Focus on "questionable research practices"
    - Rather mild dishonesty, more common & less desirability bias
  - Offer description as a preliminary step

3

Questionable Research Practices

Examples

- Fragmentation of publication (salami-slicing)
- Abuse of authorship
- Failing to present data that contradict one's own previous research
- Unauthorized use of confidential information
- Withholding details of methodology or results in papers or proposals

:

:

Dishonesty Conformity

"Authors reluctantly obey referees' instructions in order to have their papers accepted even if they contradict the author's scientific belief"

[Frey (2003) coined "academic prostitution."]

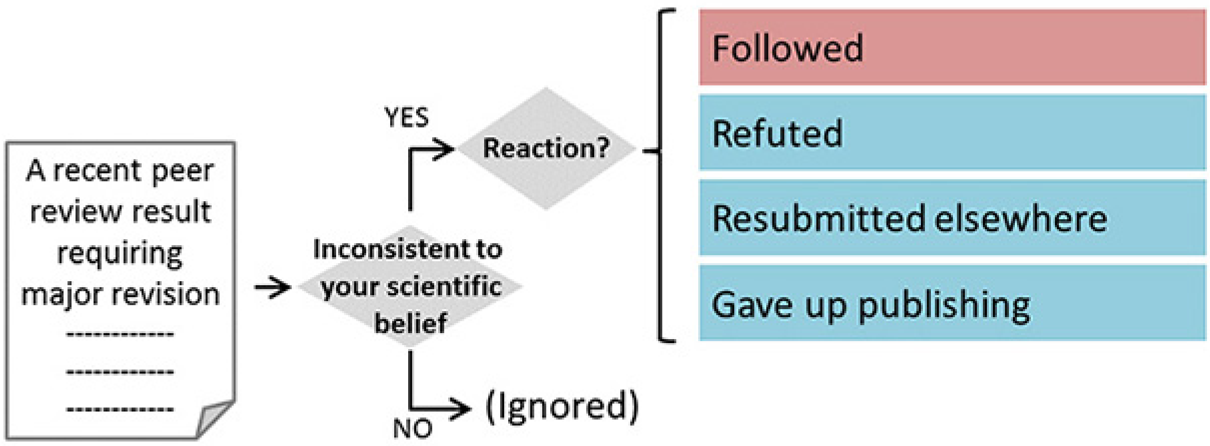
4

Empirical Approach
- Questionnaire survey -

- 360 professors in Biosciences in Japanese universities
  - Nov 2013 – Jan 2014
  - Response rate: 46%
  - Medicine (33%), Agriculture (17%), Basic Bio (51%)
  - Associate prof (41%), Full prof (59%)
  - Female (7%), Male (93%)

5

Measurement
- Dishonest Conformity -



6

Potential Determinants of Dishonesty

- Competition
- Associate Prof > Full Prof
- Low performers > High performers
- Basic (Bio) > Applied (Med/Agr)
- Low-IF Journal
- No int'l experience > 1 year+ abroad (mostly in the US)

7

Summary

- Implication
  - Publish-or-perish culture
  - Lack of training for scientific integrity
  - Cultural difference (b/w fields, countries)
  - Isolation from international community
- Future direction
  - Different types of dishonesty
  - Qualitative description
  - Other contexts: countries, fields, etc.

8


STIG
SCIENCE,TECHNOLOGY, AND INNOVATION GOVERNANCE
GraSPP
THE UNIVERSITY OF TOKYO
****
"Recent Trends in Risk Governance in Europe: From Precaution to Smarter Regulations"
****
STIG International Symposium
The University of Tokyo, 28 November 2014
Michael D. Rogers
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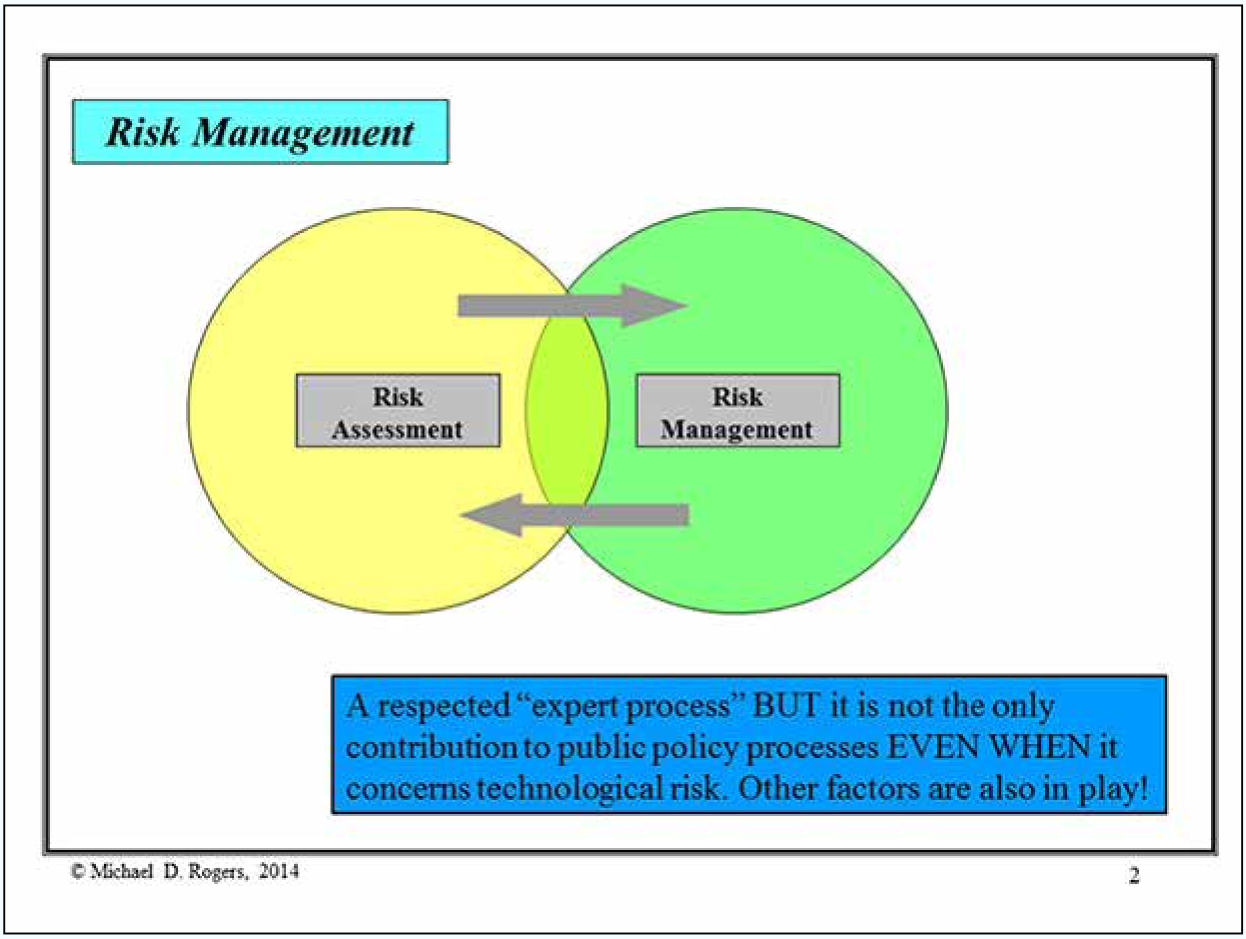
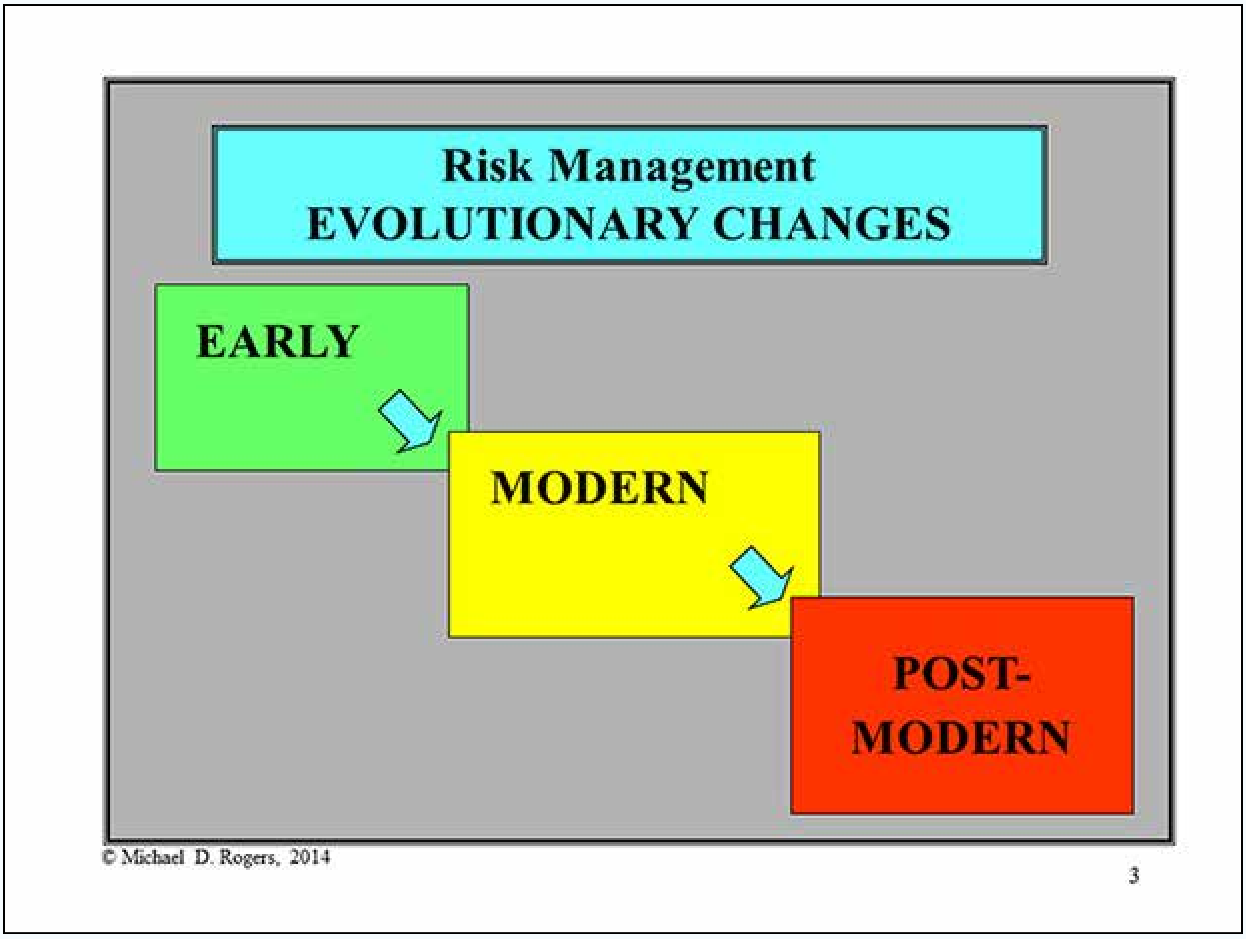
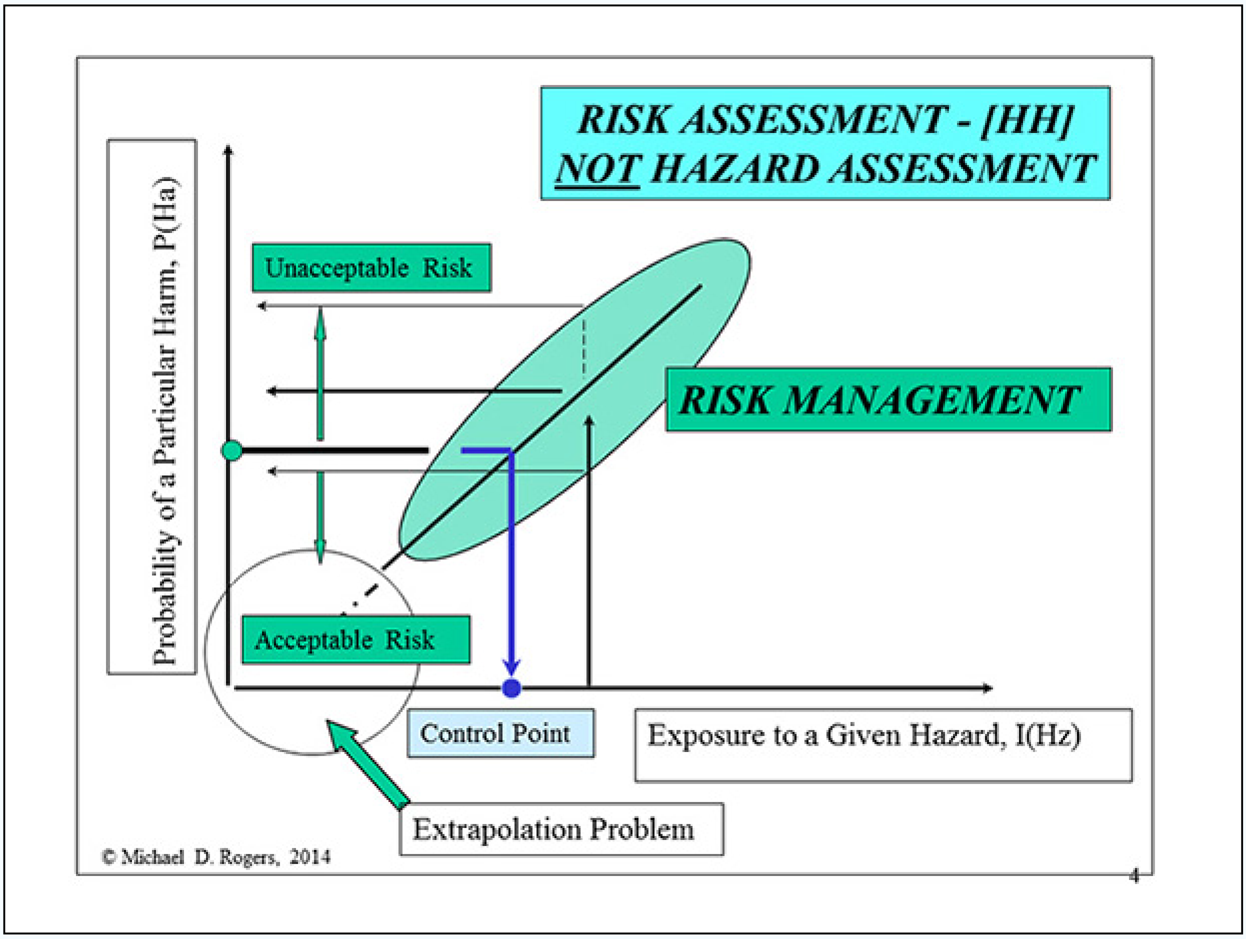
1


Risk Management
Risk Assessment
Risk Management
A respected "expert process" BUT it is not the only contribution to public policy processes EVEN WHEN it concerns technological risk. Other factors are also in play!
© Michael D. Rogers, 2014
2


Risk Management
EVOLUTIONARY CHANGES
EARLY
MODERN
POST-
MODERN
© Michael D. Rogers, 2014
3


RISK ASSESSMENT - [HH]
NOT HAZARD ASSESSMENT
Probability of a Particular Harm, P(Ha)
Unacceptable Risk
RISK MANAGEMENT
Acceptable Risk
Control Point
Exposure to a Given Hazard, I(Hz)
Extrapolation Problem
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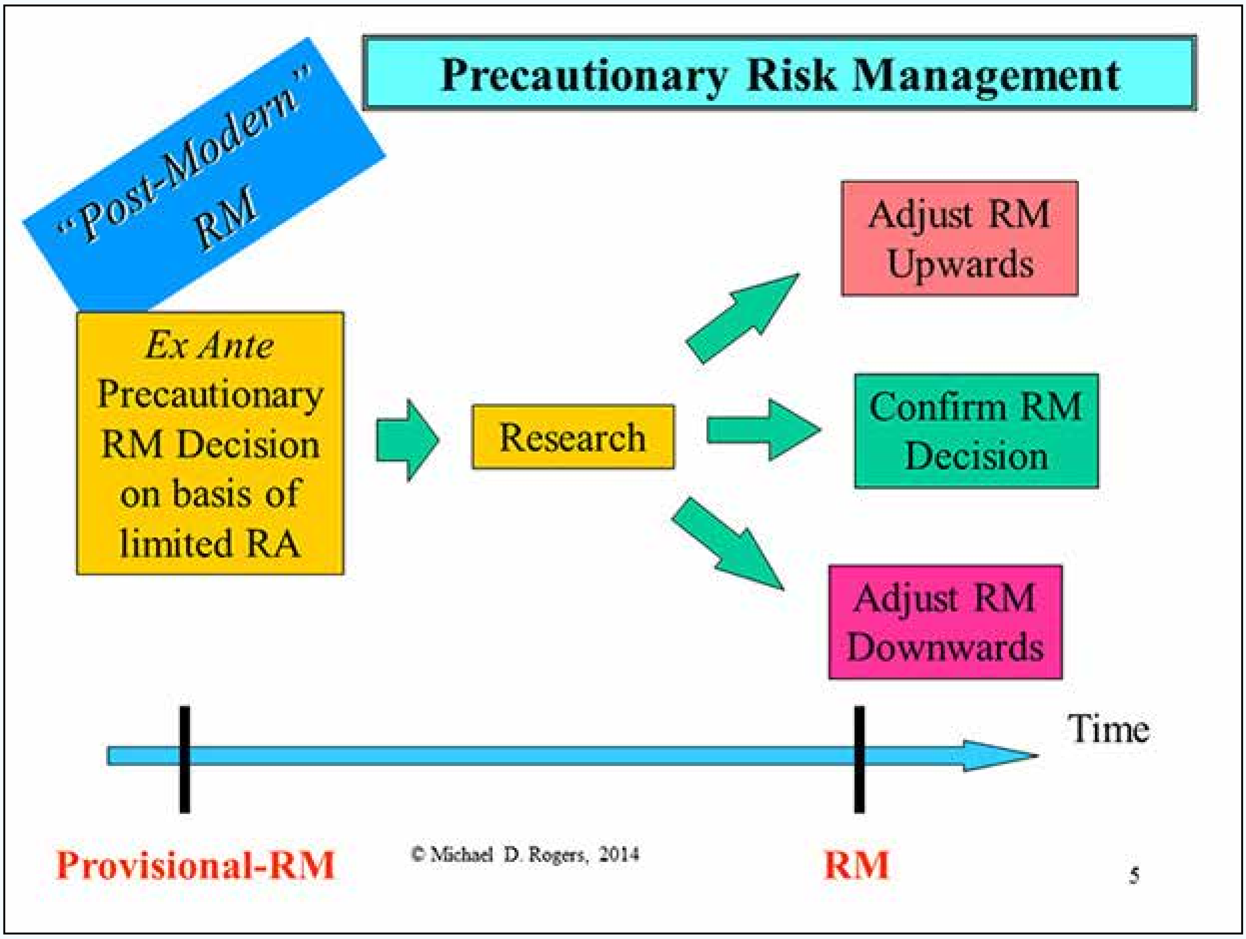
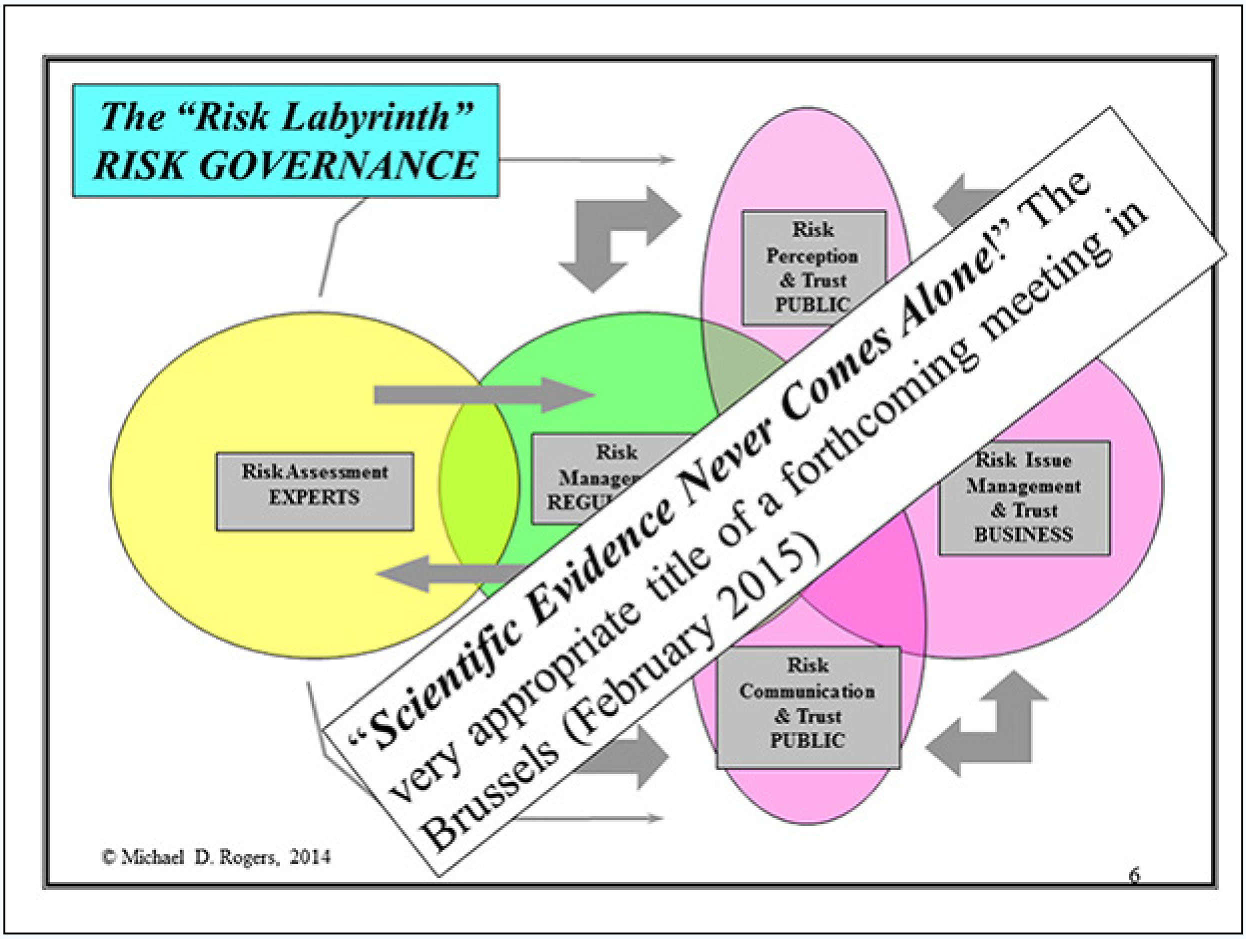
4



Precautionary Risk Management
"Post-Modern" RM
Ex Ante Precautionary RM Decision on basis of limited RA
Research
Adjust RM Upwards
Confirm RM Decision
Adjust RM Downwards
Time
Provisional-RM
© Michael D. Rogers, 2014
RM
5



The "Risk Labyrinth" RISK GOVERNANCE
Risk Perception & Trust PUBLIC
Risk Assessment EXPERTS
Risk Issue Management & Trust BUSINESS
Risk Communication & Trust PUBLIC
"Scientific Evidence Never Comes Alone!" The very appropriate title of a forthcoming meeting in Brussels (February 2015)
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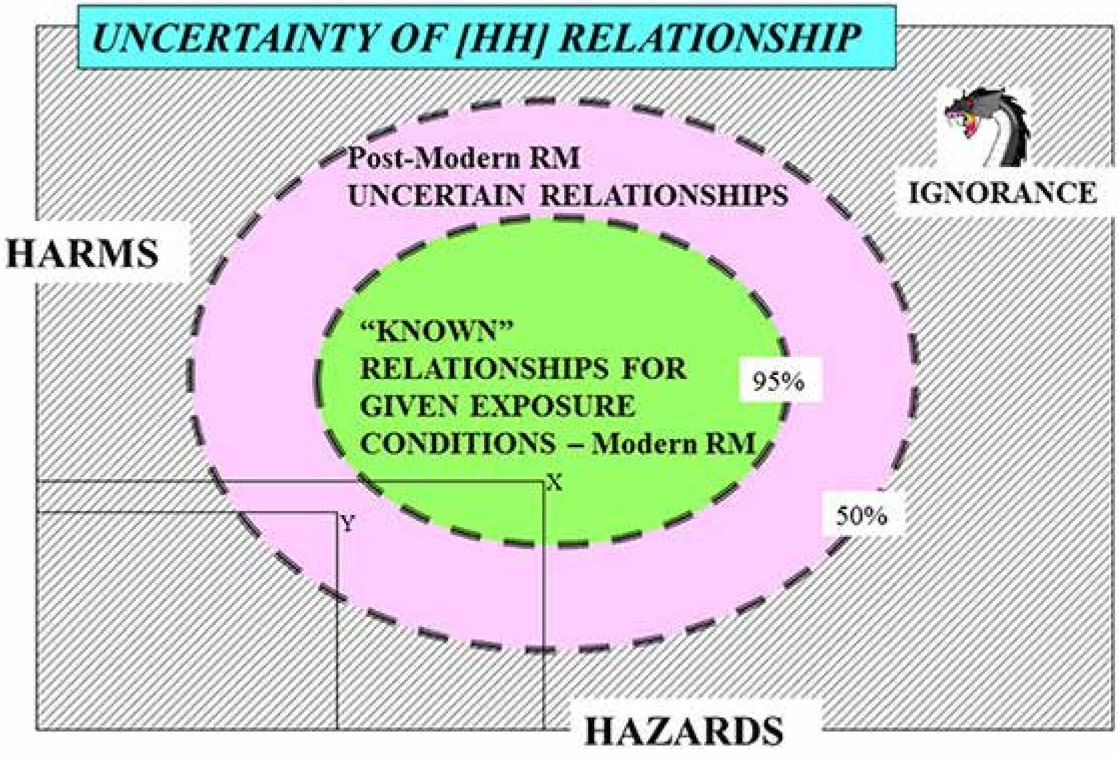
6



7

THE PRECAUTIONARY PRINCIPLE

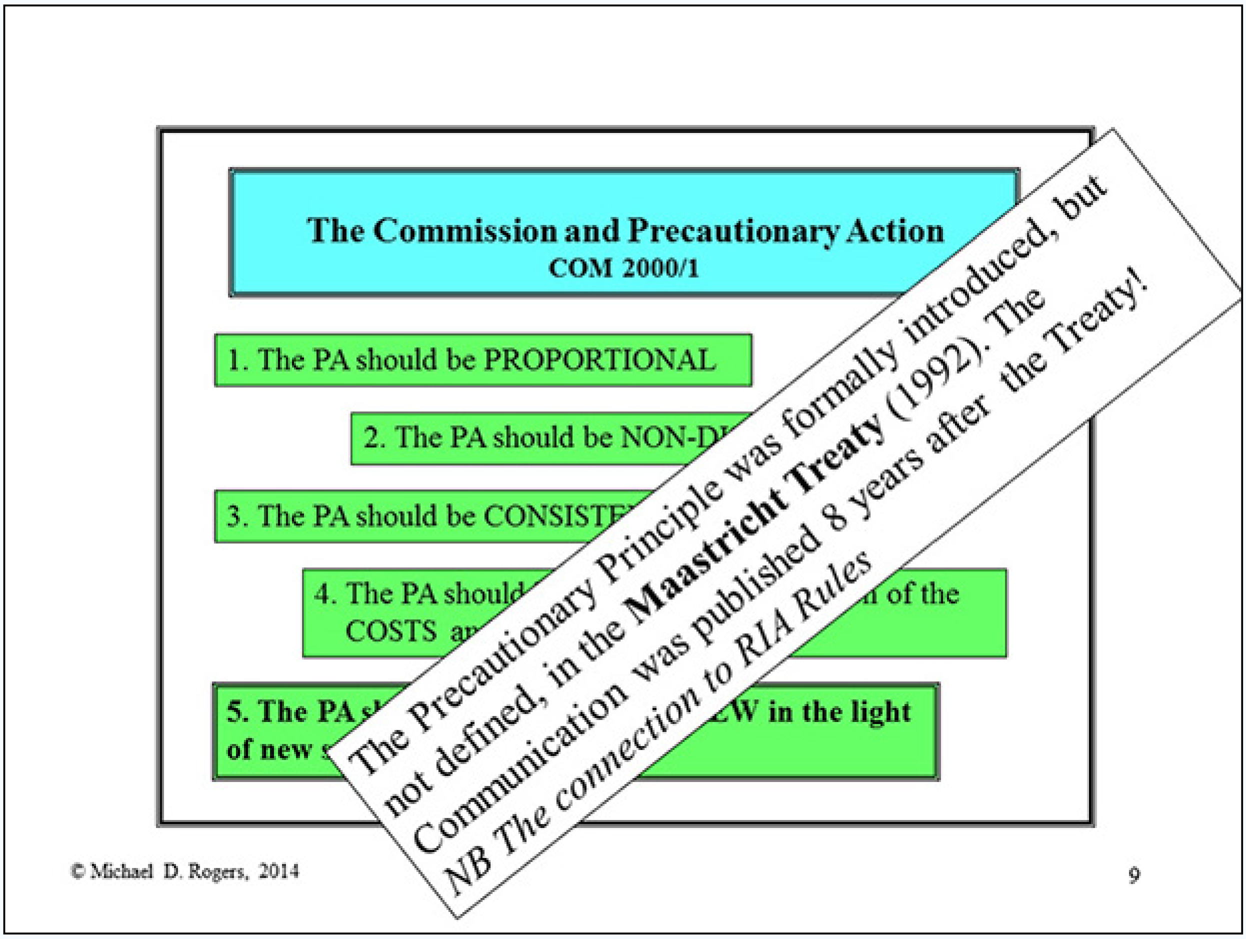
* DEFINITIONS *

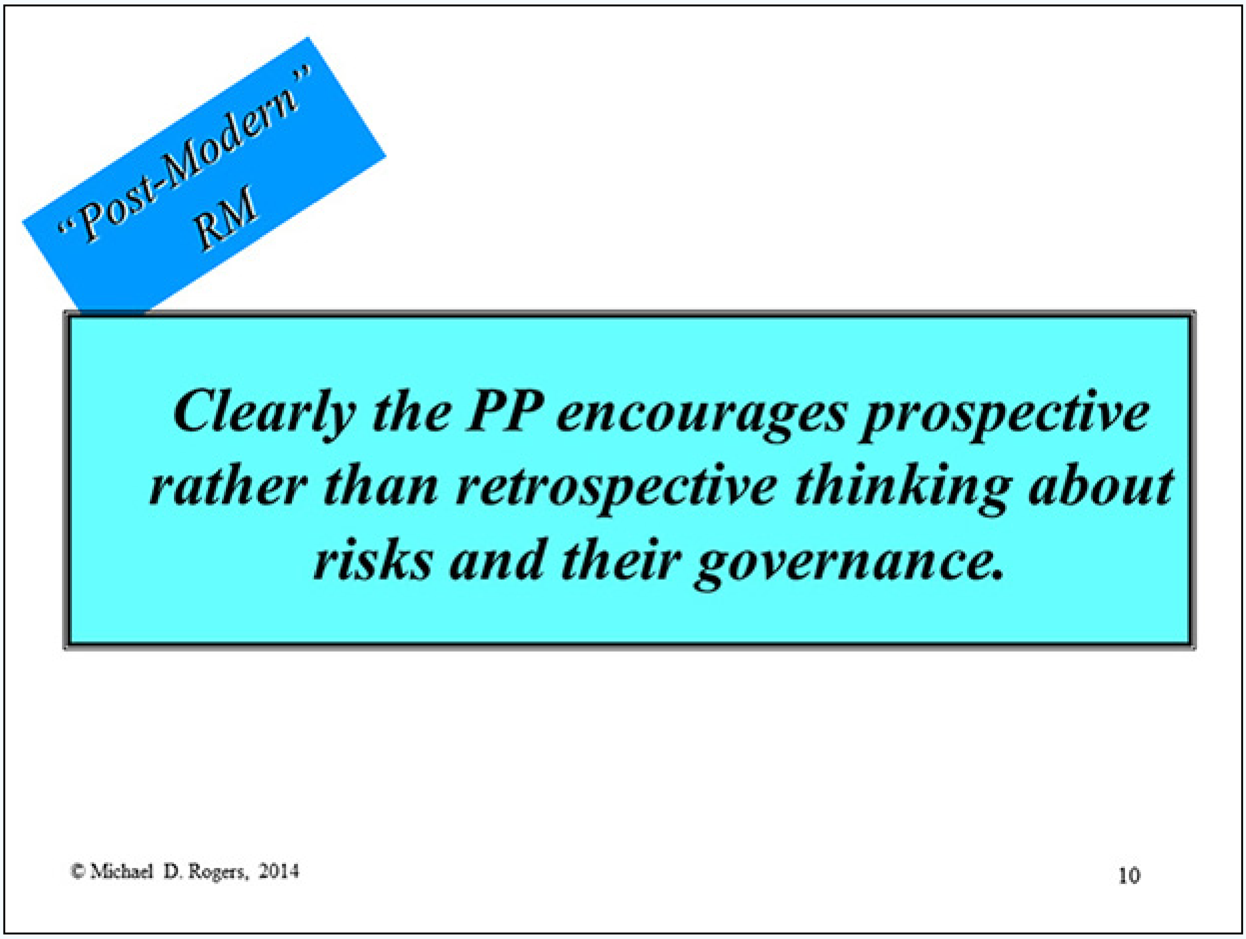
PP Definition 1 (PP1): Regulators faced with scientific uncertainty about a risk are justified in acting to prevent it. (**PERMISSION**)

PP Definition 2 (PP2): Regulators faced with scientific uncertainty about a risk are required to act to prevent it. (**OBLIGATION**)

PP Definition 3 (PP3): Regulators faced with scientific uncertainty about a risk should require the risk-generator to demonstrate that the risk level is either acceptable or justified by proposed risk management procedures before the activity is approved. (**TRANSFERRED OBLIGATION**)

8


The Commission and Precautionary Action
COM 2000/1
1. The PA should be PROPORTIONAL
2. The PA should be NON-DI
3. The PA should be CONSISTE
4. The PA should
COSTS an
of the
5. The PA s
of new s
W in the light
The Precautionary Principle was formally introduced, but not defined, in the Maastricht Treaty (1992). The Communication was published 8 years after the Treaty!
NB The connection to RIA Rules
© Michael D. Rogers, 2014
9


"Post-Modern" RM
Clearly the PP encourages prospective rather than retrospective thinking about risks and their governance.
© Michael D. Rogers, 2014
10

The Precautionary Decision to Ban the use of BST in Milk Production

A 1990 Council Decision prohibited the administration of rBST in any form to dairy cattle for a period of 10 years except for the purposes of carrying out scientific and technical trials.

It was considered that the various potential harms arising from the use of substances like BST were not sufficiently clear and that a period of time should be provided for in-depth studies.

In 1999 the precautionary action under scientific and technical uncertainty was made permanent based on research that had demonstrated that BST increased the risk of mastitis, etc. (animal welfare not human harm)

11

Comparing Precaution in the US and the EU
- (1) Some Particular Examples -

EU MORE PRECAUTIONARY?
Hormones in Beef Production
Hormones in Milk Production
GMOs – Crop GMOs – Foods
Toxic Chemicals
Phthalates as Softeners
Climate Change (Kyoto and the reduction of Greenhouse gases)
Antibiotics in Feed
Acrylamides
Promoting the use of Diesel for Cars: (Rationale – Climate Change)

US MORE PRECAUTIONARY?
BSE in Beef (early import ban but not early ban on the use of animal protein in feed)
BSE and Blood Donations
New Drug Approval (cf. Thalidomide story)
Early moves to phase out CFCs
Nuclear power
Children's Health?
Vehicle emissions: Early moves to phase out lead in fuel
Not using Diesel for cars: (Rationale - particulate emissions and health)

12

Comparing Precaution in the US and the EU - (2) A Broader Study -

Clearly, there are divergences, BUT they go in both directions: sometimes greater EU precaution (e.g. hormones in beef), and sometimes greater US precaution (e.g. air pollution, especially concerning fine particulate matter)

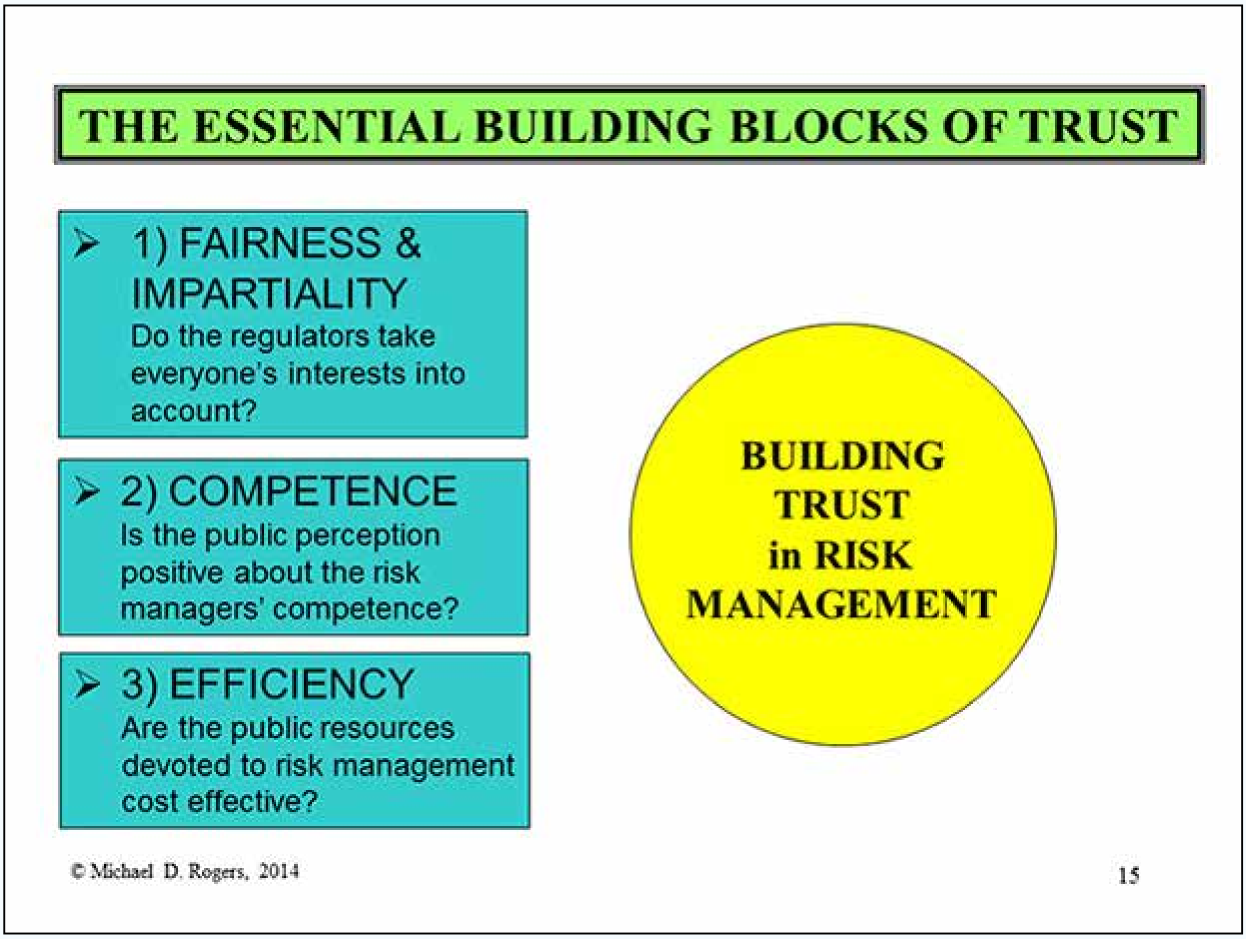
However, a larger study of almost 3,000 risks from the years 1970-2005 indicated that US and European standards are, on average, **in parity as far as precautionary risk management is concerned.**

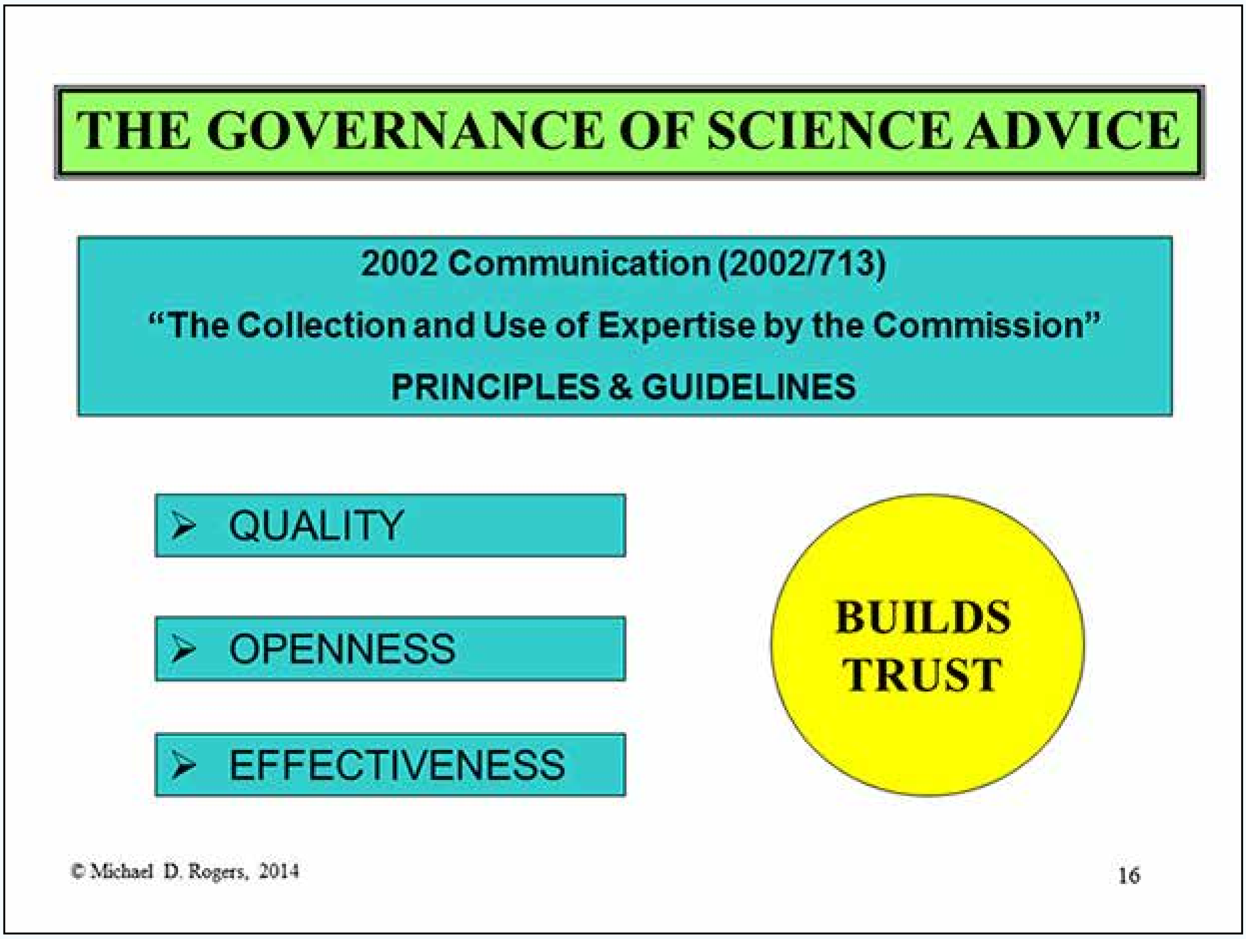
13

Project Spin-Off Value Concerning TTIP

Consequently, this research indicates that regulatory convergence through TTIP would not necessarily lower standards in Europe – or in the US. It could lead to a variety of changes, including risk management improvements in both jurisdictions.

14


THE ESSENTIAL BUILDING BLOCKS OF TRUST
1) FAIRNESS & IMPARTIALITY
Do the regulators take everyone's interests into account?
2) COMPETENCE
Is the public perception positive about the risk managers' competence?
3) EFFICIENCY
Are the public resources devoted to risk management cost effective?
BUILDING TRUST in RISK MANAGEMENT
© Michael D. Rogers, 2014
15


THE GOVERNANCE OF SCIENCE ADVICE
2002 Communication (2002/713)
"The Collection and Use of Expertise by the Commission"
PRINCIPLES & GUIDELINES
QUALITY
OPENNESS
EFFECTIVENESS
BUILDS TRUST
© Michael D. Rogers, 2014
16

Appointment of Chief Scientific Adviser to the President of the European Commission

Professor Anne Glover was appointed in December 2011

Highly qualified: Holds a chair in Molecular and Cell Biology at the University of Aberdeen

Advice: "There is no evidence that GM technologies are any riskier than conventional breeding technologies and this has been confirmed by thousands of research projects"

European "Green" Organisations Call for her Dismissal and seem to have been successful!

17

Regulatory Impact Assessment in the European Commission

Introduced in 2002: It assesses the potential impacts of new legislation or policy proposals on the **economic** (includi[...] competitiveness), **social (i.e. equity),** and **environ**[...]

All major policy initiatives and legislative pr[...] Commission's work programme

A **balanced** appraisal of all impacts [...]ether the allocated resources for the RIA are **prop**[...] the expected nature of the proposal and its likely i[...]

A wide-ranging **cons**[...] all stakeholders is an integral part of the EC im[...]ent approach

Only two Years After the Communication on the Precautionary Principle – Regulatory Evolution

18

REACH
(Registration, Evaluation & Authorisation of Chemicals)
Extended RIA
(SEC (2003) 1171/3)

➢PROBLEM: Previous legislation unfit for purpose ("Old/New" split 1981)

➢POLICY OPTIONS: Reform necessary but could be left to Member States; Proportionality test; Chemical industry role; International obligations; etc

➢INDUSTRY ASPECTS: Trade and competitiveness issue; Production and employment; Environmental performance; etc

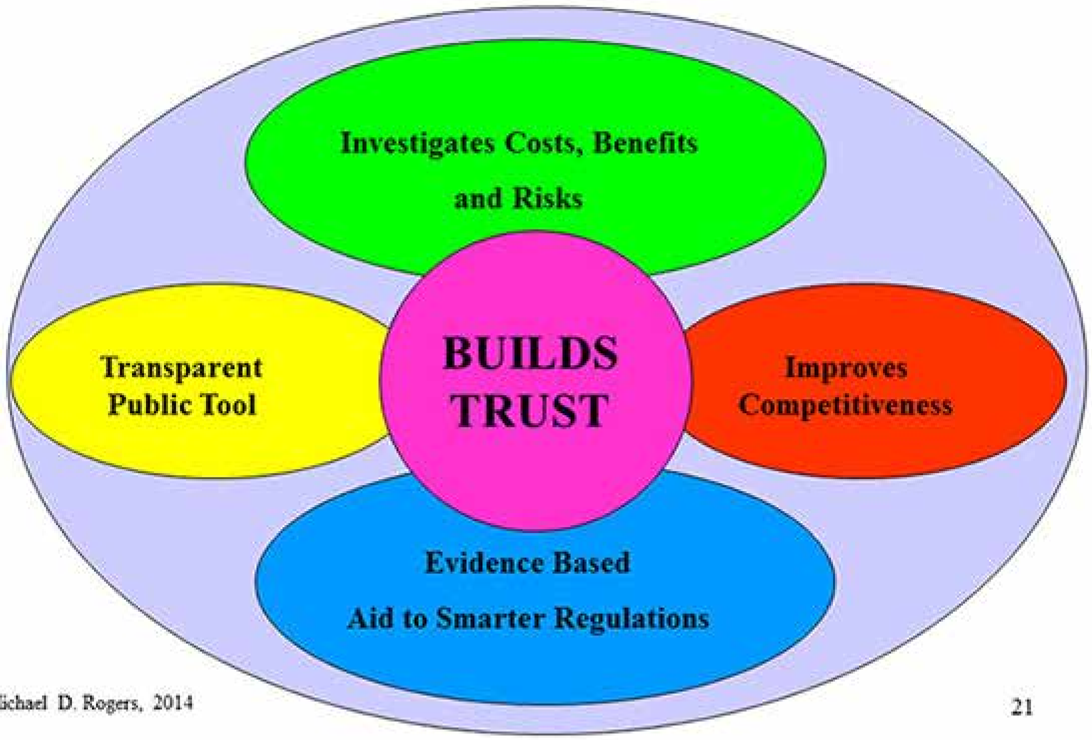
➢ECONOMIC IMPACTS: Testing and registration costs (~2 billion €): Health benefits (could be ~ 50 billion €); etc

➢STAKEHOLDER CONSULTATION: Internet consultation resulted in more than 6000 contributions

REACH
Extended RIA
Changes to the Draft Legislation
(SEC (2003) 1171/3)

➢**Simplification** of information provision requirements by industry
➢**No registration or evaluation for polymers**
➢**Lighter registration requirements for substances produced between 1 – 10 tonnes/y**
➢**A reinforced authorisation system** requiring a substitution plan when authorisations are being granted on socioeconomic grounds
➢**Streamlined administration of REACH**
➢**Greater legal certainty** for producers relating to confidential information etc.

Regulatory Impact Assessment (RIA)



Moving From a Precautionary Approach to Smarter Regulations

What Might be Wrong with Precaution (1)

Regulatory Actions based on the Precautionary Principle (PA) should be subject to REVIEW in the light of new scientific data (the 5th criteria for action)

Without effective review of regulations based on precaution the result is to paralyse progress in certain fields – witness genetically modified crops or nuclear power

What Might be Wrong with Precaution (2)

PA is often strongly influenced by societal pressure which may be counter to established expert evidence. Science isn't concerned with "faith" but with "evidence"

"**The implementation of an approach based on the precautionary principle should start with a scientific evaluation, as complete as possible, and where possible, identifying at each stage the degree of scientific uncertainty**" (COM (2000) 1, paragraph 4)

Smart Regulation in the EU – Systematic Management of All Regulations – The Four Objectives

COM (2010) 543 dated 8.10.2010

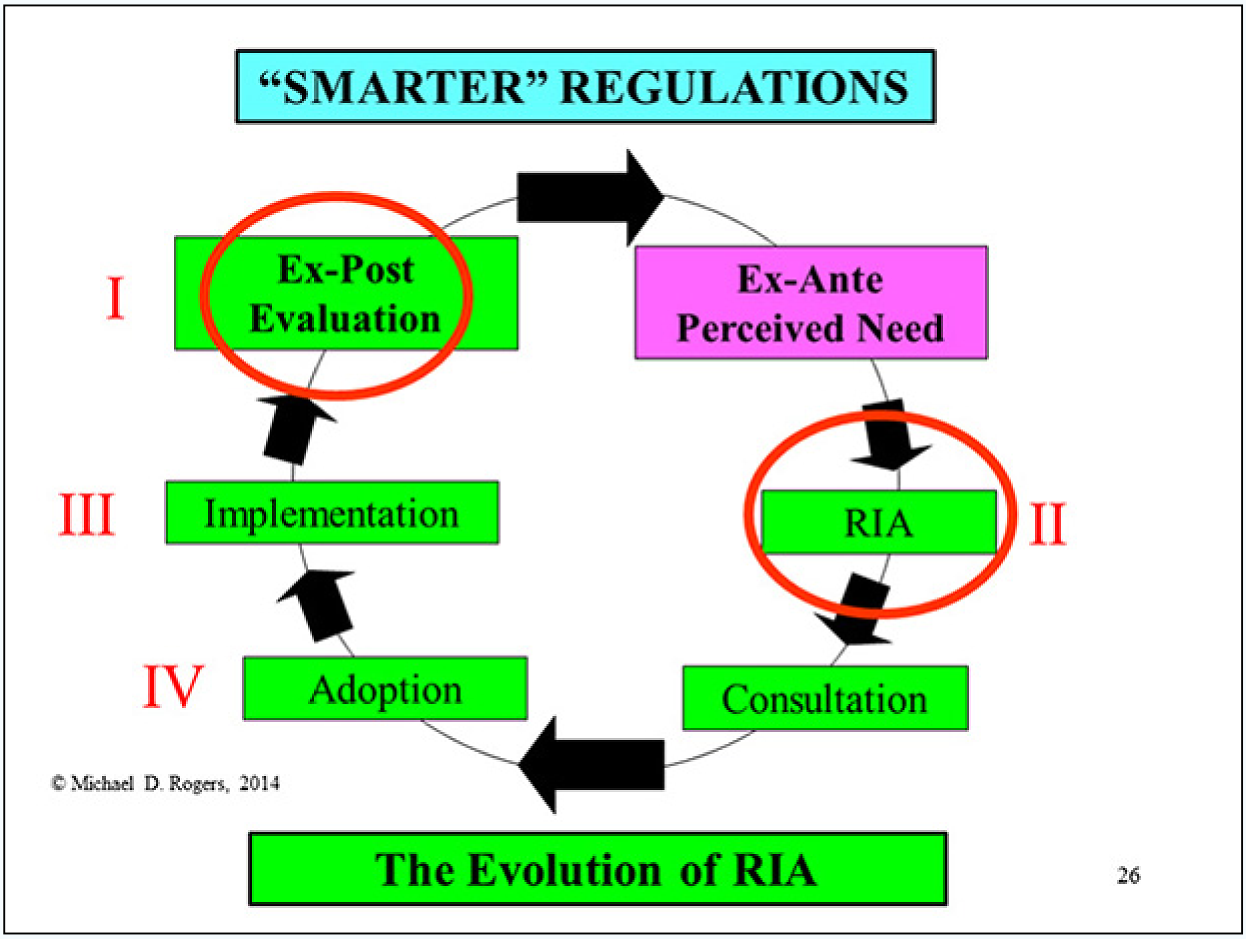
1) RETROSPECTIVE ACTION
Existing Legislation creates most of the costs and benefits – so more effort must be devoted to evaluating the functioning and effectiveness of this legislation

2) PROSPECTIVE ACTION
Improve the **Regulatory Impact Assessment** system so that **New Legislation** is the best possible legislation for the perceived need

3) CURRENT ACTION
Improve the **Transposition**, **Implementation** and **Enforcement** of EU Legislation through improved ex-post evaluations and implementation plans

4) CONTINUOUS ACTION
Make the legislation **Clearer** and **More Accessible**

25



Smart Regulation in the EU – The REFIT Programme

COM (2013) 685 dated 2.10.2013

RETROSPECTIVE ACTION
The Commission introduced a Regulatory Fitness and Performance Programme (REFIT) in 2012 (COM (2012) 746) in support of its retrospective analysis of the entire stock of EU legislation

EX POST ACTION
An increasing attention is being paid to ex-post evaluation. In the environment field Directives related to water (for example) have been reduced from 18 to 9 with savings of about 30 M Euros

FUTURE ACTION
From 2014 the Commission will programme its interventions within the REFIT programme and will carry out Fitness Checks in all important areas. This will require close coordination with the other EU Institutions and the Member States (cf "gold plating")

27

A Darwinian Approach to Public Policy Evolution?

The "Institutionalisation" of Policy Change?

28

• Response Presentation: Hideyuki Hirakawa

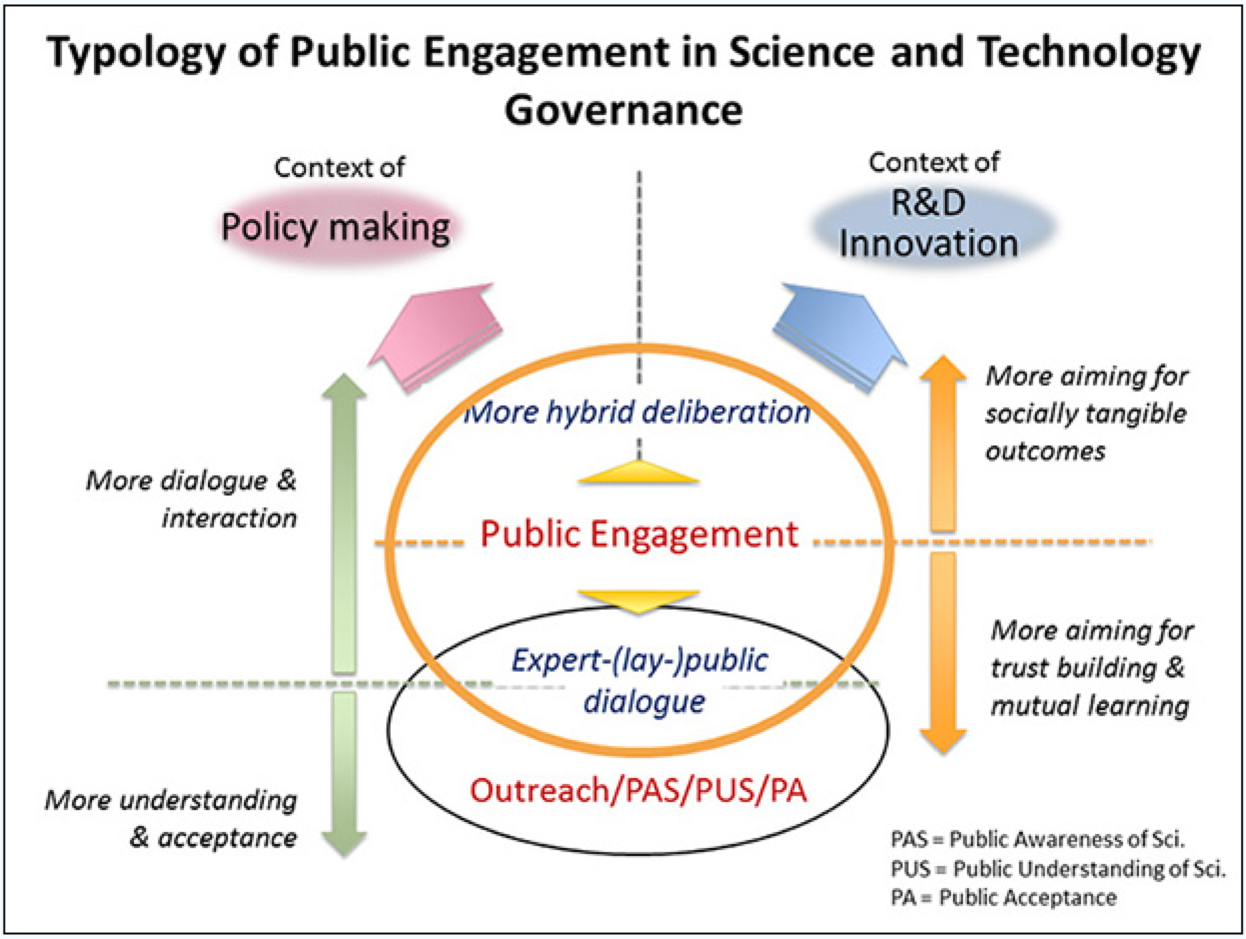
STIG 2014年度国際シンポジウム
November 28, 2014.
よりよいガバナンスによる科学技術イノベーションの有効活用
Making the Most of Science and Innovation through Better Governance

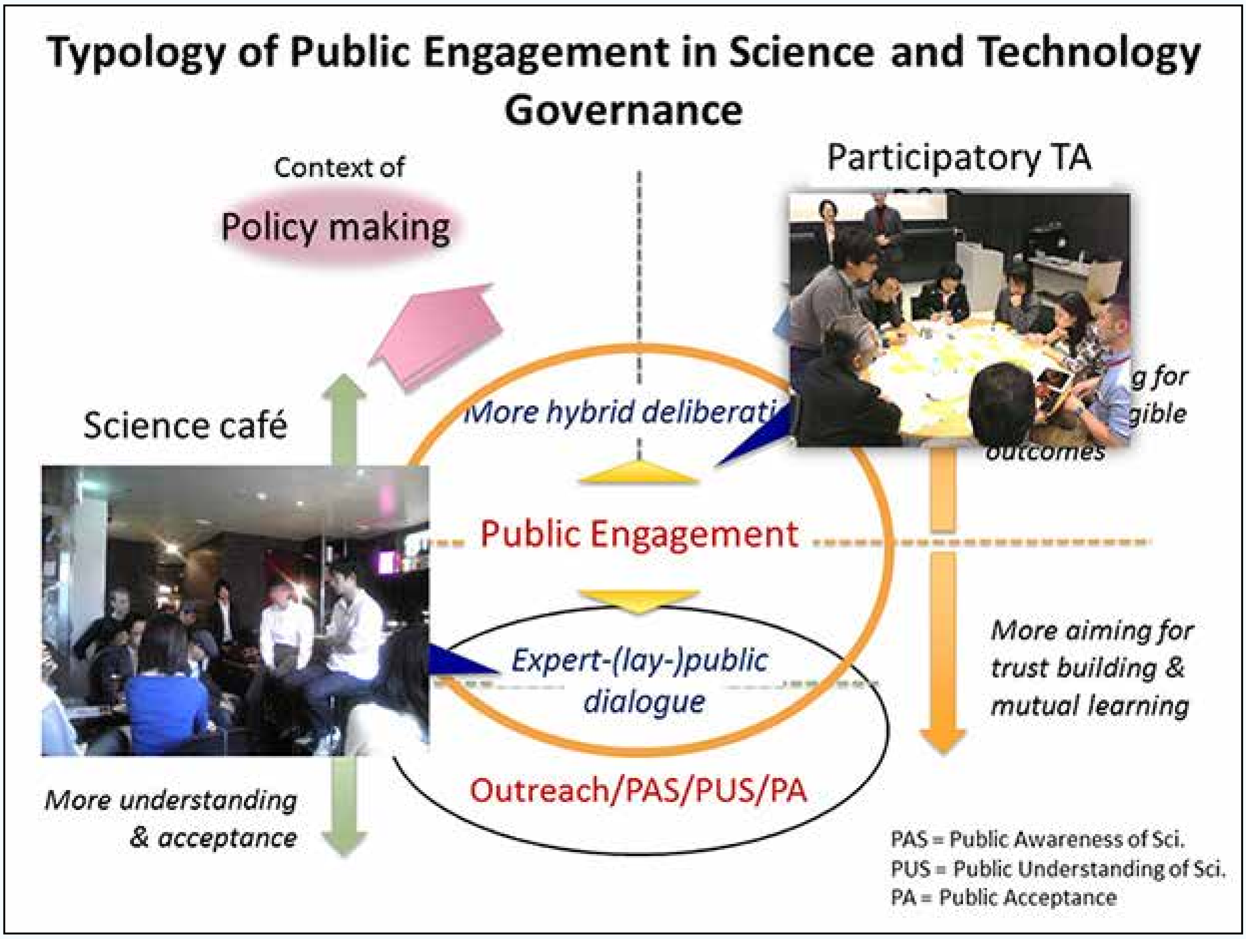
Public Engagement in Japan: Achievements and Future Challenges

平川秀幸　Hideyuki Hirakawa
大阪大学コミュニケーションデザイン・センター
Osaka University Center for the Study of Communication-Design (CSCD), Japan
公共圏における科学技術政策（STiPS）
Program for Education and Research on Science and Technology in Public Sphere (STiPS)

outline

1. Background of development of PE in Japan
2. Development of PE in Japan
3. Post-March 11 and future …


Typology of Public Engagement in Science and Technology Governance
Context of
Policy making
Context of
R&D Innovation
More hybrid deliberation
More dialogue & interaction
Public Engagement
More aiming for socially tangible outcomes
More aiming for trust building & mutual learning
Expert-(lay-)public dialogue
Outreach/PAS/PUS/PA
More understanding & acceptance
PAS = Public Awareness of Sci.
PUS = Public Understanding of Sci.
PA = Public Acceptance


Typology of Public Engagement in Science and Technology Governance
Context of
Policy making
Participatory TA
Science café
Public Engagement
Expert-(lay-)public dialogue
Outreach/PAS/PUS/PA
More aiming for trust building & mutual learning
More understanding & acceptance
PAS = Public Awareness of Sci.
PUS = Public Understanding of Sci.
PA = Public Acceptance

1. Background of development of PE in Japan (1)

1. Change of public attitude to S&T in the late 1980s: (理科離れ)
   - Decline of interest in science in younger generation;
   - Decrease of employment of science/engineering graduates in manufacturing industry;
   - Science and technology phobia etc..

1. Background of development of PE in Japan (2)

2. Series of crises and loss of trust in 90s
   - Great Hanshin-Awaji Earthquake (1995.1.17)
   - Sarin gas attack on Tokyo subway (1995.3.20)
   - FBR Monju sodium-leaking fire accident (1995.12.8)
   - Trials on HIV-tainted blood scandal (1995-96)
   - Tokai nuclear reprocessing plant fire accident (1997.3.11)
   - Tokai JCO criticality accident (1999.9.30)

1. Background of development of PE in Japan (3)

2. Series of crises and loss of trust in 2000s -
   - Domestic BSE (2001.9.10 -)
   - BSE case of US-imported beef (2003.12.24)
   - Eastern Japan Great Earthquake and Fukushima NPP accident (2011.3.11)

1990年代以降の科学技術と社会（日本）

80s末	理工系出身者の製造業離れ／理工系入試倍率が全学部平均を下回る／若年男性の科学技術に対する関心が低下が顕著に
1991年～	バブル崩壊
	「若者の科学技術離れ」の問題化
1993年	→ 平成5年版『科学技術白書』の特集
1995年	**科学技術基本法成立**
	阪神淡路大震災／地下鉄サリン事件／高速増殖炉もんじゅ事故／薬害エイズ裁判／北海道トンネル崩落事故
1996年	**第1期科学技術基本計画**（～2000年）
	英国で体細胞クローン羊「ドリー」誕生
1997年	東海再処理工場火災爆発事故／臓器移植法制定
1999年	**世界科学会議（ブダペスト会議）** ～ブダペスト宣言「社会の中の、社会のための科学」
	東海村JCO臨界事故

8

1990年代以降の科学技術と社会（日本）

2000年　雪印集団食中毒事件

2001年　**第2期科学技術基本計画**（～2005年）
～「社会の中の、社会のための科学技術」
国内BSE問題

2003年　ヒトゲノム解読完了
食品安全委員会設立
科学技術政策研究所報告書「科学技術理解増進と科学コミュニケーションの活性化について」
米国産牛肉BSE問題

2004年　文部科学省科学技術・学術審議会人材委員会報告書「科学技術と社会という視点に立った人材養成を目指して」
『平成16年度・科学技術白書』「これからの科学技術と社会」を特集

2005年　文部科学省の科学技術理解増進政策に関する懇談会報告書「人々とともにある科学技術を目指して」
京都議定書発効

2006年　**第3期科学技術基本計画**（～2010年）
～「社会・国民の支持され、成果を還元する科学技術」
山中伸弥　iPS細胞樹立

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1990年代以降の科学技術と社会（日本）

2009年　新型インフルエンザ世界的流行
民主党政権成立

2011年　**東日本大震災／福島第一原発事故**
第4期科学技術基本計画（～2015年）
～「社会及び公共のための政策」「社会とともに創り進める科学技術・政策」

2012年　JST科学コミュニケーションセンター設立
エネルギー・環境の選択肢に関する国民的議論
自民公明政権成立

2013年　大学等シーズ・ニーズ創出強化支援事業（COIビジョン対話プログラム）
イノベーション対話、デザイン思考

2014年　文部科学省科学技術・学術審議会 研究計画・評価分科会 安全・安心科学技術及び社会連携委員会報告書「リスクコミュニケーションの推進方策」
文部科学省　リスクコミュニケーションのモデル形成事業.

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2. Development of PE in Japan

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  - PUS/PA dominant based on the deficit model, even faced with loss of trust caused by crises.
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    - Budapest Declaration of the World Conference on Science in 1999: "Science in Society, Science for Society"

"Science and Technology Governance" in White Paper

To maintain the accord between science and technology and society, it is important to establish **science and technology governance**, or a means of actively accepting the intentions of each player into discussions on policy formation, based on the premise of a dialogue and communication between the government, the scientific community, businesses, local communities, the public, and other players.

科学技術と社会との調和のためには、政府、科学者コミュニティ、企業、地域社会、国民等のそれぞれの主体間の対話と意思疎通を前提として、各主体から能動的に発せられる意思を政策形成等の議論の中に受け入れられるような、いわゆる**科学技術ガバナンス**の確立が重要であろう。

FY2004 White Paper on Science & Technology（平成16年度科学技術白書）

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  - **Creation of RISTEX (Research Institute for Science and Technology for Society) in 2001 as a department of JST (Japan ST Agency)**

about RISTEX

- Characteristics of funding
  - Creating social and public values through funding R&D which aims at finding solution of social problems.
  - Multi-disciplinary approach
  - Co-design & co-production with stakeholders
  - ❖Cf. Responsible Research and Innovation (RRI) in EU
- Budget
  - 1.8 billion yen (FY 2013) = 13 million €
- Number of projects funded since 2001
  - More than 180 projects, including many STS

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  - **Promotion of ST Communication.**

Promoting ST communication

Training science communicators & journalists

Training courses funded by gov't

- Hokkaido university
- University of Tokyo
- Waseda University

and other universities and science museums

Communication in Science & Technology Education & Research Program

Science Interpreter Training Program
College of Arts and Sciences, The University of Tokyo

早稲田大学 大学院政治学研究科 ジャーナリズムコース
JOURNALISM SCHOOL

Proliferation of science café

Started in 2004 ~ 2005

More than 1000 cafés / a year

Museum of Osaka University

Science Café at Machikaneyama

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  - Promotion of ST Communication.
  - **Practices and studies of participatory TA increased.**

pTA practices in Japan （http://decocis.net/navi/）

開催年	会議名	手法	地域
1998	遺伝子治療を考える市民の会議	コンセンサス会議	京都
1999	高度情報化社会 -とくにインターネットを考える市民の会議	コンセンサス会議	埼玉
2000	遺伝子組換え農作物を考えるコンセンサス会議	コンセンサス会議	東京
2000	ヒトゲノム研究を考えるコンセンサス会議	コンセンサス会議	東京
2002	安間川の整備に関するコンセンサス会議	コンセンサス会議	静岡
2002	三番瀬再生計画検討会議(円卓会議)	円卓会議	千葉
2003	市民会議 -食と農の未来と遺伝子組換え農作物-	市民パネル会議	東京
2003	三番瀬の未来を考えるシナリオ・ワークショップ	シナリオ・ワークショップ	千葉
2003	市民が創る循環型社会フォーラム:ステークホルダー会議	ステークホルダー会議	愛知
2004	市民が創る循環型社会フォーラム: 市民パネル会議	市民パネル会議	愛知
2005	市民が考える脳死・臓器移植–専門家との対話を通して	ディープ・ダイアローグ	東京
2005	地球温暖化問題に関する討議型世論調査	熟議型投票	東京
2006	遺伝子組換え作物の栽培について道民が考える「コンセンサス会議」	コンセンサス会議	北海道

2007	小型家電を考える市民の会議	コンセンサス会議, シナリオ・ワークショップ	秋田
2008	ナノトライ(グループ・インタビュー)	フォーカスグループ	北海道
2008	ナノトライ(サイエンスカフェ)	サイエンスカフェ	北海道
2008	ナノトライ(ミニ・コンセンサス会議)	コンセンサス会議	北海道
2009	World Wide Views in JAPAN ～日本からのメッセージ: 地球温暖化を考える～	討論型世論調査	京都
2010	原子力政策円卓会議2010	円卓会議	東京
2010	熟議キャラバン2010 -再生医療編-	論点抽出ワークショップ アジェンダ設定会議	大阪他
2006-08	遺伝子組換え作物対話フォーラム	小規模対話フォーラム、円卓会議、大規模対話フォーラム	北海道
2010	BSE熟議場in北大	熟議場	北海道
2010	GM熟議場in北大	熟議場	北海道
2011	遺伝子組換え作物を考えるGMどうみん会議	市民陪審	北海道
2011	BSE問題に関する討論型世論調査	討論型世論調査	北海道

2012	BSE熟議場 in 帯広	その他	北海道
2012	…(パブリッ クコメント)	パブリックコメント	全国
2012	エネルギー・環境の選択肢に関する国民的議論(意見聴取会)	意見聴取会	全国11
2012	エネルギー・環境の選択肢に関する国民的議論(討論型	討論型世論調査	東京
2012	エネルギー・環境戦略 市民討議	討論型世論調査	川崎
2012	世界市民会議 World Wide Views −生物多様性…		東京

Consensus Conference

Scenario Workshop

Citizen Juries

Deliberative Polling

World Wide Views
on Climate Change/Biodiversity

original methods

Conveners = { Researchers / National/local government }

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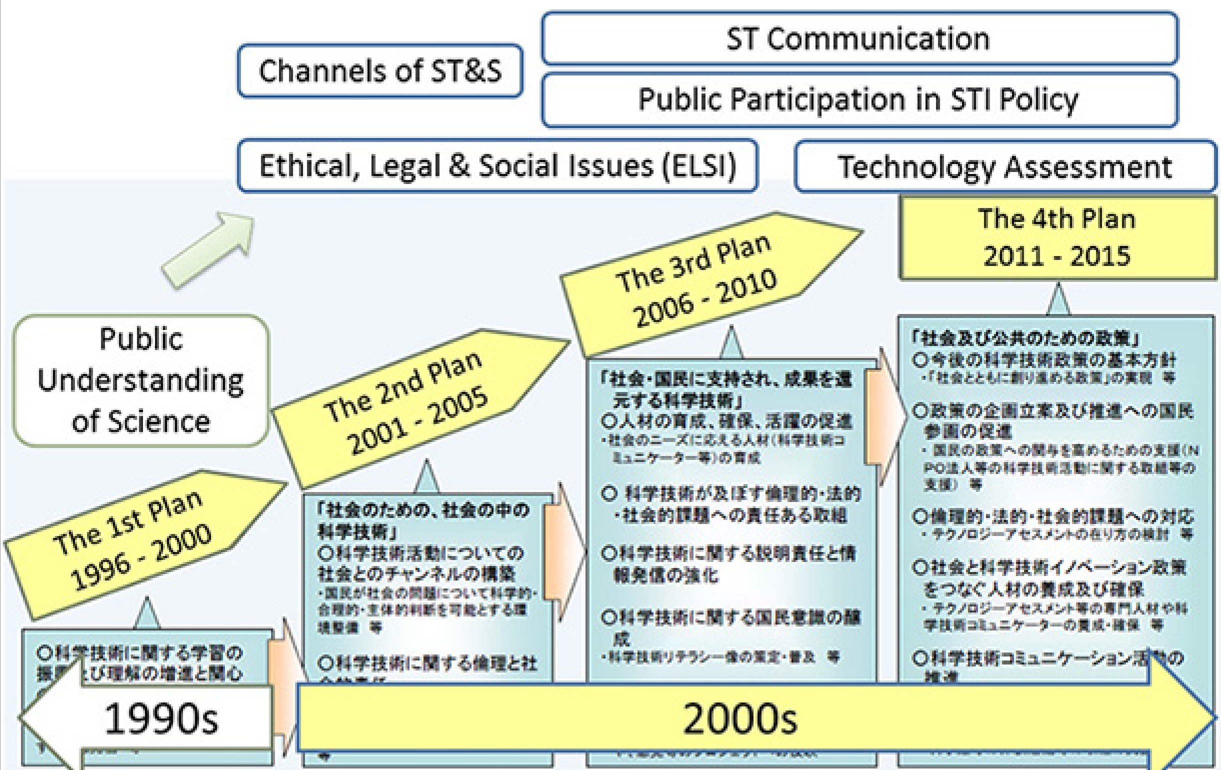
pTA practices sponsored by national/local governments

- ❖ Consensus conference on GM crops (2000)
  - Ministry of Agriculture, Forestry & Fishery (MAFF)
- ❖ Consensus conference on Human Genome (2000)
  - Science & Technology Agency (STA: now MEXT)
- ❖ Consensus conference on GM crops (2006)
  - Hokkaido prefecture, office of Agricultural Policy
- ❖ Public Debate on the Options of Energy and Environment (2012)
  - Cabinet Secretariat, National Policy Unit
  - Public comments, Public hearing, and Deliberative polling

Policy development: ST&S ideas in ST Basic Plan

Period (FY)	Principle related to ST&S	Policy concepts related to ST&S
1st 1996 - 2000	No.	• Promoting public learning, understanding and awareness.
2nd 2001 – 2005	"ST in/for Society"	• Building channel between ST&S • Ethics & social responsibility
3rd 2006 - 2010	"ST to be supported by society and citizens, and to return profits to society"	• Engaging in ELSI • Strengthen the accountability and information dissemination • Raising public awareness • Promoting active public participation
4th 2011 - 2015	"STI policy to be co-created with society"	• Promoting public participation • Engaging in ELSI & TA • Promoting ST communication • Developing human resources

Development of ST&S ideas in S&T Basic Plan



(MEXT. White Paper on Science and Technology 2011)

3. Post-March 11 and future ...

- Responses to the Crisis of trust (cf. UK House of Lords, 2000) in terms of PE:
  - Policy interests in risk communication.
  - In relation to issues of radiation, most of approaches have remained PUS/PA;
  - Focus on disaster prevention
  - Some focus on more interactive communication (PE): MEXT committee
  - Deliberative polling on innovative energy and environment policy strategy in 2012 by DPJ administration.
  - After the change of power to LDP: Backlash?

New trend: Promotion of Innovation dialogue

- As a tool for new University-Industry Collaboration (UIC)
  - A part of COI (Center of Innovation) Stream (2013-), a new initiative of MEXT's UIC policy.
- New Policy concept = "Co-creation" (共創 *kyo-so*)
- FY2013, 30 universities were funded.
- Background: mismatch of needs and supply

design thinking

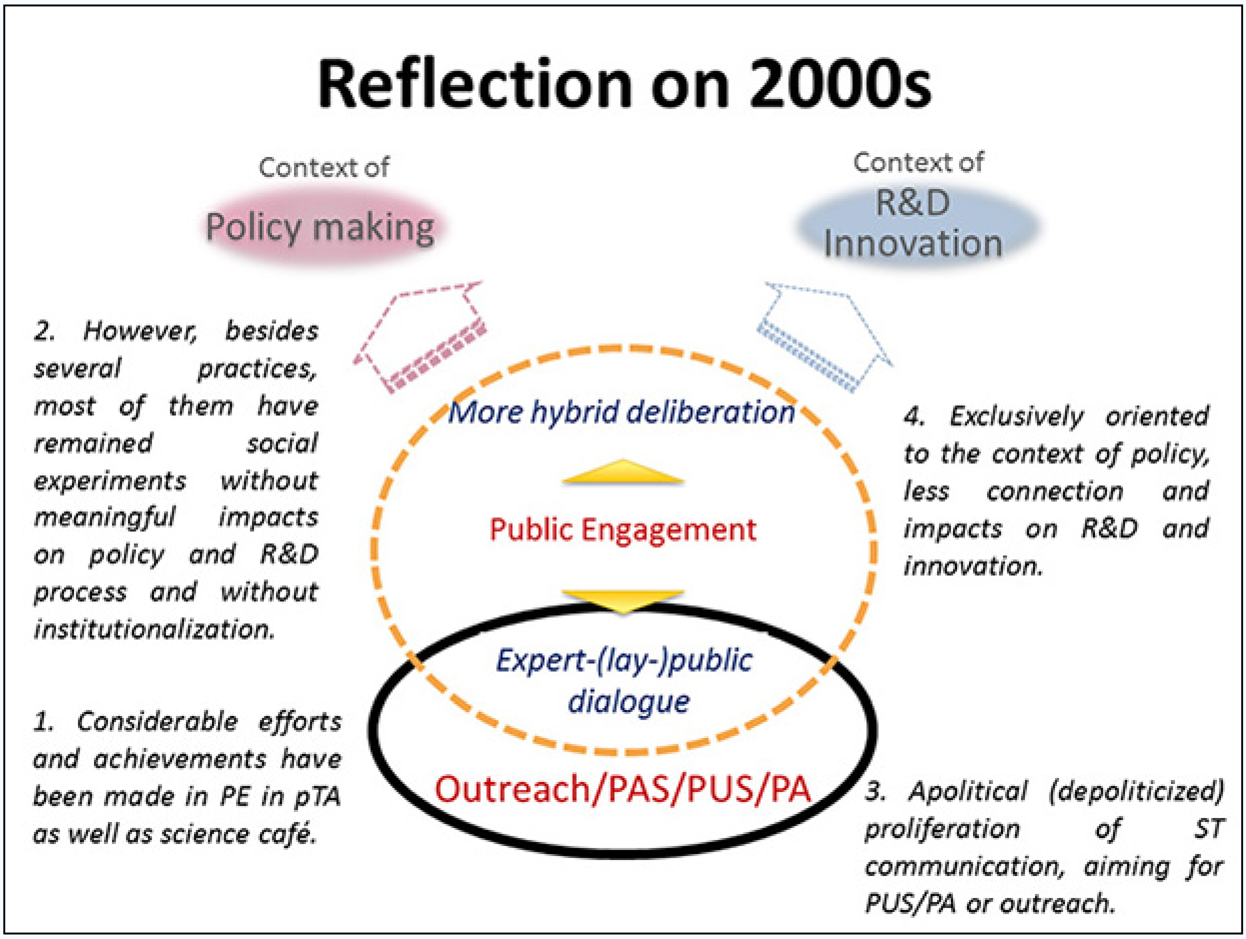
needs-seeds matching

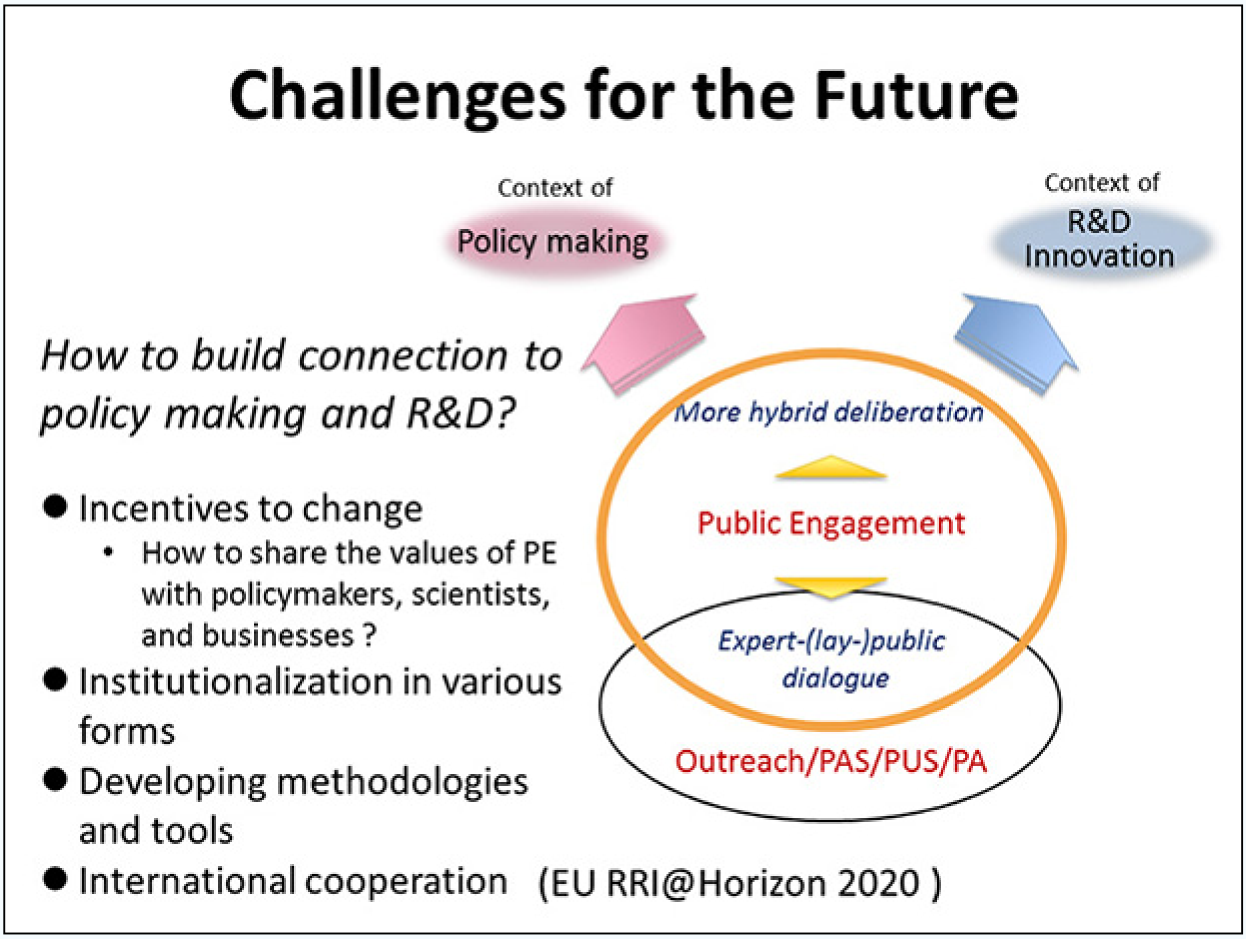
backcasting

future sessions

world café

multi-sector/multi-disciplinary/multi-actor


Reflection on 2000s
Context of
Policy making
Context of
R&D
Innovation
2. However, besides several practices, most of them have remained social experiments without meaningful impacts on policy and R&D process and without institutionalization.
More hybrid deliberation
Public Engagement
Expert-(lay-)public dialogue
Outreach/PAS/PUS/PA
4. Exclusively oriented to the context of policy, less connection and impacts on R&D and innovation.
1. Considerable efforts and achievements have been made in PE in pTA as well as science café.
3. Apolitical (depoliticized) proliferation of ST communication, aiming for PUS/PA or outreach.

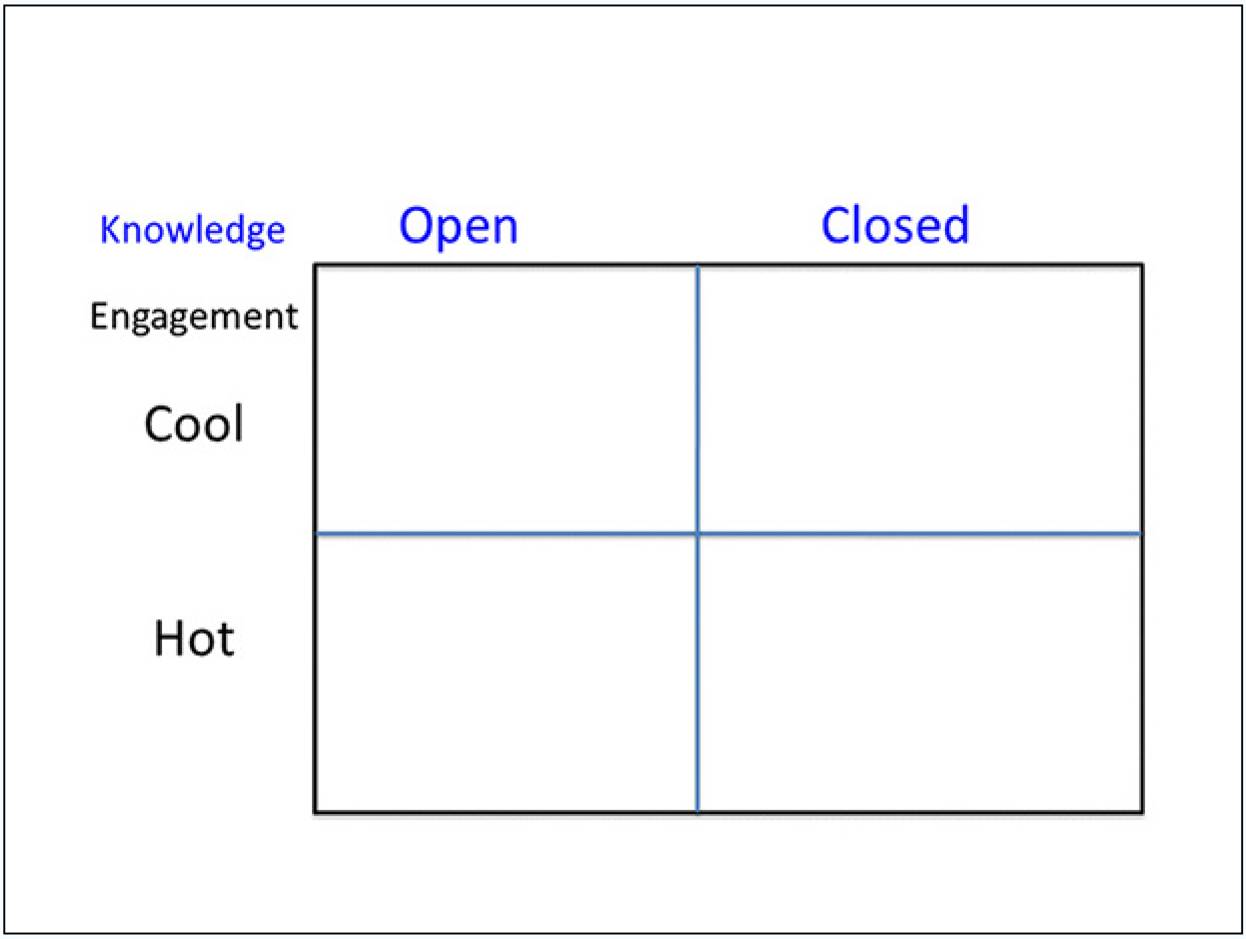

Challenges for the Future
Context of
Policy making
Context of
R&D
Innovation
How to build connection to policy making and R&D?
● Incentives to change
• How to share the values of PE with policymakers, scientists, and businesses ?
● Institutionalization in various forms
● Developing methodologies and tools
● International cooperation (EU RRI@Horizon 2020)
More hybrid deliberation
Public Engagement
Expert-(lay-)public dialogue
Outreach/PAS/PUS/PA

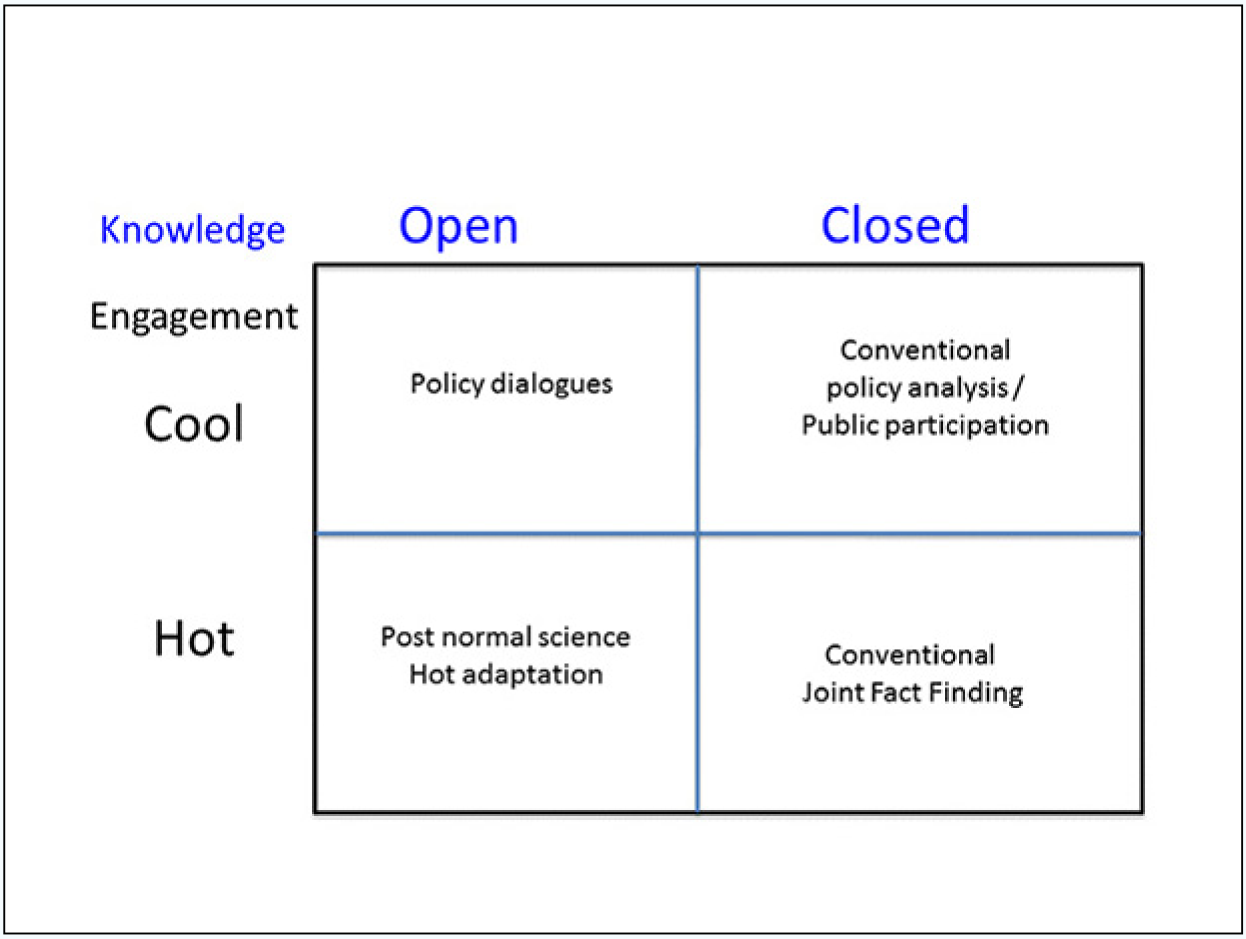
Hot Adaptation: Working between facts and stakeholders

David Laws
University of Amsterdam
November 2014

Domain

- Someone is going to act:
  - Highlights stakes/consequence.
  - Triggers doubts.
  - Sets a local context.
  - Initiates an exchange.
- Framing: facts, experience, values mix in making sense
  - Exploration of relationships with others and with environment
- In this sharing, a community arises around questions that are likely to be controversial.
  - Both destructive and constructive potential.
- What shapes its role and development?


Knowledge
Open
Closed
Engagement
Cool
Hot


Knowledge
Open
Closed
Engagement
Cool
Policy dialogues
Conventional policy analysis / Public participation
Hot
Post normal science Hot adaptation
Conventional Joint Fact Finding

What makes policy action hot?
A Dutch Controversy

Changing water management

- History mixes technology, nature and society.
- Policy to create “new nature”
- Local concerns about how will affect homes and businesses.
- Disagree with the policy facts
- Rebel

"Hot Cognition" in the polder (Kunda, 1999)

Escalation and Political theater

`'The lightning and thunder
And it rains lots of protest
The inhabitants of the polder
They are angry, but do their best,

to reverse the water tide,
no wetland, but then what
Meadow Lakes should be
Away with all the doom &
gloom"

A counter narrative

- With so many fellow sufferers have to live in a gutter
- Do listen to the residents, or else we'd rather be dead.
- We are people with experience, stop the green lie soon ...
- Otherwise you may repent

2 takes on Janus faced science (Latour, 1987)

Science knows

Science does not (yet) know

Light Rail: Fighting words

- "We had a big debate about that. The institutions were saying that the train needed to go underground because the concrete tunnel and the steel rebar in the tunnel will dissipate the magnetic fields."
- "The City's saying, "Absolutely not—it's too expensive to put this thing underground. We've got to keep it above-ground."

Turning the corner

- "As a group, they had to realize … that they were stuck"
- "They realized that they could talk until they were blue in the face, and the other wasn't going to convince them."
- "So now it was a matter of saying, "Guys, how are we going to get around this?" What do <u>you</u> need in order to get around this? '"

Joint Fact Finding

- We jointly defined the question clearly and got agreement on it.
- Then we asked, "Well, what are the skills that are needed in order to actually answer the question? What kind of skills does a person need?" … then we said, "Ok, who's out there?"
- This consultant became a servant of the negotiating team, the entire negotiating team. It wasn't your person, it wasn't my person, it was our person

A surprising recommendation

- The consultant then came back with a recommendation that said, “In this particular case, above ground or below ground, it’s still going to impact the MRIs. You’re going to have to protect the MRIs—you are going to have to put a shield around them.”
- As a result they ended up talking about putting one-foot thick lead walls all around these machines.

Legitimate/justifiable action

- But because [this recommendation] was independent, the city people could go back to their political bosses and say, with confidence, “This is what we have to do.”
-
- The health care and academic reps could go back to their Boards of Governors and say, “You know, yes, we thought that [going] underground would solve the problem, but technical expertise says that it’s not going to make a difference [to put it underground].”

The other face of science

This LLW disposal site accepts waste from States participating in a regional disposal agreement.

- I'm listening to what people are saying and feeling very strongly that if we were to say, 'Thank you for listing all those concerns and now we will go along with the process of talking about siting,' that it would be utterly inappropriate.
- So the only way I know to take on the broader issues that have been raised is to structure the agenda, stretch it, divide it, and if we're going to talk about it in a way that answers questions, we're going to have to get people in who can answer questions.

Dealing with a controversial question

- "t]he goal was not to get someone to say what the truth was. The goal was to get someone to array the debate"
- "this group over here thinks this because of that, but these people have these studies over here and they think this because of that."
- "And it isn't going to be a simple presentation. But the hope was that it [wouldn't be'] a partisan presentation."

A difficult conversation

- "I regard it as a privilege to be here to tell you what I think is the consensus opinion about the effects of radiation, not only in the U.S., but internationally."
- "The question is, "What are some of the other views ...that you may not have touched on that would lead people to different conclusions perhaps?"

Citizens democratize boundary with science

- "The reason I'm uncomfortable in specifically addressing disposal site criteria-...is because it's exactly what they want to hear."
- " This body ought to keep itself aloof enough, independent enough, and become educated enough, that it can tell the Authority what the Authority may not want to hear, if we deem it in the best interest of the safety of the people of the state."
- "If that means, ignoring the federally mandated time limits, so be it. That's not what the Authority wants to hear because they're mandated to work under those state and federal time frames and constraints."

(continued)

- "I think we should be free to say, "That's full of beans and you ought to do something about it." I think that's our role. I think we're supposed to reflect the public— not to be subsidiary staff to the Authority."

Echoes a "post normal" approach

- Need for public involvement "is not merely the result of ... external ... pressures on science ... when the general public is concerned . . ."
- When:
  - "Problems do not have neat solution",
  - "phenomena ... are ambiguous,"
  - "techniques are open to methodological criticism"
- "[D]ebates on quality are not enhanced by the exclusion of all but ... academic or official experts."
- Knowledge of local conditions:
  - "can determine which data is strong and relevant."
  - "cannot be the exclusive property of experts ..."
- Need to involve people who have "a keen awareness of how general principles are realized in their 'backyards."

A footnote on inquiry

- "all cooperative activity involves a moment of inquiry, if only in the ongoing perception that the activity is going smoothly/not going smoothly."

- Any community that "wants to know what is right and good," it should "organize itself in accordance with democratic standards and ideals, not only because they are good in themselves (and they are), but *because they are the prerequisites for the application of intelligence to inquiry*. . . ."

- "[A]ny society that limits democracy, that organizes itself hierarchically, thereby limits the rationality of those at both ends of the hierarchy. Hierarchy stunts intellectual growth of the oppressed, and forces the privileged to construct rationalization to justify their position." (Hilary Putnam)

Epilogue

- "The Committee will operate by consensus, meaning that there must be no dissent by any member in order for the Committee to be considered to have achieved consensus. Thus, no member can be outvoted. Members should not block or withhold consensus unless they have serious reservations with the approach or solution that is proposed for consensus. Absence will be equivalent to not dissenting. All consensus agreements reached during the negotiations are assumed to be tentative agreements until members of the Committee agree to make them final agreements."

Process demands

	Open	Closed
Cool		
Hot	Democratic opportunities Share knowledge and doubts Reason, design , revise, and act together	

• Response Presentation: Masahiro Matsuura

共同事実確認方式の実践の課題

Reflecting on the practice of introducing joint fact-finding processes to Japan

東京大学公共政策大学院
特任准教授　松浦正浩

Masahiro (Masa) Matsuura, Ph.D.
Graduate School of Public Policy, University of Tokyo

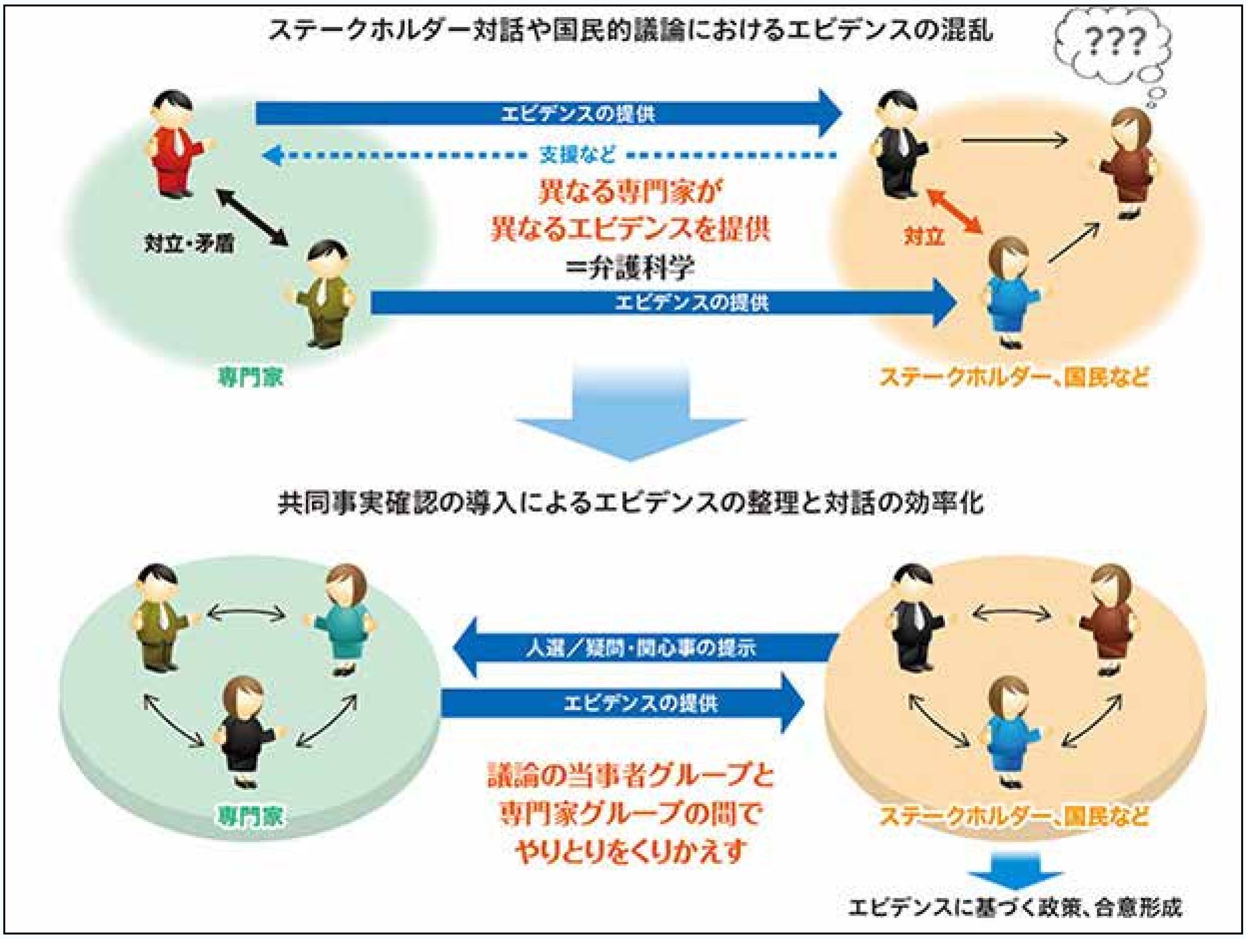
iJFF 共同事実確認手法を活用した政策形成の検討と実装プロジェクト

RISTEX-iJFF Project

iJFF

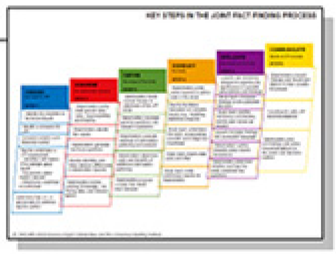
- 文部科学省「科学技術イノベーション政策のための科学」事業の一環
  - 客観的根拠（エビデンス）に基づく合理的なプロセスによる政策形成の実現のため…
- 科学技術振興機構社会技術研究開発センターの「科学技術イノベーション政策のための科学」研究開発プログラム 採択課題
- ３年間の事業（2011年11月～2014年11月）
- 研究代表者
  - 松浦正浩（東大公共政策・特任准教授）
- コアメンバー
  - 馬場健司（法政大地域研・特任教授）
  - 松尾真紀子（東大公共政策・特任研究員）
  - 高田百合奈（東大公共政策・特任研究員）

iJFF



成果１：共同事実確認の再検討

- 共同事実確認のコンセプトを再構築
  - 特定の「手法」としてのJFFの模倣はしない



  - “Fact”をとらえなおす
  - JFFは手法・方法論ではない
    - ✓ コンセンサス会議も一種のJFF(?)
  - JFFは原則・概念ではないか
    - ✓ 多様なプロセスデザインにおける「科学的情報」の接続方法のデザインprinciple（原則）としてのJFF

iJFF

成果２：アクションリサーチ

- 対馬における木質バイオマス利活用の検討
- 食品中の放射性物質に関する基準設定過程の検証
- 岡山県日生における海洋空間計画の検討

iJFF

成果３：ガイドライン

1. エビデンスは議論の当事者が取得する
2. エビデンスについて共通理解の形成を試みる
3. 多様なディシプリンから網羅的にエビデンスを収集する
4. エビデンスの不確実性（入手不可能性）について意識する
5. 議論の当事者が誰なのかについて意識する

iJFF

成果４：アウトリーチ・連携など

- 国際シンポジウムの開催
  - H23度：「共同事実確認の可能性：政策形成における科学的情報の役割」
  - H25度：「科学的エビデンスと政策をつなぐ共同事実確認の実践をふりかえる」
  - H26度：「「共同事実確認」のこれから：政策形成の実践へと着実に引き継ぐために」
- 国際連携の強化
  - JFFワークショップ（Accord 3.0と共催）
- マスメディアを通じた広報、国会参考人招致など
- 研究集会、学会等での発表や論文発表
- Brown Bag Lunch in 虎ノ門の開催
- 書籍化プロジェクト

iJFF

プロジェクトから得た知見

(1) ステークホルダーから「議論の当事者」へ

(2) 科学的情報から「エビデンス」へ

(3) 共同事実確認の「事実」の幅の広さ

(4) 共同事実確認における専門家の役割の再考の必要性

(5) ステークホルダーが間接的に「対話」する政策形成過程における共同事実確認の難しさ

(6) 社会実装に力点を置いたアクションリサーチの課題とトランジションマネジメントの必要性

(7) 非接続スタンドアロン型共同事実確認の可能性

iJFF

• Response Presentation: Masaru Yarime

東京大学
THE UNIVERSITY OF TOKYO

STIG
SCIENCE, TECHNOLOGY, AND INNOVATION GOVERNANCE

Governing Science, Technology, and Innovation for Societal Challenges: Stakeholder Platforms and Social Experimentation

YARIME Masaru 鎗目 雅
Project Associate Professor of Science, Technology, and Innovation Governance (STIG), Graduate School of Public Policy, University of Tokyo &
Honorary Reader, Department of Science, Technology, Engineering and Public Policy (STEaPP), University College London (UCL)
yarimemasa@gmail.com

International Symposium on Science, Technology, and Innovation Governance: Making the Most of Science and Innovation through Better Governance
University of Tokyo, Japan, November 28, 2014

Recent Trends in Science, Technology & Innovation Policy 1

- Stagnation of Economic Growth
  - Since the oil crises in the 1970s, particularly industrialized countries
- Increasing Importance of Knowledge in Economic Growth
  - Endogenous Growth Models (Paul Romer)
  - Knowledge-Based Economies, OECD
- New Industrial Policy
  - Integration of Science, Technology, and Innovation Policy with Economic Policy
- Emphasis on Intellectual Property Rights
  - US Bayh-Dole Act (1980)
  - Allows universities to apply for patents based on the results of scientific research activities funded by the federal government, with similar legislation subsequently enacted in other industrialized countries
- Promotion of University-Industry-Government Collaboration

2

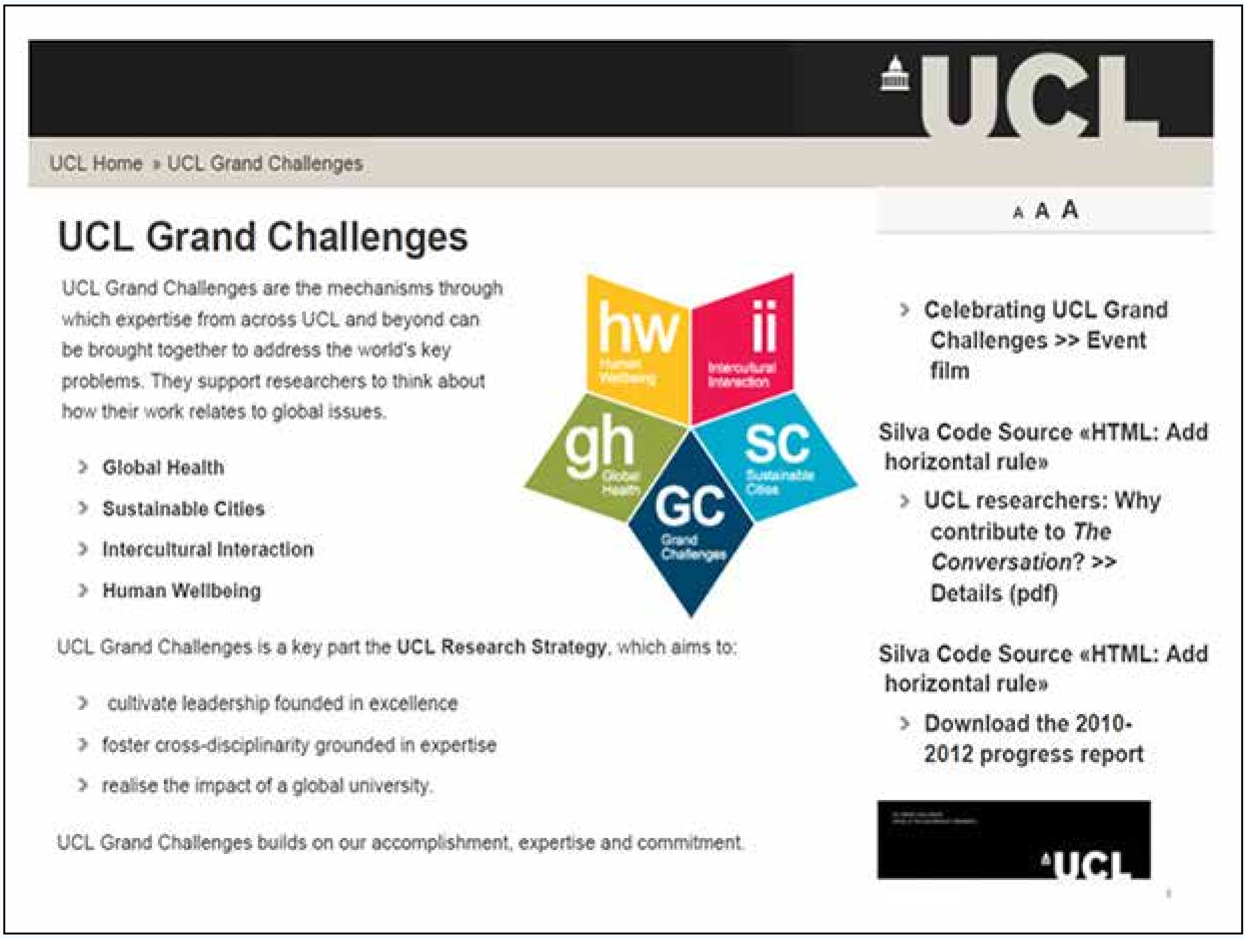
Recent Trends in Science, Technology & Innovation Policy 2

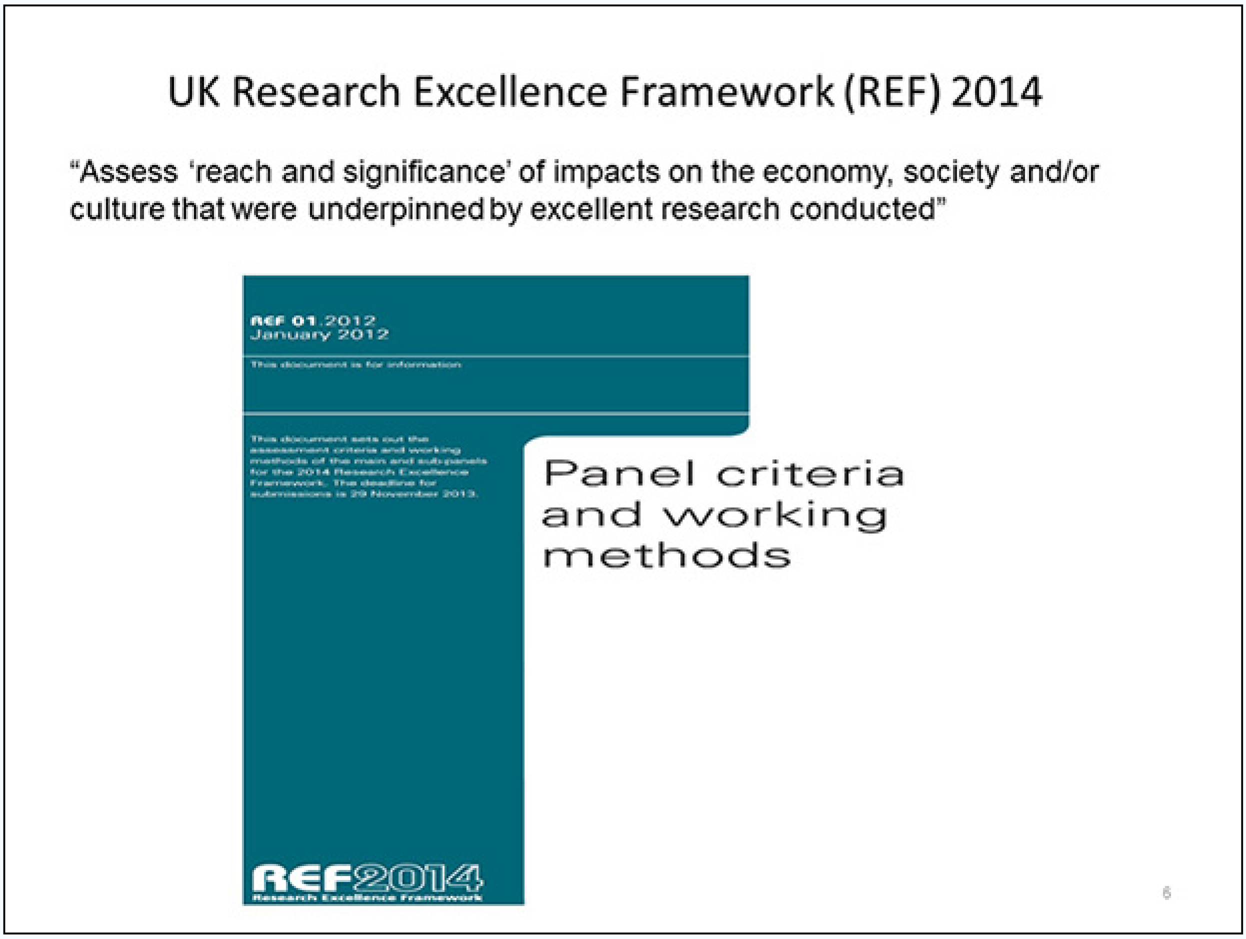
- Increasing Expectations to Address Societal/Grand Challenges
  - Environmental protection, energy security, public health, etc.
  - Global issues, requiring international coordination and harmonization
- Transformation of Society
  - Social innovation
  - Inclusive innovation
- European Union: Horizon 2020
- OECD Innovation Strategy (2010)
  - Applying innovation to address global and social challenges
  - Contemporary world's societies facing severe economic and social challenges
  - Many of challenges global in nature (climate change) or requiring global action (Health, food security, clean water)
  - Technological cooperation, predictable policy regime and long term incentives, new financing mechanism, flexible policy, effective policy mix
- OECD Green Growth Strategy (2010)
  - Remove barriers to green growth, support the transition, green job and skill development, strengthen international cooperation

3

U.S. National Academy of Engineering

4


UCL
UCL Home » UCL Grand Challenges
A A A
UCL Grand Challenges
UCL Grand Challenges are the mechanisms through which expertise from across UCL and beyond can be brought together to address the world's key problems. They support researchers to think about how their work relates to global issues.
Global Health
Sustainable Cities
Intercultural Interaction
Human Wellbeing
hw
ii
gh
sc
GC
UCL Grand Challenges is a key part the UCL Research Strategy, which aims to:
cultivate leadership founded in excellence
foster cross-disciplinarity grounded in expertise
realise the impact of a global university.
UCL Grand Challenges builds on our accomplishment, expertise and commitment.
Celebrating UCL Grand Challenges >> Event film
Silva Code Source «HTML: Add horizontal rule»
UCL researchers: Why contribute to The Conversation? >> Details (pdf)
Silva Code Source «HTML: Add horizontal rule»
Download the 2010-2012 progress report
UCL


UK Research Excellence Framework (REF) 2014
"Assess 'reach and significance' of impacts on the economy, society and/or culture that were underpinned by excellent research conducted"
REF 01.2012
January 2012
Panel criteria and working methods
REF2014
6

7

Grand Challenges for Global Sustainability

- Improvement on forecasts
- Integration of observations
- Management of disruptive change
- Determination of institutional changes
- Encouragement of innovation

- Better integration of social science research required for progress in understanding and addressing global sustainability

8

Beyond Basic vs. Applied Research: Science for Societal Challenges in Stoke's Quadrants

Research inspired by...

Quest for fundamental understanding?	Considerations of use? No	Considerations of use? Yes
No		Applied research (Edison)
Yes	Basic research (Bohr)	*Use-inspired basic research (Pasteur)*

Stokes (1997), Clark (2007)

9

Evolution of University Missions

Teaching University	Research University	Entrepreneurial University
Preservation and dissemination of knowledge	First academic revolution	Second academic revolution
New missions generate conflict of interest controversies	Two missions: teaching and research	Third mission: economic and social development; traditional missions continued

Etzkowitz (2003)

10

Outputs of University Research

- Scientific and technological information
  - Can increase the efficiency of applied R&D in industry by guiding research towards more fruitful departures
- Equipment and instrumentation
  - Used by firms in their production processes or their research
- Skills/Human capital
  - Embodied in students and faculty members
- Prototypes for new products and processes
- Network of scientific and technological capabilities
  - Facilitate the diffusion of new knowledge

11

University-Industry Collaboration for Innovation

- The United States first to move to establish explicit institutional conditions to strengthen the economy by strategic utilization of science and technology (Etzkowitz, Webster, and Healey, 1998)
- Passage of the Bayh-Dole Act (1980), which allowed universities to apply for patents based on the results of scientific research activities funded by the federal government (Mowery, Nelson, Sampat, and Ziedonis, 2004)
- Similar legislation enacted in other industrialized countries as well
- Japan adopting in the 1990s a series of public policies aimed at facilitating science and technology for innovation, including the Science and Technology Basic Law (1995) and the First Science and Technology Basic Plan (1996) as a comprehensive and systematic design to promote science and technology over the next five years
- University-industry collaboration particularly considered an effective way to do this, with the Law for Promoting Technology Transfer from Universities (1998) establishing the legal framework
- Institutional reforms subsequently implemented in many areas of science and technology

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Challenges in the Conventional Model of Entrepreneurial University

- Focus on commercial applications, encouraging pursuit of economic rather than social development (Bok, 2004; Washburn 2006; Slaughter and Leslie, 2001; Canaan and Shumar, 2008)
- Technology transfer mainly concentrated in specific fields, particularly ICT and biotechnology, difficult to lead to large-scale, multi-disciplinary, socio-technical collaborations for sustainability (Yarime et al., 2012)
- Critically examined on various grounds:
  - Economic: Republic of Science vs. Enterprise of Technology (David 2003; Nelson 2004; Thursby et al. 2001)
  - Scientific: Tragedy of Anti-commons (David 2003; Heller and Eisenberg, 1998; Mowery et al. 2004; Nelson 2004)
  - Ethical: (Bok, 2004; Washburn, 2006)

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Dilemmas in University-Industry Collaboration

- Individual Scientists
  - Potential trade-off between basic research activities and those activities required to successfully develop and commercialize academic inventions
  - Papers vs. Patents
  - Faculty efforts required in the management of relations with industry, including invention disclosure, identification of partners, contribution to the development of the technology, which potentially diverts faculty from its role in academic research
- Innovation System
  - Tension between the need of firms involved in the commercialization of academic research to rely upon clear and solid intellectual property rights (IPRs), and the cumulativeness of the scientific enterprise, which requires the results of academic research to be freely accessible
  - Republic of Science vs. Enterprise of Technology
  - Firms' willingness to engage resources in post-invention activities conditional to the creation of a secure economic environment for their investments through exclusive licensing
  - Potentially weakening the social norm of knowledge openness and sharing through various feedbacks and influences
  - Anticommons through fragmentation of IPRs

Thursby and Thursby (2003), Foray and Lissoni (2010) 14

Sustain Sci (2012) 7 (Supplement 1):101–113
DOI 10.1007/s11625-012-0157-5

SPECIAL FEATURE: ORIGINAL ARTICLE

Sustainability science: bridging the gap between science and society

Establishing sustainability science in higher education institutions: towards an integration of academic development, institutionalization, and stakeholder collaborations

Masaru Yarime · Gregory Trencher · Takashi Mino · Roland W. Scholz · Lennart Olsson · Barry Ness · Niki Frantzeskaki · Jan Rotmans

Received: 17 October 2011 / Accepted: 3 January 2012 / Published online: 3 February 2012

Abstract The field of sustainability science aims to understand the complex and dynamic interactions between natural and human systems in order to transform and develop these in a sustainable manner. As sustainability problems cut across diverse academic disciplines, ranging from the natural sciences to the social sciences and humanities, interdisciplinarity has become a central idea to the realm of sustainability science. Yet, for addressing complicated, real-world sustainability problems, interdisciplinarity per se does not suffice. Active collaboration with various stakeholders throughout society—transdisciplinarity—must form another critical component of sustainability science. In addition to implementing interdisciplinarity and transdisciplinarity in practice, higher education institutions also need to deal with the challenges of institutionalization. In this article, drawing on the experiences of selected higher education academic programs on sustainability, we discuss academic, institutional, and societal challenges in sustainability science and explore the potential of uniting education, research and societal contributions to form a systematic and integrated response to the sustainability crisis.

Keywords Higher education institutions · Interdisciplinarity · Transdisciplinarity · Institutionalization · Stakeholder collaboration · Social experimentation

Handled by Arnim Wiek, Arizona State University, USA.

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Academic, institutional, and societal challenges in sustainability science

Global sustainability concerns long-term constraints on resources, including, among others, food, water, and energy. The challenge of sustainability is the reconciliation of society's development goals with the planet's environmental limits over the long term (Clark and Dickson 2003). The field of sustainability science aims to use the understanding of complex and dynamic interactions between natural and human systems for transforming and developing these sustainably (Clark and Dickson 2003; Jerneck et al. 2011; Kates et al. 2001; Komiyama and Takeuchi 2006; Komiyama et al. 2011; Spangenberg 2011; Wiek et al. 2012a).

Sustainability science faces the critical challenge of establishing itself as an academic field (Clark 2007; Komiyama and Takeuchi 2006; Lang et al. 2012; Talwar et al. 2011; Wiek et al. 2011a; Yarime 2011c). Major hurdles include the development and use of concepts and methodologies, the transforming of institutional structures (e.g., incentives and reward systems), the initiation of collaboration with stakeholders outside of academia (Yarime 2011c), as well as the development of a coherent set of sustainability competencies and effective pedagogical

University-Stakeholder Platform for Promoting Innovation for Sustainability

- Leading universities across the world reaching out campus boundaries to form partnerships with industry, government and civil society organizations, attempting to materialize sustainable development
  - Yarime, Trencher, Mino, Scholz, Olsson, Ness, Frantzeskaki, and Rotmans, 2012; Trencher and Yarime, 2012; Trencher, Yarime, and Kharrazi, 2013
- Evolving from the dominant model of an "entrepreneurial university," where the notion of contributing to society has been focusing on contributing to the economy via technology transfer and commercialization of research results
- Collaborating with diverse social actors to trigger and drive the sustainable transformation at regional, national, and global levels
  - Trencher, Yarime, and Kharrazi, 2013; Trencher, Yarime, McCormick, Doll, and Kraines, 2014; Trencher, Bai, Evans, McCormick, Yarime, 2014

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Some Research Questions

- What are the types and characteristics of university partnerships with stakeholders for sustainability innovation?
- By what kind of mechanisms do universities collaborate with stakeholders?
- What functions do university-stakeholder collaboration play in promoting transitions to sustainability?
- What are the motivations for university researchers and stakeholders in society with different interests and backgrounds to join such collaboration?
- What are the outputs and impacts of university-stakeholder collaboration?
- What factors contribute to or obstruct the successful implementation of such collaboration? (drivers and barriers)
- What kinds of incentives, policies, and institutions are required to promote further these types of collaboration?

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doi:10.1093/scipol/sct044

Beyond the third mission: Exploring the emerging university function of co-creation for sustainability

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**Corresponding author. Email: trencher@sustainability.k.u-tokyo.ac.jp.*

This paper explores a global trend where universities are collaborating with government, industry and civil society to advance the sustainable transformation of a specific geographical area or societal sub-system. With empirical evidence, we argue that this function of 'co-creation for sustainability' could be interpreted as the seeds of an emerging, new mission for the university. We demonstrate that this still evolving mission differs significantly from the economic focus of the third mission and conventional technology transfer practices, which we argue, should be critically examined. After defining five channels through which a university can fulfil the emerging mission, we analyse two frontrunner 'transformative institutions' engaged in co-creating social, technical and environmental transformations in pursuit of materialising sustainable development in a specific city. This study seeks to add to the debate on the third mission and triple-helix partnerships. It does so by incorporating sustainable development and place-based co-creation with government, industry and civil society.

Keyword: sustainability; co-creation; university; mission; transformation; collaboration.

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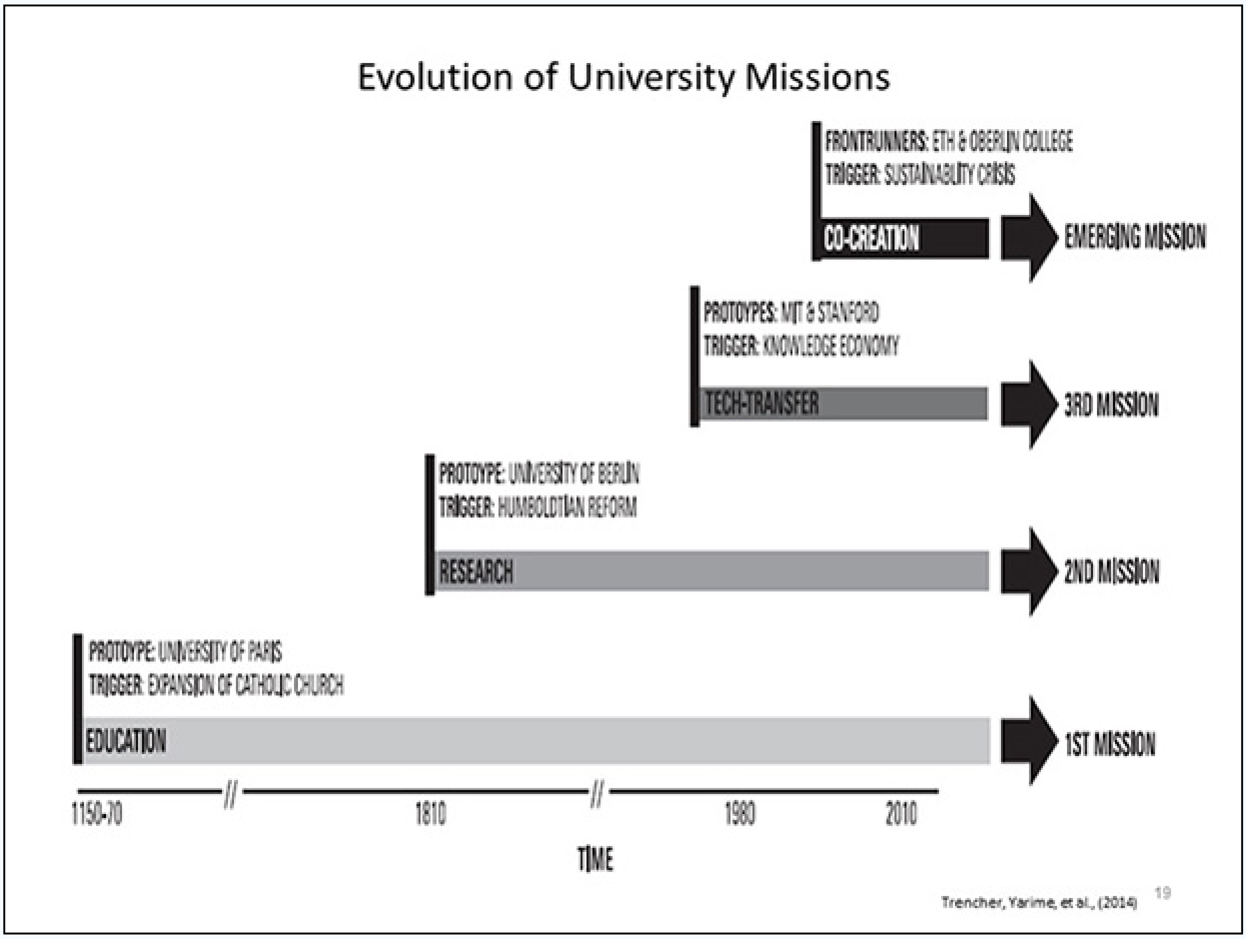

Key Properties of Third and Emerging Missions of University

	Third Mission	Emerging Mission
Mode	Technology transfer	Co-creation and co-implementation of knowledge
Objective	Contribute to economic development	Create societal transformations to materialize sustainable development
Model	Entrepreneurial university	Transformative university
Paradigm	Market orientation and entrepreneurship	Collaboration with stakeholders in society
Discipline	Mainly natural sciences and engineering	Broad range of fields including humanities and social sciences, in addition to natural sciences and engineering, inter-/trans-disciplinarity
Approach	• Closed to university researcher and company • Exclusive agreement on intellectual property • Devices/tools orientated • Response to problems in isolation	• Open to various stakeholders • Place and stakeholder oriented • Comprehensive, systematic response to complex, interwoven problems • Integrated use of various methodologies

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Key Properties of Third and Emerging Missions of University

	Third Mission	Emerging Mission
Time frame	Short- to mid-term	Mid- to long-term
Collaboration type	Specialists from academia, industry and government	Large-scale coalition with both specialists and non-specialists from academia, industry, government and civil society
University actors	Faculty, with aid from administration and technology transfer office (TTO)	Faculty/researchers, administration, students, and bridging organizations
Chief drivers	• Specialized scientific knowledge • Technological innovation	• Multi-disciplinary scientific knowledge • Technological and social innovation • Socially embedded knowledge and transdisciplinary mutual learning • Socio-technical transformations
Setting	Laboratory/controlled environment (technology park, ventures, incubators)	Real-world setting: specific location (community, city, region, nation), living laboratory
Problem	Specific technical/scientific problems	Social, ill-defined, interlinked problems

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Key Properties of Third and Emerging Missions of University

	Third Mission	Emerging Mission
Channels	• Article publications, conference presentations • Patent applications, licenses • Technology transfer • Spin-off firms, technology parks • Consultation, supply of graduates	• Knowledge management • Technical demonstration projects • Social experiments

22

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University partnerships for co-designing and co-producing urban sustainability

Gregory Trencher[a,*], Xuemei Bai[b], James Evans[c], Kes McCormick[d], Masaru Yarime[e,f]

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[b] Australian National University, Fenner School of Environment and Society, Australia
[c] University of Manchester, School of Environment, Education and Development, United Kingdom
[d] Lund University, International Institute for Industrial Environmental Economics, Sweden
[e] University of Tokyo, Graduate School of Public Policy, Japan
[f] University College London, Department of Science, Technology, Engineering and Public Policy, United Kingdom

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Urban
Co-design
Co-production
Stakeholder collaborations

ABSTRACT

Universities are playing an increasingly central role in advancing sustainability at the local, regional and national scale through cross-sector collaborations. Accompanying the launch of Future Earth, interest is mounting in the co-design and co-production of knowledge and solutions for advancing global sustainability, particularly in urban areas. Place-based university partnerships appear as particularly significant vehicles for enacting co-design and co-production in the context of urban sustainability. However, the nature and role of these partnerships are not well understood, in part due to the absence of systematic analyses across multiple cases. To fill this gap, the objectives of this paper were to conduct a large-scale international survey focusing on university partnerships for urban sustainability in industrialised Europe, Asia and North America to (1) determine defining features such as focus areas, geographical scales, mechanisms, actors and motivations, and (2) identify commonly encountered drivers, barriers and potential impacts.

Results indicate that partnerships most typically target energy, buildings, governance and social systems, unfold at local or city-scales, and involve collaborations with local or regional government. Our analysis shows that potential outcomes of university initiatives to co-design and co-produce urban sustainability are not limited to knowledge and policy. They also encompass the creation of new technological prototypes, businesses and new socio-technical systems, in addition to transformations of the built and natural environment. Findings also suggest that individual partnerships are making strong social, environmental and sustainability impacts, with less evidence of economic contributions. Strategies are required to enhance project management and ensure that projects address contrasting priorities and time horizons in academia and local government. Implications for policy include findings that targeted funding programmes can play a key role in fostering partnerships. Measures are also required to challenge academic norms and incentive structures that, in some cases, hinder university efforts to engage in place-based initiatives to co-design and co-produce urban sustainability.

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Cases of Stakeholder Collaborations for Sustainability

- **East Bay Green Corridor**, University of California, Berkley, East Bay area, San Francisco, USA
- **Grand Rapids Community Sustainability Partnership**, Grand Valley State University, Aquinas College, Grand Rapids Community College, Michigan, Grand Rapids, USA
- **Oberlin Project**, Oberlin College, Oberlin, Ohio, USA
- **Rust to Green**, Cornell University and partners, New York State, USA
- **Smart City San Diego**, University of California, San Diego, California, USA
- **Tompkins County Climate Protection Initiative**, Cornell University, Ithaca College, Tompkins Cortland, Community College, Tompkins Country, New York, USA
- **UniverCity**, Simon Fraser University, Burnaby, British Columbia, Canada
- **City Lab Coventry**, Coventry University, Coventry City, England
- **2000 Watt Society Pilot Regions**, Swiss Federal Institute of Technology (ETH), Basel, Geneva & Zurich, Switzerland
- **Sustainable Glasgow**, University of Strathclyde, Glasgow, Scotland
- **Sustainable Urban Neighborhoods**, University of Liege, Meuse-Rhine Euregion, EU
- **NESTown**, Swiss Federal Institute of Technology (ETH), Lake Tana, Buranest, Ethiopia
- **Urban Reformation Program for a Bright Low-Carbon Society**, University of Tokyo, Kashiwa City, Japan

Trencher, Yarime, and Kharrazi (2013); Trencher, Yarime, McCormick, Doll, and Kraines (2014); Trencher, Bai, Evans, McCormick, Yarime (2014)

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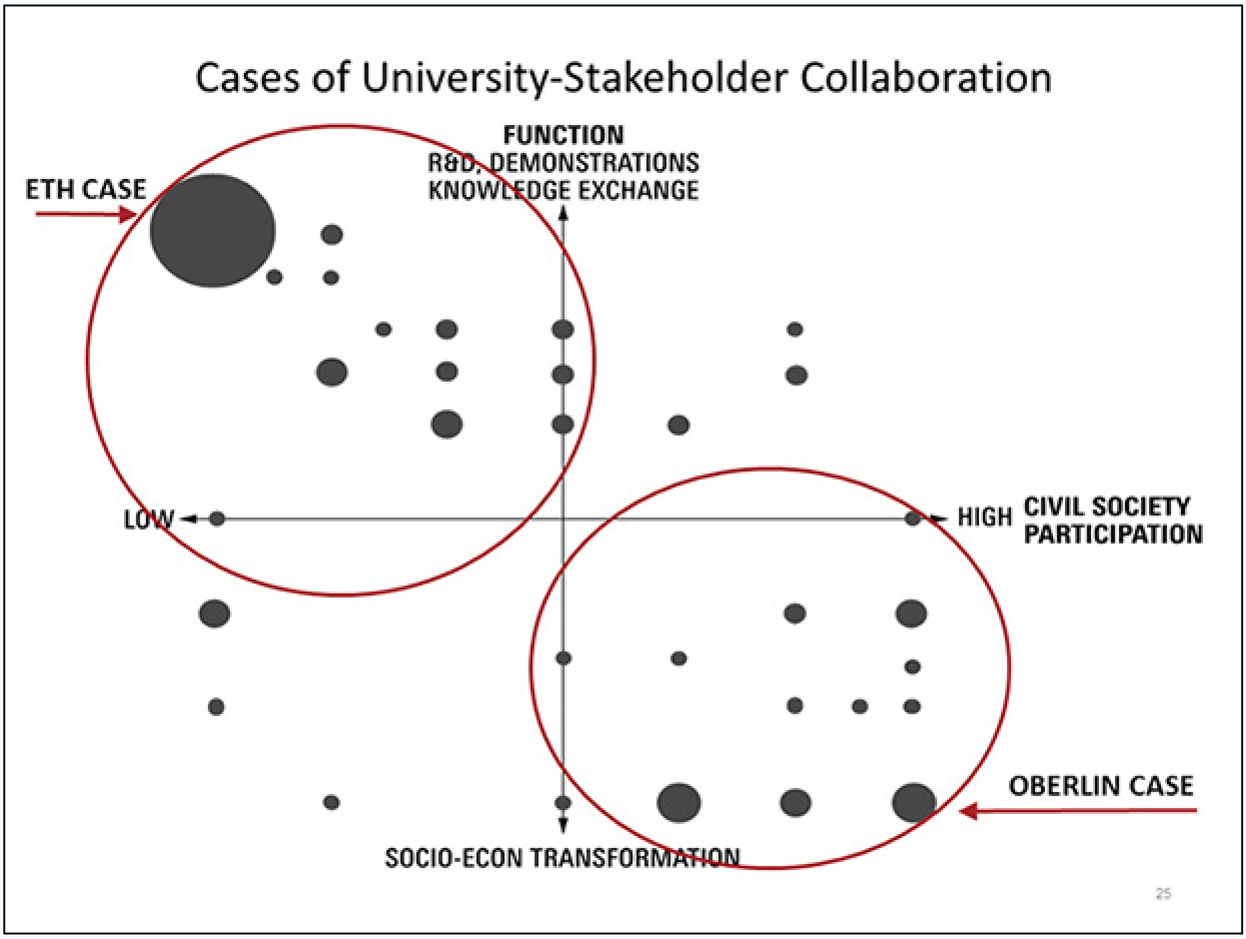
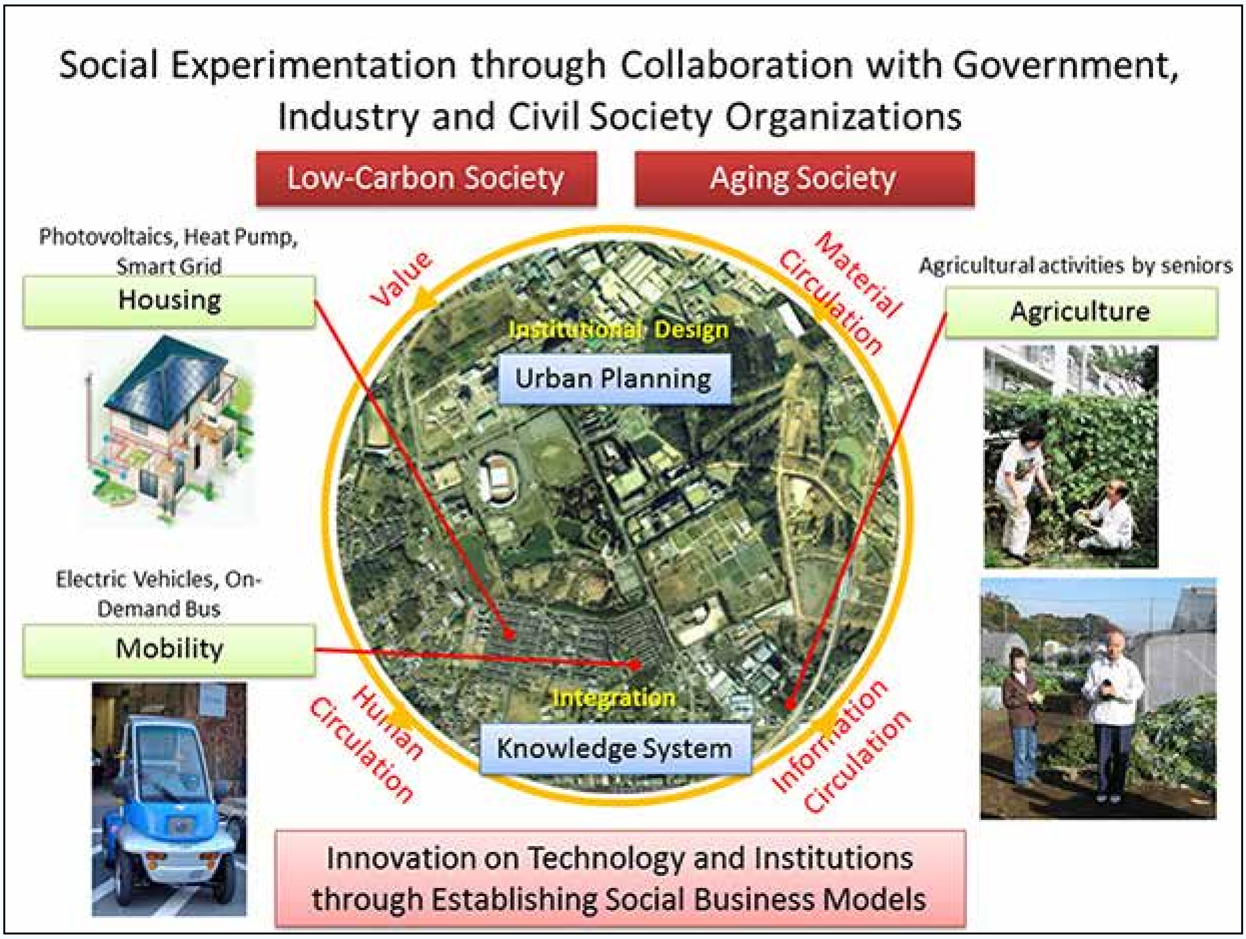

Cases of University-Stakeholder Collaboration
FUNCTION
R&D, DEMONSTRATIONS
KNOWLEDGE EXCHANGE
ETH CASE
LOW
HIGH
CIVIL SOCIETY
PARTICIPATION
OBERLIN CASE
SOCIO-ECON TRANSFORMATION
25


Social Experimentation through Collaboration with Government, Industry and Civil Society Organizations
Low-Carbon Society
Aging Society
Photovoltaics, Heat Pump, Smart Grid
Housing
Value
Material Circulation
Institutional Design
Urban Planning
Agricultural activities by seniors
Agriculture
Electric Vehicles, On-Demand Bus
Mobility
Integration
Knowledge System
Human Circulation
Information Circulation
Innovation on Technology and Institutions through Establishing Social Business Models

Functions of Universities-Stakeholder Collaboration for Innovation for Societal Challenges

- Creation of future visions based on science
- Setting of concrete and practical goals and targets
- Joint scenario making with stakeholders
- Promotion of active participation and engagement of various stakeholders
- Data collection and analysis on societal needs
- Development of new technologies and systems through social experimentation with university as a platform, living laboratory
- Impact Assessment, with transparency, objectivity, practicality
- Legitimation of innovation in society
- Effective feedback to decision makers in the private & public sectors
- Incorporation into institutional design
- Agenda-setting at regional, national, and global levels

Yarime and Trencher (2014) 27

Some Issues for Further Exploration

- Trade-off between basic research and grand/societal challenges?
- Integration in practice (especially small-scale, incremental innovation)
  - Risk management and governance
  - Research and development
- Methodological complementarities
  - Science and Technology Studies (STS) (framing, normative issues)
  - Sociology of Science (behavior of scientists)
  - Industrial Organization and Economics of Innovation (strategy, management, investment)
- Examination of the effects of public policies for promoting science, technology, and innovation for societal challenges

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Norms, Incentives, and Evaluation

- Current academic norms and incentives potentially hindering university actors from engaging in placed-based sustainability work with external stakeholders
- Internal university policies yet to prove a substantial driver for sustainability partnerships
- Academic incentive structures encouraging tangible and quantifiable outputs such as publications in established journals
- Difficulty to evaluate efforts to engage with society and tackle place-specific challenges
- Measures required to shift such priorities (Crow, 2010)
- University appraisal and performance based research funding systems from national governments could serve as policy instruments, shifting market signals in research and innovation systems (Hicks, 2012) by placing explicit demands on outputs not only to the economy, but also to society.

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RESEARCH
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Vol 6(1): 63–77
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The Issues and Methodologies in Sustainability Assessment Tools for Higher Education Institutions

A Review of Recent Trends and Future Challenges

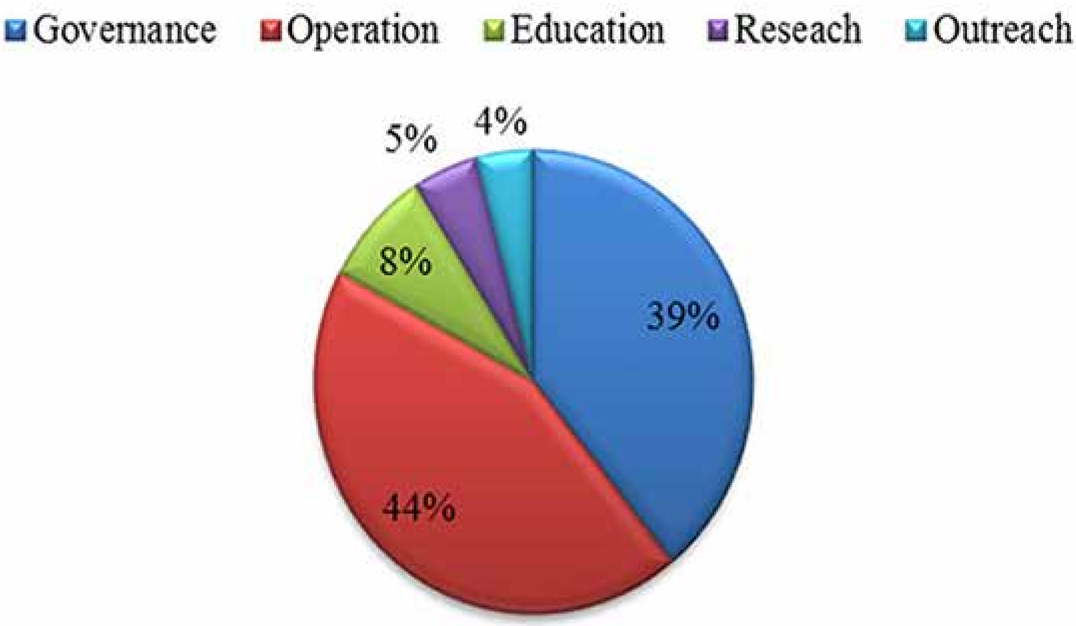
MASARU YARIME AND YUKO TANAKA

Abstract

Assessment tools influence incentives to higher education institutions by encouraging them to move towards sustainability. A review of 16 sustainability assessment tools was conducted to examine the recent trends in the issues and methodologies addressed in assessment tools quantitatively and qualitatively. The characteristics of the current approaches as well as problems and obstacles are identified, and implications and suggestions offered for improvements. The sustainability assessment tools reviewed focus mainly on the environmental impacts of university operation and issues related to governance. Aspects of education, research and outreach activities are not well addressed by these tools. As activities for sustainability at higher education institutions increasingly involve inter-/trans-disciplinary cooperation and close collaboration with diverse stakeholders in society, it will be of critical importance to develop and implement concepts and methodologies for conducting comprehensive, long-term and integrated assessment of research, education, and outreach on sustainability at higher education institutions.

Keywords: sustainability assessment tool, higher education institutions, governance, operation, education, research, outreach

Areas Addressed in Sustainability Assessment Tools for Universities



Yarime and Tanaka (2012) 31

Challenges in Institutionalization

- Education, research, and contribution to society to be combined effectively to produce graduates with necessary skills as well as to produce outputs useful for addressing societal needs
- Incentives of researchers need to be adjusted to promote cooperation and collaboration between those in different disciplines and faculties
  - Change in the criteria for performance evaluation
- Promotion and tenure structure need to be adjusted not only in one university, but also in other universities and research institutes
  - Promoting mobility between different places
  - Developing long-term career paths
- Exploration of career paths for graduates in industry, government, and civil society
- Great potential in global collaboration between academic programs in STI policy and governance

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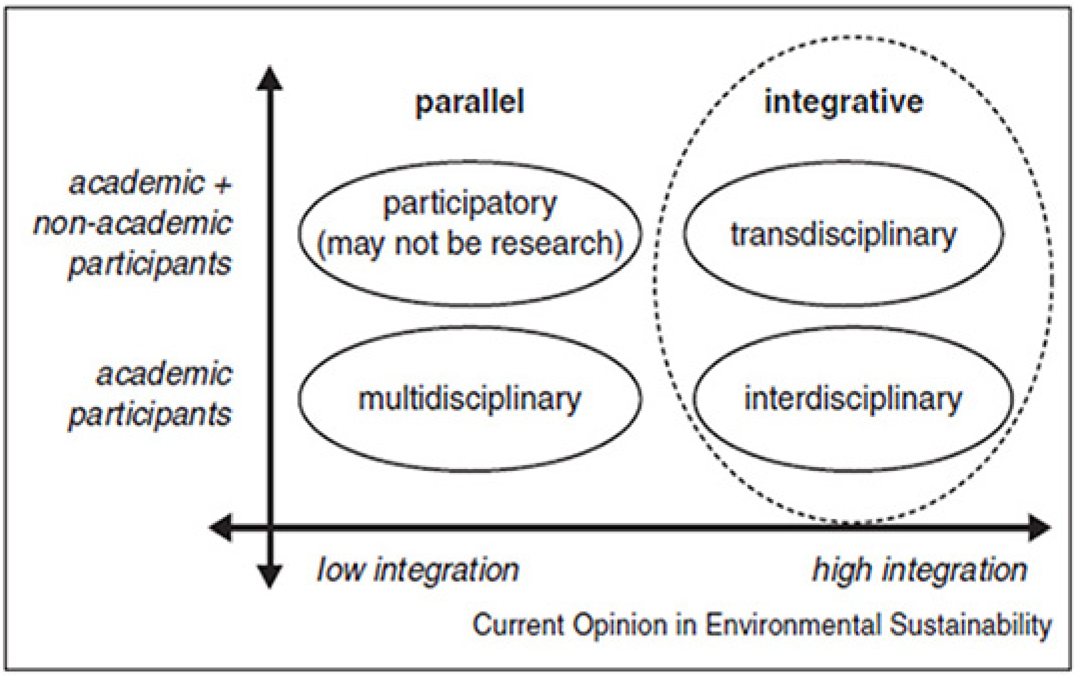
Degrees of integration and stakeholder involvement in integrative and non-integrative approaches



Mauser, Klepper, Rice, Schmalzbauer, Hackmann, Leemans and Mooreet (2013) 33

Transdisciplinary Research

- Active collaboration with various stakeholders throughout society
- Going beyond academia, organizing processes of mutual learning among science and society, and innovates conventional patterns of knowledge exchange
- Integrating experiential knowledge and values about real-world problems provided by practitioners and stakeholders with scientific knowledge about systems provided by researchers
- Joint process initiated by non-academia, including government, industry, public, and NGOs, or scientists on an "ill-defined," societally relevant, real-world problem that includes challenging scientific questions
  - Yarime, Trencher, Mino, Scholz, Olsson, Ness, Frantzeskaki, and Rotmans, 2012

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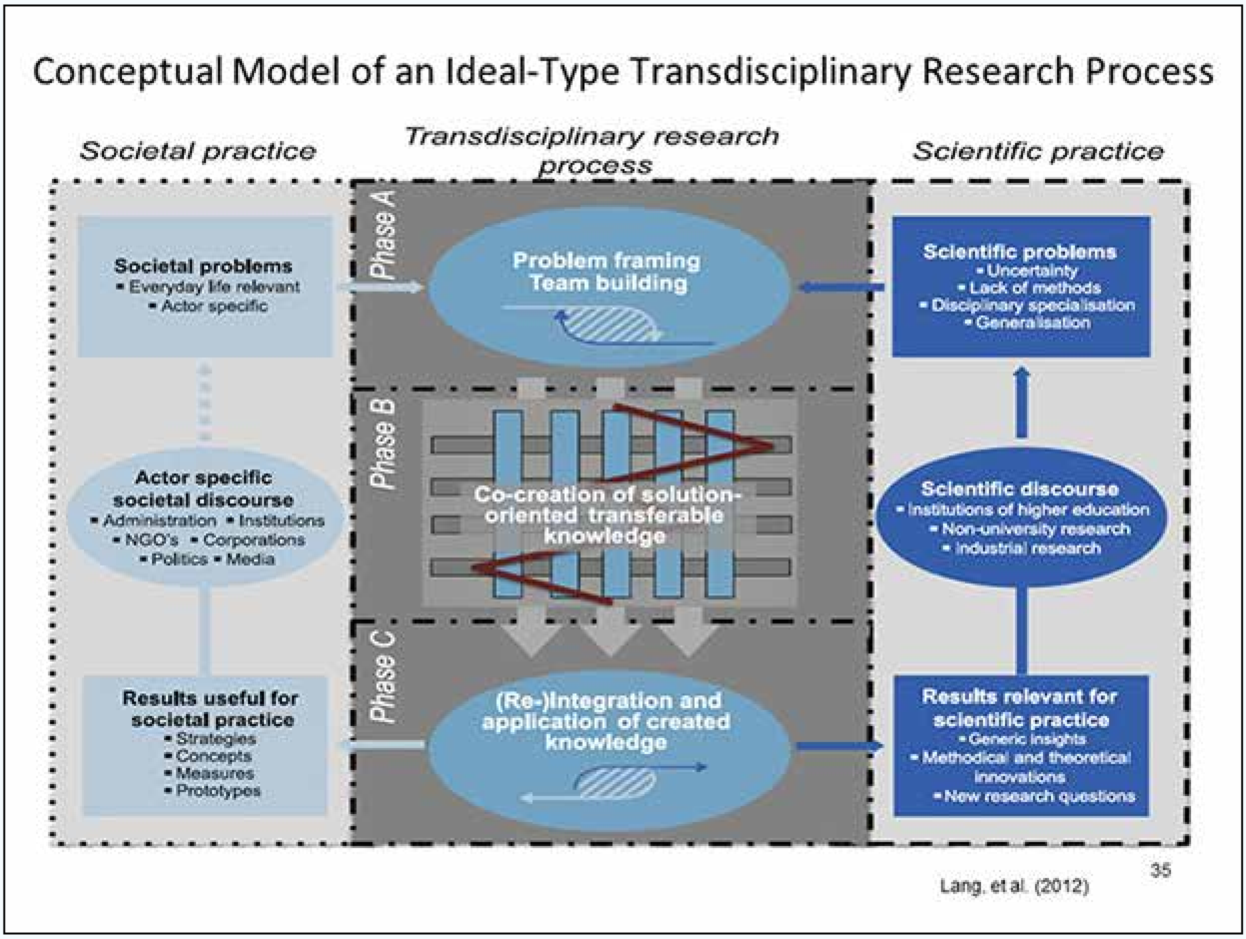
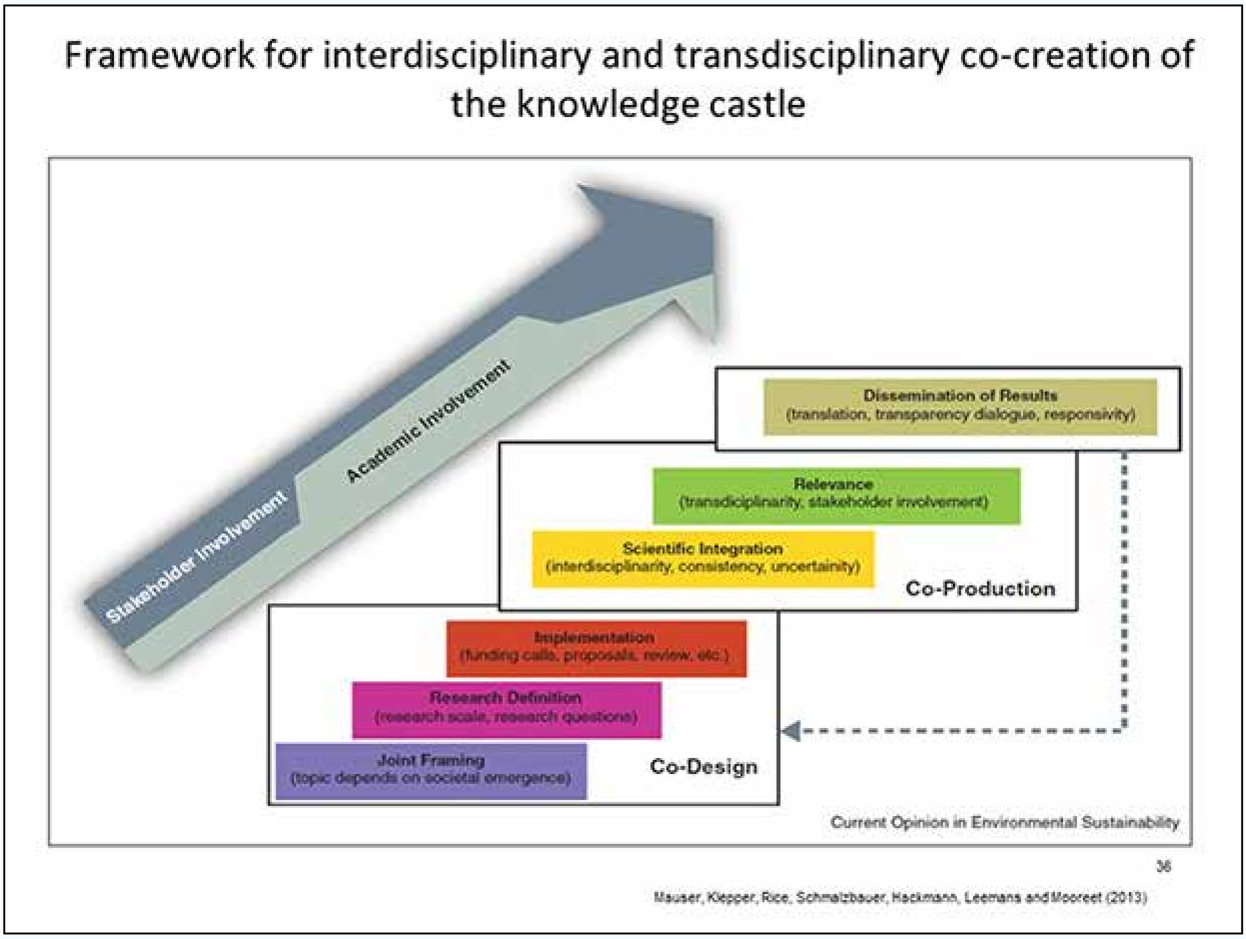
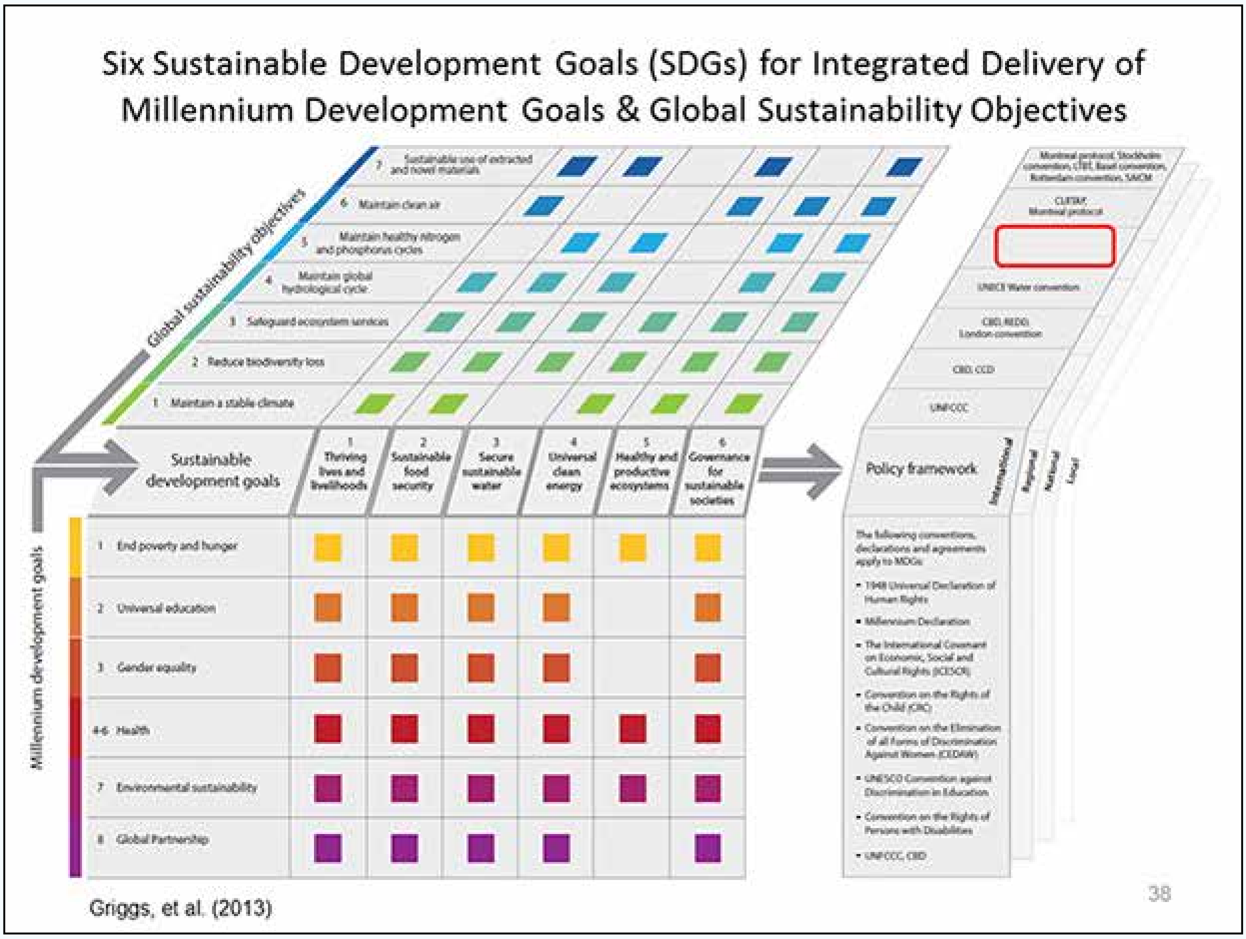
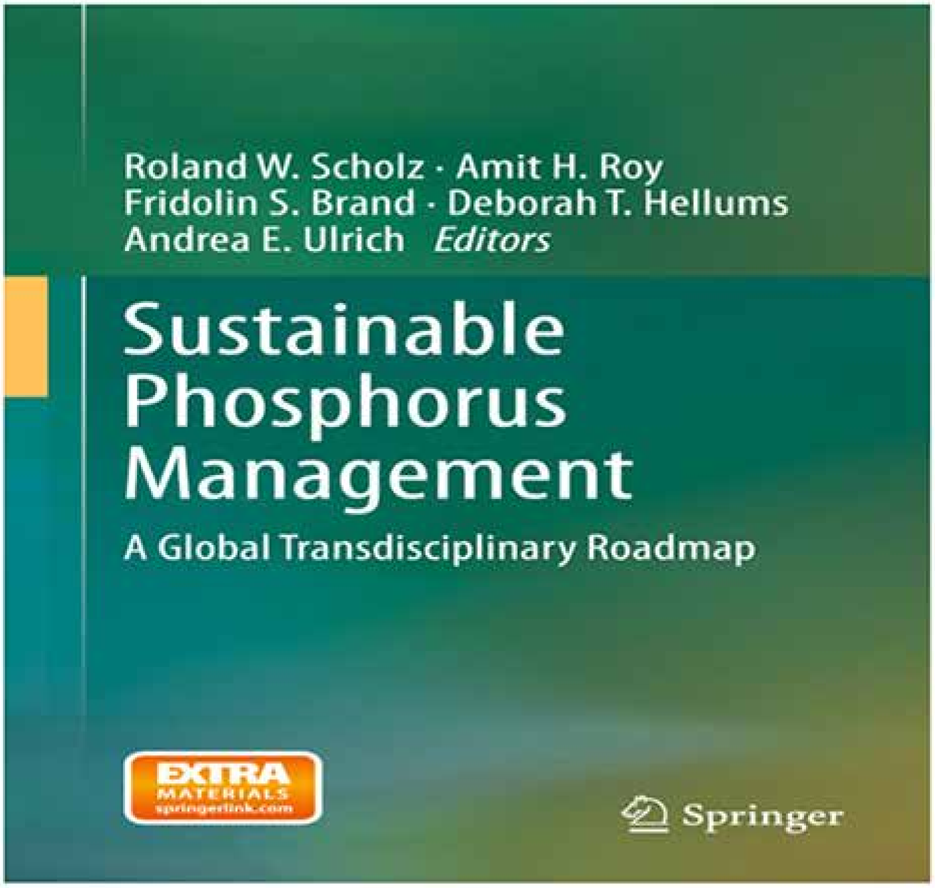

Conceptual Model of an Ideal-Type Transdisciplinary Research Process
Societal practice
Transdisciplinary research process
Scientific practice
Phase A
Phase B
Phase C
Societal problems
▪ Everyday life relevant
▪ Actor specific
Problem framing
Team building
Scientific problems
▪ Uncertainty
▪ Lack of methods
▪ Disciplinary specialisation
▪ Generalisation
Actor specific societal discourse
▪ Administration ▪ Institutions
▪ NGO's ▪ Corporations
▪ Politics ▪ Media
Co-creation of solution-oriented transferable knowledge
Scientific discourse
▪ Institutions of higher education
▪ Non-university research
▪ Industrial research
Results useful for societal practice
▪ Strategies
▪ Concepts
▪ Measures
▪ Prototypes
(Re-)Integration and application of created knowledge
Results relevant for scientific practice
▪ Generic insights
▪ Methodical and theoretical innovations
▪ New research questions
35
Lang, et al. (2012)


Framework for interdisciplinary and transdisciplinary co-creation of the knowledge castle
Stakeholder involvement
Academic involvement
Dissemination of Results
(translation, transparency dialogue, responsivity)
Relevance
(transdiciplinarity, stakeholder involvement)
Scientific Integration
(interdisciplinarity, consistency, uncertainity)
Co-Production
Implementation
(funding calls, proposals, review, etc.)
Research Definition
(research scale, research questions)
Joint Framing
(topic depends on societal emergence)
Co-Design
Current Opinion in Environmental Sustainability
36
Mauser, Klepper, Rice, Schmalzbauer, Hackmann, Leemans and Mooreet (2013)

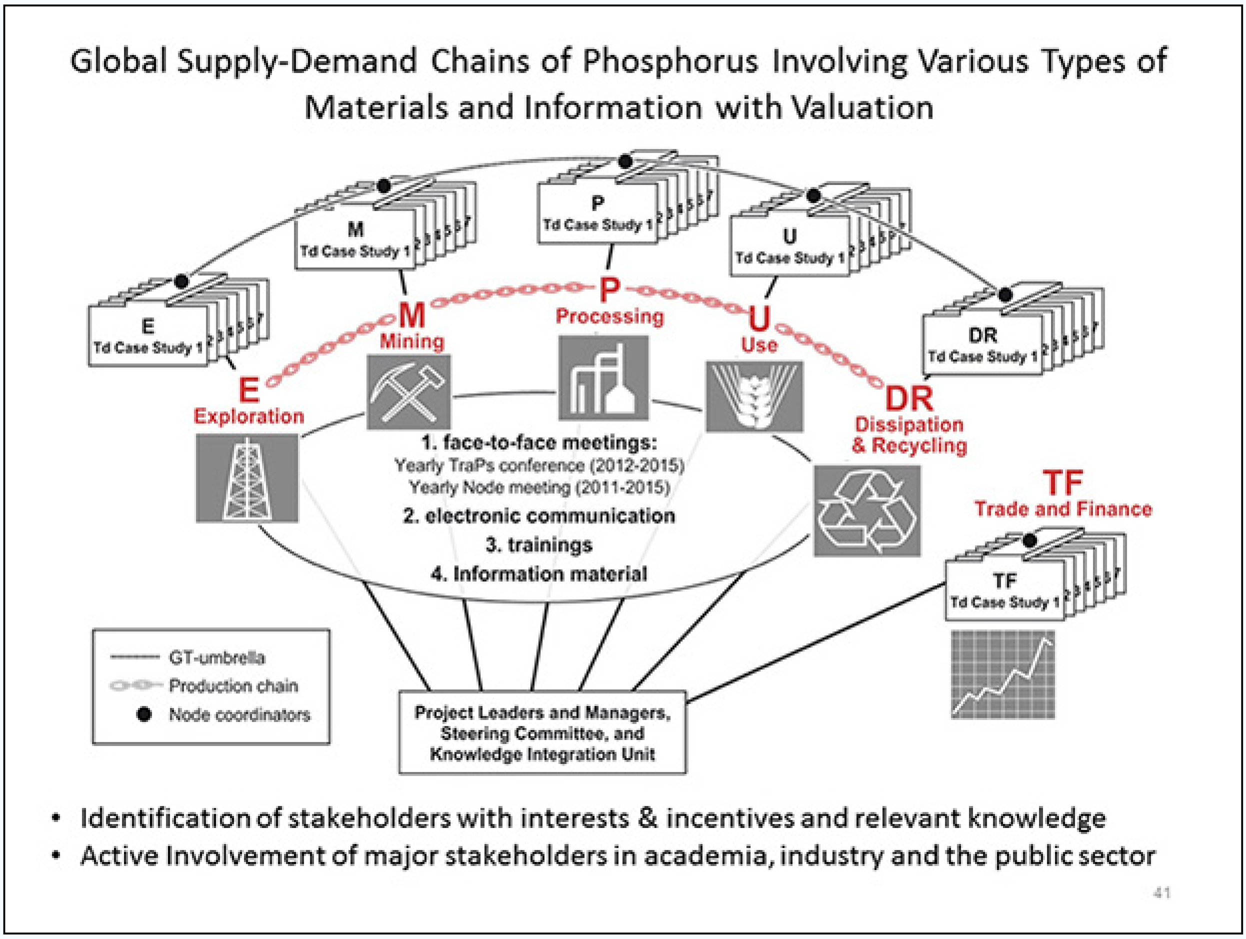

Future
Earth
2025
Vision
futurearth
research for global sustainability

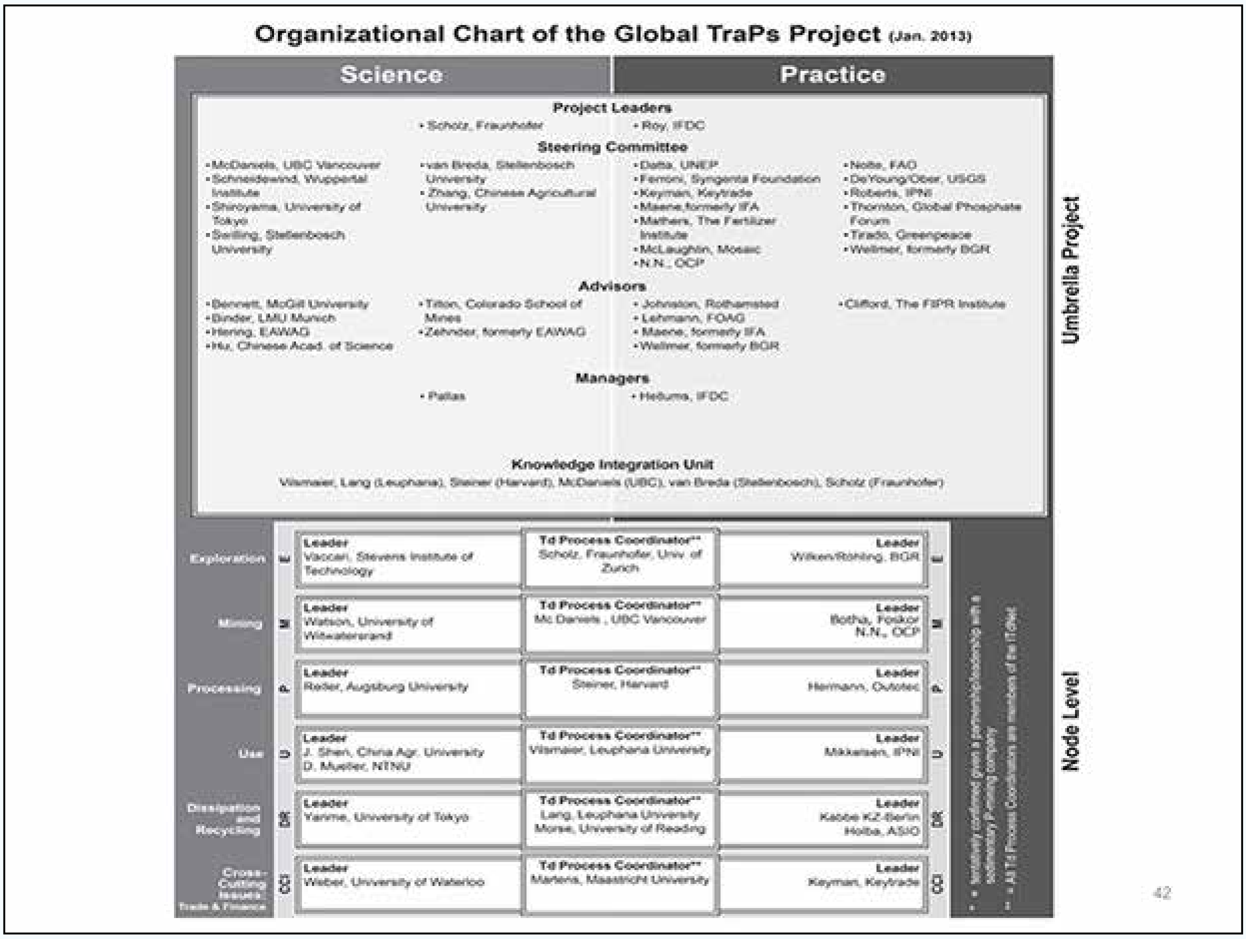

Six Sustainable Development Goals (SDGs) for Integrated Delivery of Millennium Development Goals & Global Sustainability Objectives
Global sustainability objectives
7 Sustainable use of extracted and novel materials
6 Maintain clean air
5 Maintain healthy nitrogen and phosphorus cycles
4 Maintain global hydrological cycle
3 Safeguard ecosystem services
2 Reduce biodiversity loss
1 Maintain a stable climate
Sustainable development goals
1 Thriving lives and livelihoods
2 Sustainable food security
3 Secure sustainable water
4 Universal clean energy
5 Healthy and productive ecosystems
6 Governance for sustainable societies
Millennium development goals
1 End poverty and hunger
2 Universal education
3 Gender equality
4-6 Health
7 Environmental sustainability
8 Global Partnership
Policy framework
International
Regional
National
Local
UNECE Water convention
CBD, CCD
UNFCCC
The following conventions, declarations and agreements apply to MDGs:
1948 Universal Declaration of Human Rights
Millennium Declaration
The International Covenant on Economic, Social and Cultural Rights (ICESCR)
Convention on the Rights of the Child (CRC)
Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW)
UNESCO Convention against Discrimination in Education
Convention on the Rights of Persons with Disabilities
UNFCCC, CBD
Griggs, et al. (2013)
38

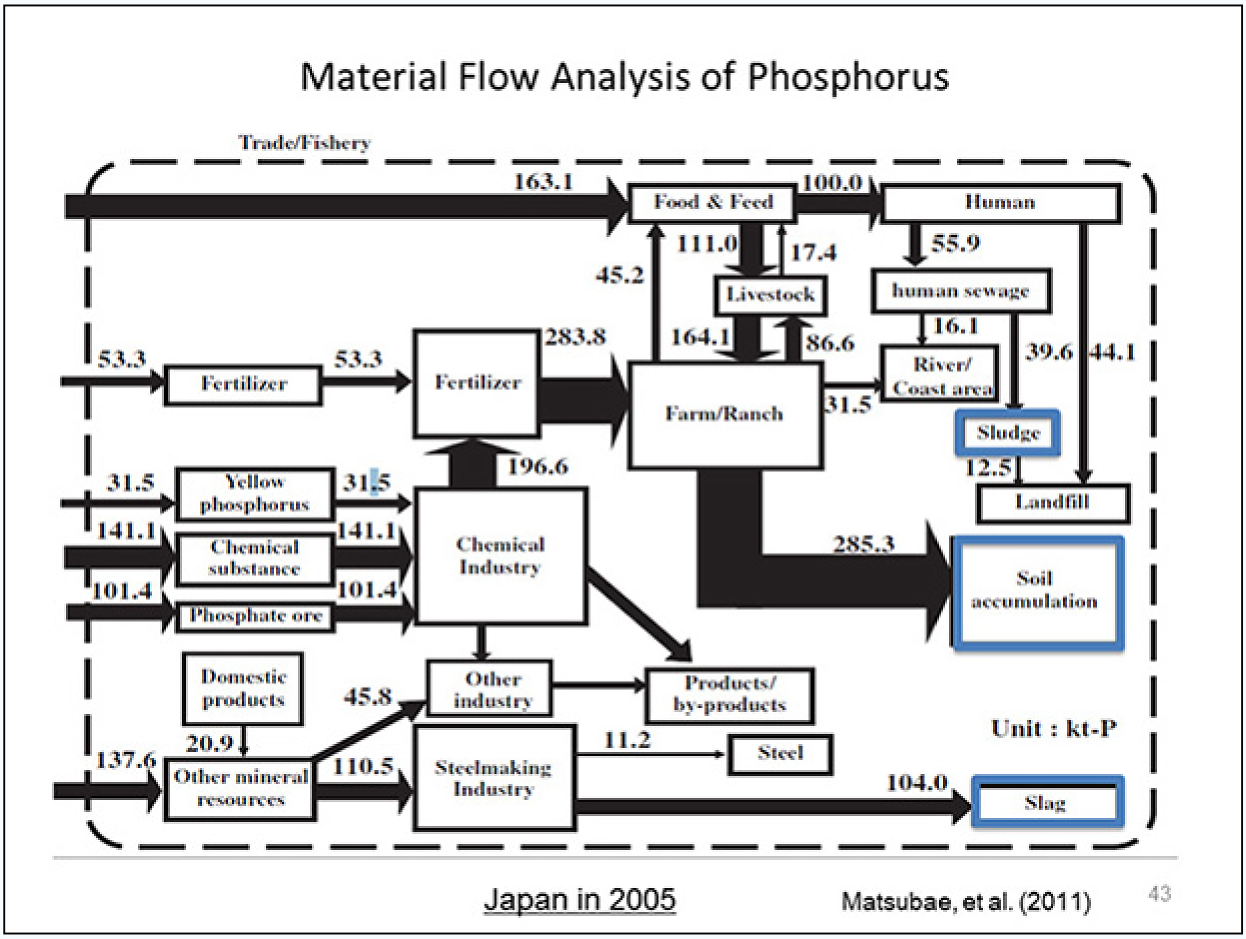

Roland W. Scholz · Amit H. Roy
Fridolin S. Brand · Deborah T. Hellums
Andrea E. Ulrich Editors
Sustainable Phosphorus Management
A Global Transdisciplinary Roadmap
EXTRA MATERIALS springerlink.com
Springer

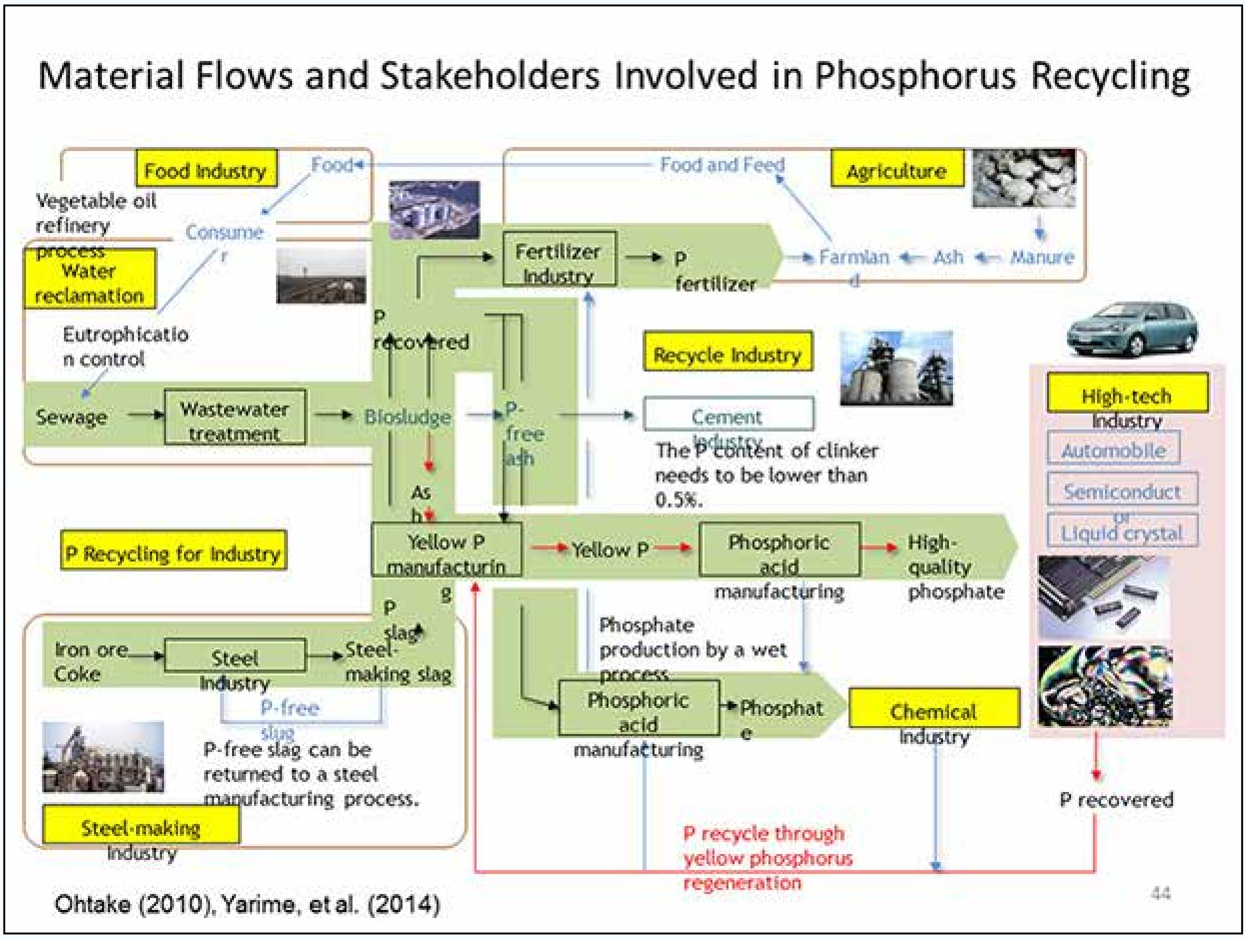
39

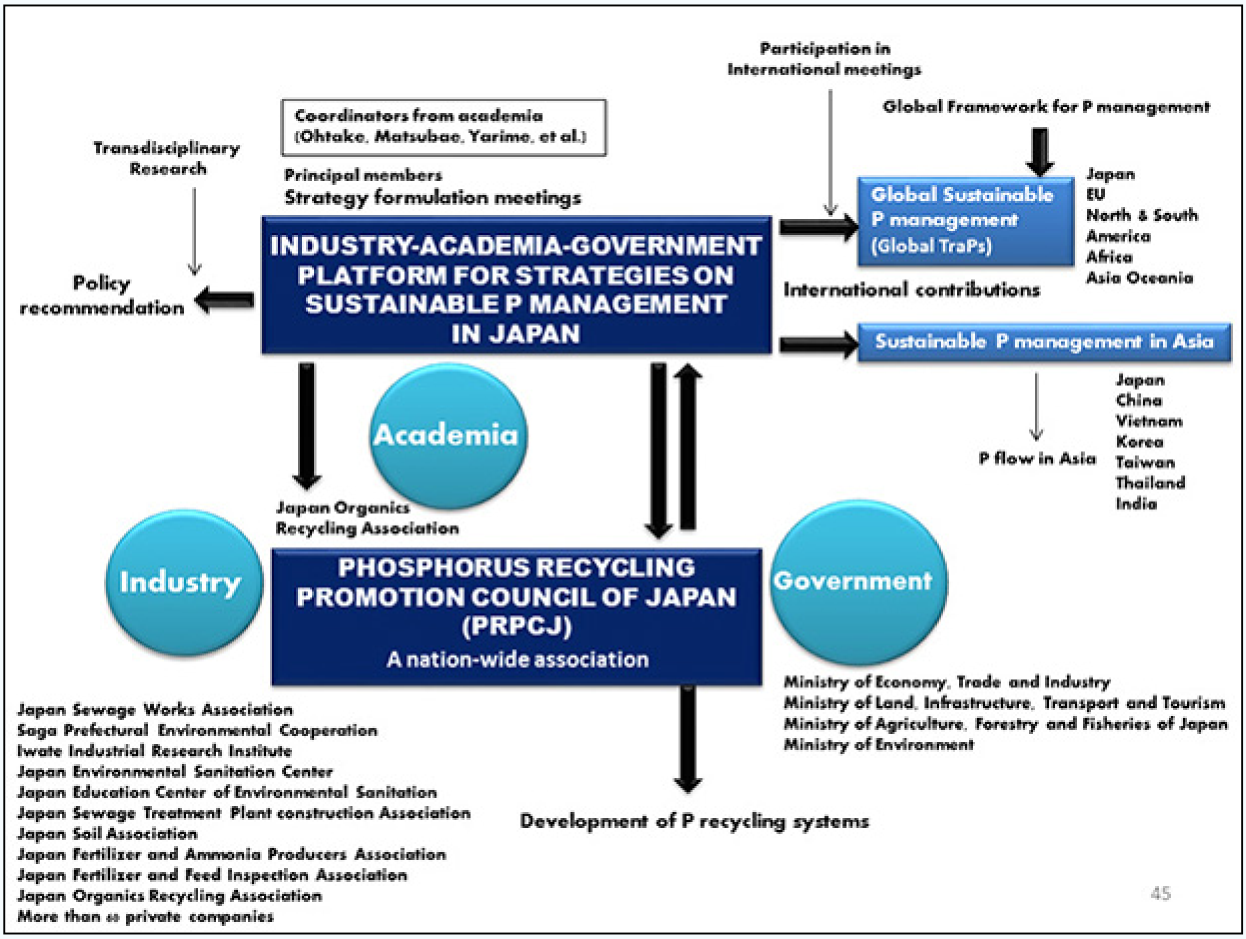
40


Global Supply-Demand Chains of Phosphorus Involving Various Types of Materials and Information with Valuation
E
Td Case Study 1
M
Td Case Study 1
P
Td Case Study 1
U
Td Case Study 1
DR
Td Case Study 1
E
Exploration
M
Mining
P
Processing
U
Use
DR
Dissipation & Recycling
TF
Trade and Finance
TF
Td Case Study 1
1. face-to-face meetings:
Yearly TraPs conference (2012-2015)
Yearly Node meeting (2011-2015)
2. electronic communication
3. trainings
4. Information material
GT-umbrella
Production chain
Node coordinators
Project Leaders and Managers, Steering Committee, and Knowledge Integration Unit
• Identification of stakeholders with interests & incentives and relevant knowledge
• Active Involvement of major stakeholders in academia, industry and the public sector
41

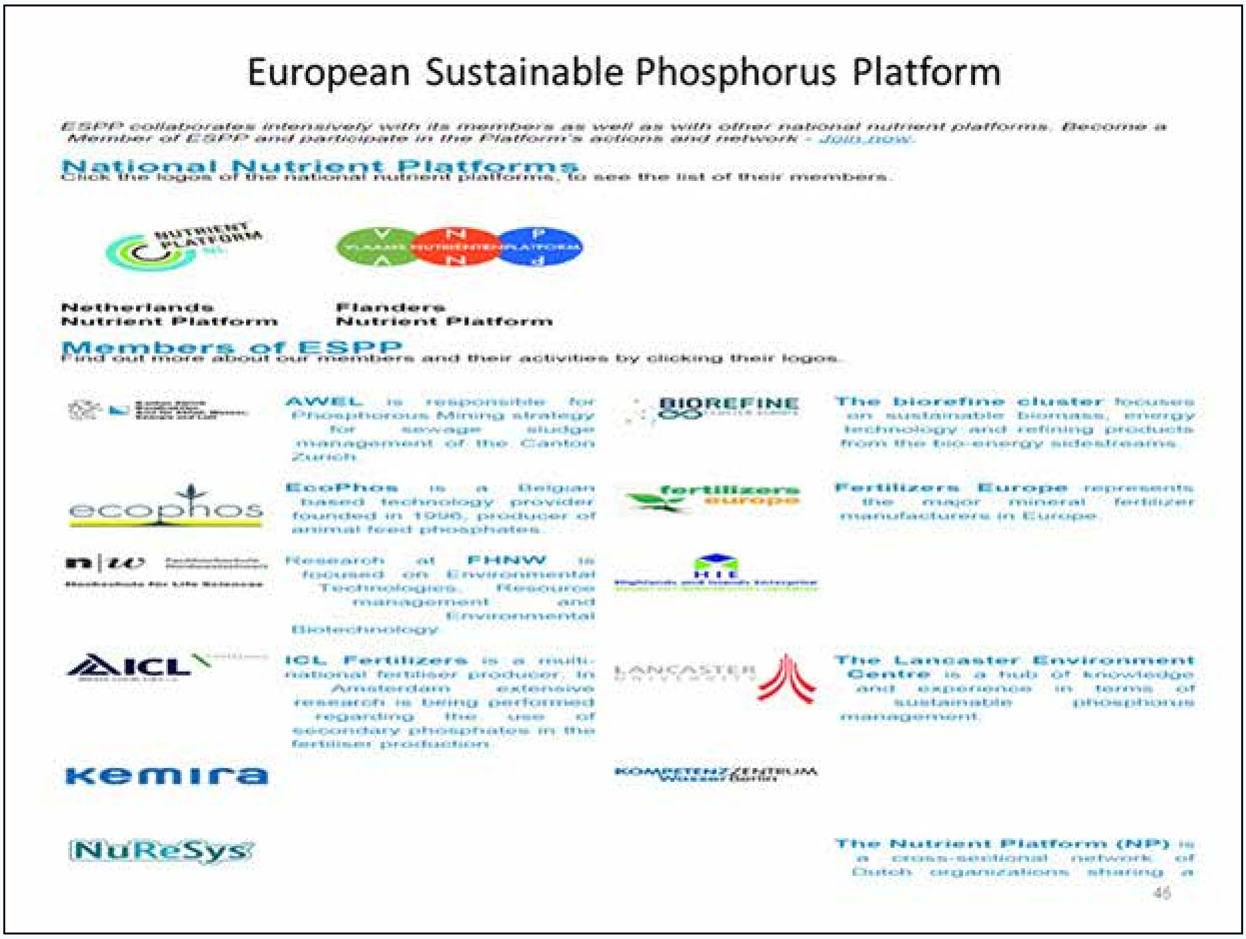

Organizational Chart of the Global TraPs Project (Jan. 2013)
Science
Practice
Project Leaders
• Scholz, Fraunhofer
• Roy, IFDC
Steering Committee
• McDaniels, UBC Vancouver
• Schneidewind, Wuppertal Institute
• Shiroyama, University of Tokyo
• Swilling, Stellenbosch University
• van Breda, Stellenbosch University
• Zhang, Chinese Agricultural University
• Datta, UNEP
• Ferroni, Syngenta Foundation
• Keyman, Keytrade
• Maene, formerly IFA
• Mathers, The Fertilizer Institute
• McLaughlin, Mosaic
• N.N., OCP
• Nolte, FAO
• DeYoung/Ober, USGS
• Roberts, IPNI
• Thornton, Global Phosphate Forum
• Tirado, Greenpeace
• Wellmer, formerly BGR
Advisors
• Bennett, McGill University
• Binder, LMU Munich
• Hering, EAWAG
• Hu, Chinese Acad. of Science
• Tilton, Colorado School of Mines
• Zehnder, formerly EAWAG
• Johnston, Rothamsted
• Lehmann, FOAG
• Maene, formerly IFA
• Wellmer, formerly BGR
• Clifford, The FIPR Institute
Managers
• Pallas
• Hellums, IFDC
Knowledge Integration Unit
Vilsmaier, Lang (Leuphana), Steiner (Harvard), McDaniels (UBC), van Breda (Stellenbosch), Scholz (Fraunhofer)
Umbrella Project
Exploration
E
Leader
Vaccari, Stevens Institute of Technology
Td Process Coordinator**
Scholz, Fraunhofer, Univ. of Zurich
Leader
Wilken/Röhling, BGR
Mining
M
Leader
Watson, University of Witwatersrand
Td Process Coordinator**
Mc Daniels , UBC Vancouver
Leader
Botha, Foskor
N.N., OCP
Processing
P
Leader
Reller, Augsburg University
Td Process Coordinator**
Steiner, Harvard
Leader
Hermann, Outotec
Use
U
Leader
J. Shen, China Agr. University
D. Mueller, NTNU
Td Process Coordinator**
Vilsmaier, Leuphana University
Leader
Mikkelsen, IPNI
Dissipation and Recycling
DR
Leader
Yarime, University of Tokyo
Td Process Coordinator**
Lang, Leuphana University
Morse, University of Reading
Leader
Kabbe KZ-Berlin
Holba, ASIO
Cross-Cutting Issues: Trade & Finance
CCI
Leader
Weber, University of Waterloo
Td Process Coordinator**
Martens, Maastricht University
Leader
Keyman, Keytrade
Node Level
42


Material Flow Analysis of Phosphorus
Trade/Fishery
163.1
Food & Feed
100.0
Human
111.0
17.4
45.2
55.9
Livestock
human sewage
283.8
164.1
86.6
16.1
53.3
Fertilizer
53.3
Fertilizer
Farm/Ranch
River/
Coast area
39.6
44.1
31.5
Sludge
196.6
12.5
31.5
Yellow
phosphorus
31.5
Landfill
141.1
Chemical
substance
141.1
Chemical
Industry
285.3
Soil
accumulation
101.4
Phosphate ore
101.4
Domestic
products
45.8
Other
industry
Products/
by-products
20.9
Unit : kt-P
137.6
Other mineral
resources
110.5
Steelmaking
Industry
11.2
Steel
104.0
Slag
Japan in 2005
Matsubae, et al. (2011)
43


Material Flows and Stakeholders Involved in Phosphorus Recycling
Food Industry
Food
Food and Feed
Agriculture
Vegetable oil
refinery
process
Consumer
Water
reclamation
Fertilizer
Industry
P
fertilizer
Farmland
Ash
Manure
Eutrophication control
P
recovered
Recycle Industry
Sewage
Wastewater
treatment
Biosludge
P-
free
ash
Cement
Industry
The P content of clinker
needs to be lower than
0.5%.
High-tech
Industry
Automobile
Semiconductor
Liquid crystal
Ash
P Recycling for Industry
Yellow P
manufacturing
Yellow P
Phosphoric
acid
manufacturing
High-
quality
phosphate
P
slag
Phosphate
production by a wet
process
Iron ore
Coke
Steel
Industry
Steel-
making slag
P-free
slag
Phosphoric
acid
manufacturing
Phosphate
Chemical
Industry
P-free slag can be
returned to a steel
manufacturing process.
P recovered
Steel-making
Industry
P recycle through
yellow phosphorus
regeneration
Ohtake (2010), Yarime, et al. (2014)
44



Participation in International meetings
Coordinators from academia (Ohtake, Matsubae, Yarime, et al.)
Transdisciplinary Research
Principal members
Strategy formulation meetings
Global Framework for P management
Global Sustainable P management (Global TraPs)
Japan
EU
North & South America
Africa
Asia Oceania
Policy recommendation
INDUSTRY-ACADEMIA-GOVERNMENT PLATFORM FOR STRATEGIES ON SUSTAINABLE P MANAGEMENT IN JAPAN
International contributions
Sustainable P management in Asia
Japan
China
Vietnam
Korea
Taiwan
Thailand
India
P flow in Asia
Academia
Japan Organics Recycling Association
Industry
PHOSPHORUS RECYCLING PROMOTION COUNCIL OF JAPAN (PRPCJ)
A nation-wide association
Government
Ministry of Economy, Trade and Industry
Ministry of Land, Infrastructure, Transport and Tourism
Ministry of Agriculture, Forestry and Fisheries of Japan
Ministry of Environment
Japan Sewage Works Association
Saga Prefectural Environmental Cooperation
Iwate Industrial Research Institute
Japan Environmental Sanitation Center
Japan Education Center of Environmental Sanitation
Japan Sewage Treatment Plant construction Association
Japan Soil Association
Japan Fertilizer and Ammonia Producers Association
Japan Fertilizer and Feed Inspection Association
Japan Organics Recycling Association
More than 60 private companies
Development of P recycling systems
45



European Sustainable Phosphorus Platform
ESPP collaborates intensively with its members as well as with other national nutrient platforms. Become a Member of ESPP and participate in the Platform's actions and network - Join now.
National Nutrient Platforms
Click the logos of the national nutrient platforms, to see the list of their members.
Netherlands Nutrient Platform
Flanders Nutrient Platform
Members of ESPP
Find out more about our members and their activities by clicking their logos.
AWEL is responsible for Phosphorous Mining strategy for sewage sludge management of the Canton Zurich
The biorefine cluster focuses on sustainable biomass, energy technology and refining products from the bio-energy sidestreams.
EcoPhos is a Belgian based technology provider founded in 1996, producer of animal feed phosphates.
Fertilizers Europe represents the major mineral fertilizer manufacturers in Europe.
Research at FHNW is focused on Environmental Technologies, Resource management and Environmental Biotechnology
ICL Fertilizers is a multi-national fertiliser producer. In Amsterdam extensive research is being performed regarding the use of secondary phosphates in the fertiliser production
The Lancaster Environment Centre is a hub of knowledge and experience in terms of sustainable phosphorus management.
The Nutrient Platform (NP) is a cross-sectional network of Dutch organizations sharing a
46

- Round Table on National/Regional Phosphorus Platforms : Lessons Learned?, bringing scientists and stakeholders together
  - Philippe Hinsinger (Chair of Local Organizing Committee & Scientific Committee)
  - Jim Elser (US platform)
  - Philippe Eveillard (UNIFA)
  - Marion Guillou (FACCE JPI)
  - Tanja Runge (Copa-Cogeca)
  - Chris Thornton (European platform)
  - Masaru Yarime (Japanese platform)
- An global platform emerging for integrating diverse knowledge and promoting collaboration among stakeholders for sustainable phosphorus governance through transdisciplinarity

47

futurearth BLOG
research for global sustainability

Can we build sustainable phosphorus governance?

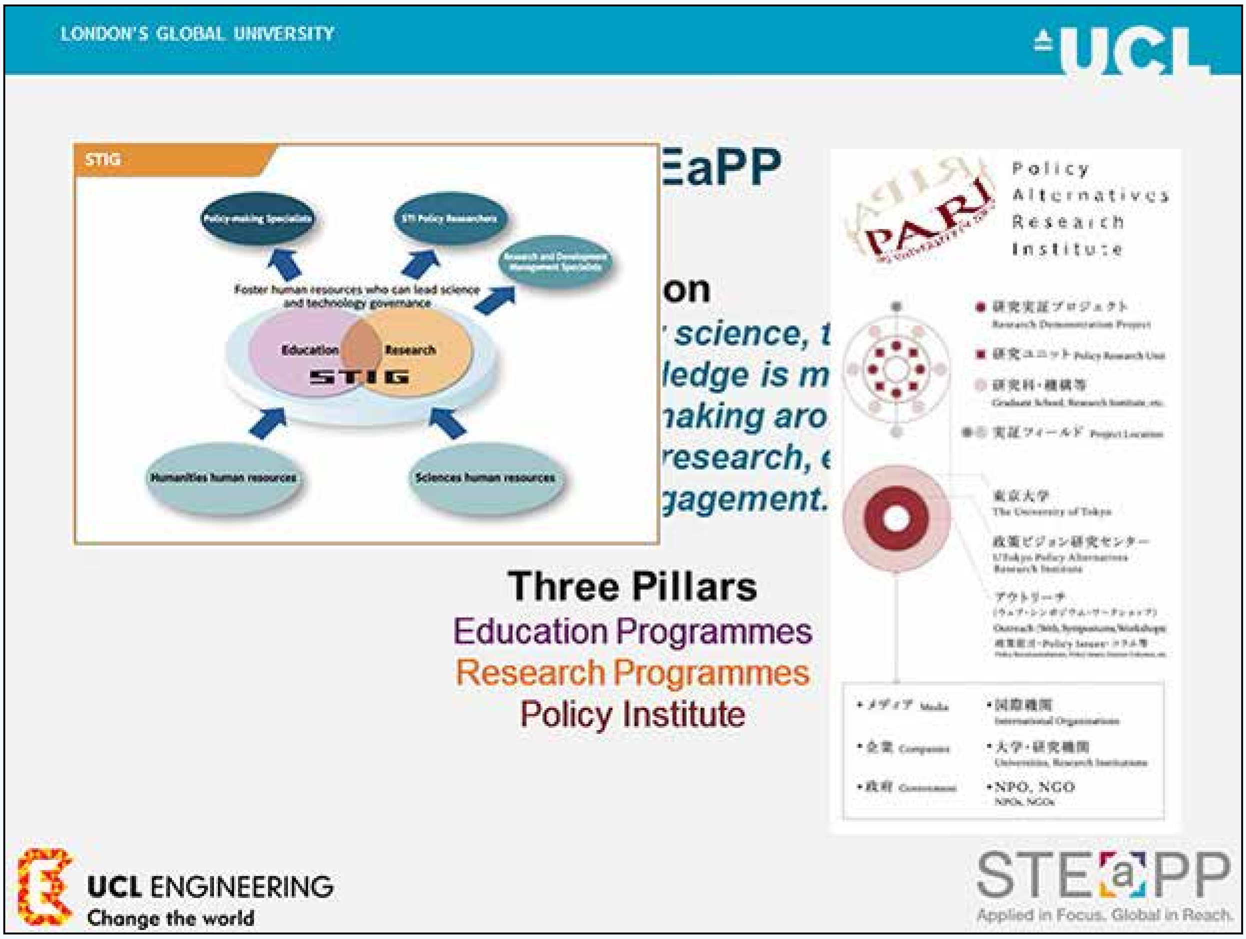
Spreading fertilizer. Photo:ILO/Truong Van Vi

OCT 2014 16

by Masaru Yarime

48

• Keynote Speech 4: Jason J. Blackstock



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STE Knowledge within Public Decision Making

Motivation and Rationale for the focus of UCL STEaPP

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STEaPP
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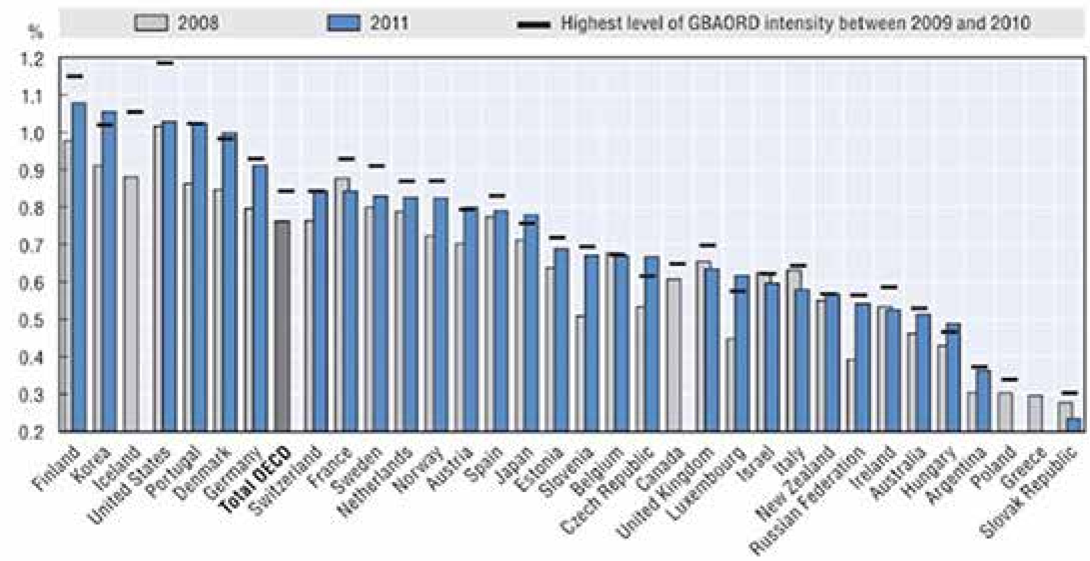
Figure 2. **R&D and innovation have been an important component of recovery packages**

Government budget appropriations or outlays for R&D (GBAORD) as a % of GDP, between 2008 and 2011



Note: Countries are ranked by descending order of GBAORD intensity in the last year for which data are available.

Source: OECD, Research and Development (RDS) Database, June 2012.

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STE Knowledge within Public Decision Making

Motivation and Rationale for the focus of UCL STEaPP

Underpins the Innovation Ecosystem

- Reliable STE knowledge underpinning legislation and regulation supports prosperity by creating the ***enabling environment*** through which STE becomes innovation and economic growth

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International Meetings in 2015

Sustainable Development Goals

HFA

Hyogo Framework for Action 2005-2015:

Building the Resilience of Nations and Communities to Disasters

United Nations Framework Convention on Climate Change

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STE Knowledge within Public Decision Making

Motivation and Rationale for the focus of UCL STEaPP

Underpins the Innovation Ecosystem

- Reliable STE knowledge underpinning legislation and regulation supports prosperity by creating the ***enabling environment*** through which STE becomes innovation and economic growth

Enables our Societies to tackle '21C Grand Challenges'

- *Credible, legitimate* and *salient* STE knowledge is needed to both understand the challenges our societies are facing, and the options we have for addressing them.

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Evolving Institutional Frameworks

International

ipcc INTERGOVERNMENTAL PANEL ON climate change

National

City/Local ?????

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Building Capacity for Effective STE within Public Decision Making

Institutions
- Mapping and understanding diverse institutional frameworks

Practices
- Day-to-day activities of STE knowledge mobilisation vary widely, even within similar institutional frameworks

Skills
- The skills and abilities required to broker knowledge at the STE-PP interface need to be better understood

… for both STE *and* PP Communities
- Both communities need support in developing their institutions, practices and skills to enable this interface more effectively

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UCL STEaPP

Mission

To support and improve how science, technology and engineering (STE) knowledge is mobilised in support of public decision making around the world, through world-leading research, education and policy engagement.

Three Pillars

Education Programmes
Research Programmes
Policy Institute

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UCL STEaPP

Aims

- Educate current and future generation of…
  - Scientists and Engineers to engage with Public Decision Making
  - Policymakers to leverage STE expertise and knowledge
- Improve our understanding of the STE and PP landscape through research co-produced with policy communities
- Develop and test "models" for mobilising STE knowledge from within Academia into public decision making – *our policy institute*

A key issue throughout…

- The cultures and incentives within both Academa and Public Decision Making

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UCL STEaPP
Education

Focus on ***Experiential Learning***

Graduate
- MPA – our flagship
- Doctoral Training Programme
- Contributions to other UCL Graduate Programmes

Undergraduate
- How to Change the World
- Minor in Science, Engineering and Public Policy
- Leadership Education for scientists and engineers

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Masters of Public Administration…

…in Science, Engineering and Public Policy
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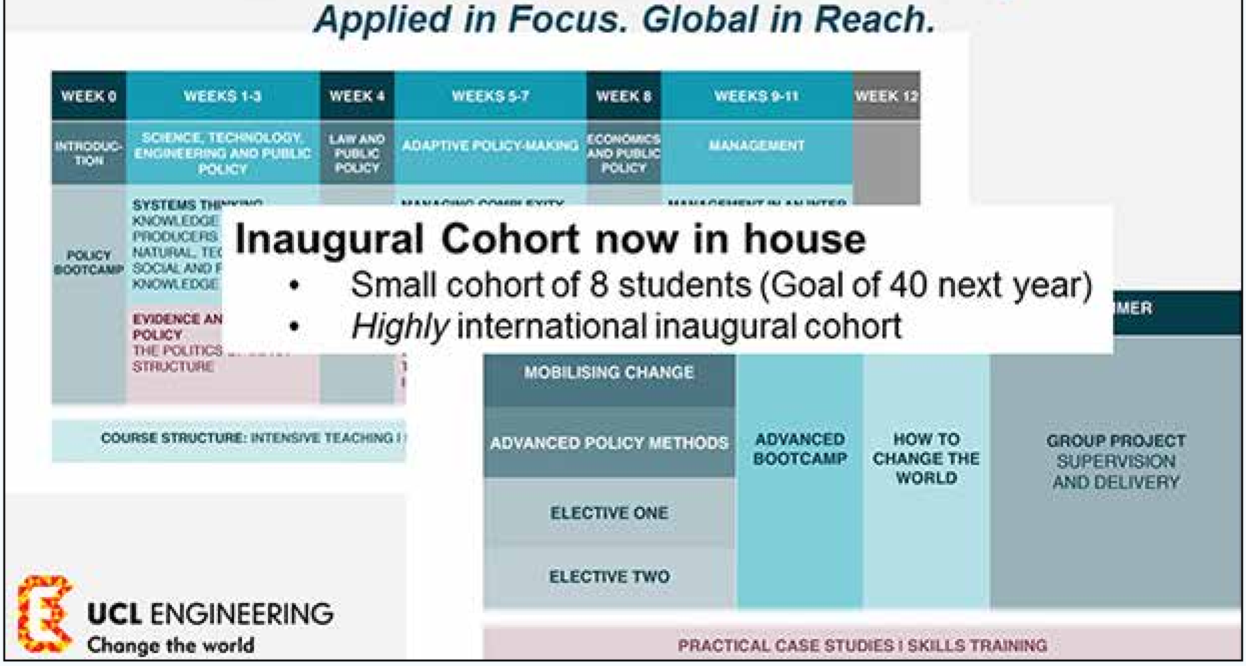

Inaugural Cohort now in house
- Small cohort of 8 students (Goal of 40 next year)
- *Highly* international inaugural cohort

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Doctoral Training Programme

Focus on knowledge systems, policy impact and co-production

PhD in STEaPP

-"1+3 model" (MPhil + PhD), putting "global reach and applied focus" in practice.

- develop a cohort of researchers with STEaPP's (multi)disciplinary approach
- stimulate doctoral research that is inherently impact-savvy and co-produced
- **starting in September 2015; target of ~5 PhD students in first cohort**

Doctor of Public Administration (DPA) in STEaPP

-"1+3 model" similar to EngD approach (MPhil + DPA)

- develop a cohort of policymakers with STEaPP's (multi)disciplinary approach to practice
- stimulate professional research that is academically solid, applied and co-produced
- **starting in September 2015; target size of ~5 DPA students in first cohort**

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How to Change the World...

Highly successful inaugural programme...

- 500+ students
- Five (very happy) national and international 'challenge partners'

RED CROSS/RED CRESCENT CLIMATE CENTRE
The World Bank
Department of Energy & Climate Change
Department for Transport
Environment Agency

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Research

Applied in Focus: *Linking SE & PP*

Emerging Research Areas

- Impact
- Science Advice
- Science Diplomacy
- Risk & Uncertainty
- Innovation
- Leadership
- Interactive Policy Processes (Foresight, Games, etc)

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Building Capacity for Effective STE within Public Decision Making

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Research

Global in Reach: ***Our Focal 'Global Policy Challenges'***

Emerging Topical Clusters

- Sustainability (*Energy, Environment, Climate*)
- Urbanisation
- Development
- Digital & Cyber
- Humanitarian Response
- Global Health
- Global Security

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UCL STEaPP
Policy Institute

- **Executive and Professional Education**
  - Early-Career Professionals – *introductory courses*
  - Mid-Career Professional – *skills training*
  - Executive – *strategic enhancements*
- **Networking**
  - Global Fellows Programme
- **Policy Consultancy… aka 'Open Policymaking'**
  - *'Menu of options' for policy communities*

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STEaPP
Applied in Focus. Global in Reach.

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The need for an international academic network…

Three Near-Term Goals:

(1) Mapping and Comparing Institutions, Practices & Skills

(2) Sharing and Improving Educational Approaches

(3) Sharing Best Practice for interfacing Academic STE knowledge/expertise with Public Policy environments

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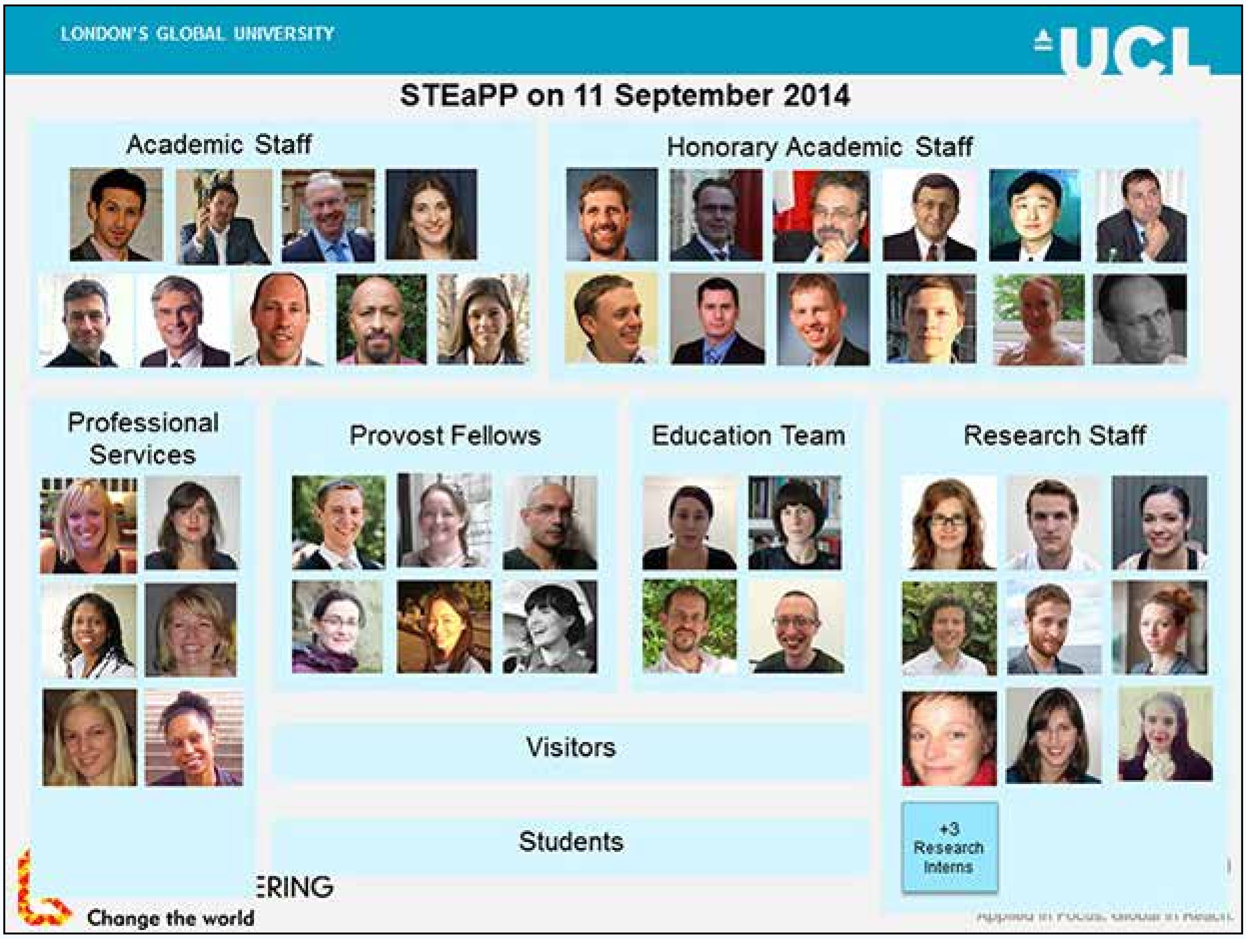
STEaPP
Applied in Focus. Global in Reach.



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Thank you!!!

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Change the world

STE[a]PP
Applied in Focus. Global in Reach.

The University of Tokyo

STIG (Science, Technology, and Innovation Governance) and related Education Program

Overview

STIG
SCIENCE, TECHNOLOGY, AND INNOVATION GOVERNANCE

東京大学 THE UNIVERSITY OF TOKYO

Head
Graduate School of Public Policy
Professor
Hideaki Shiroyama

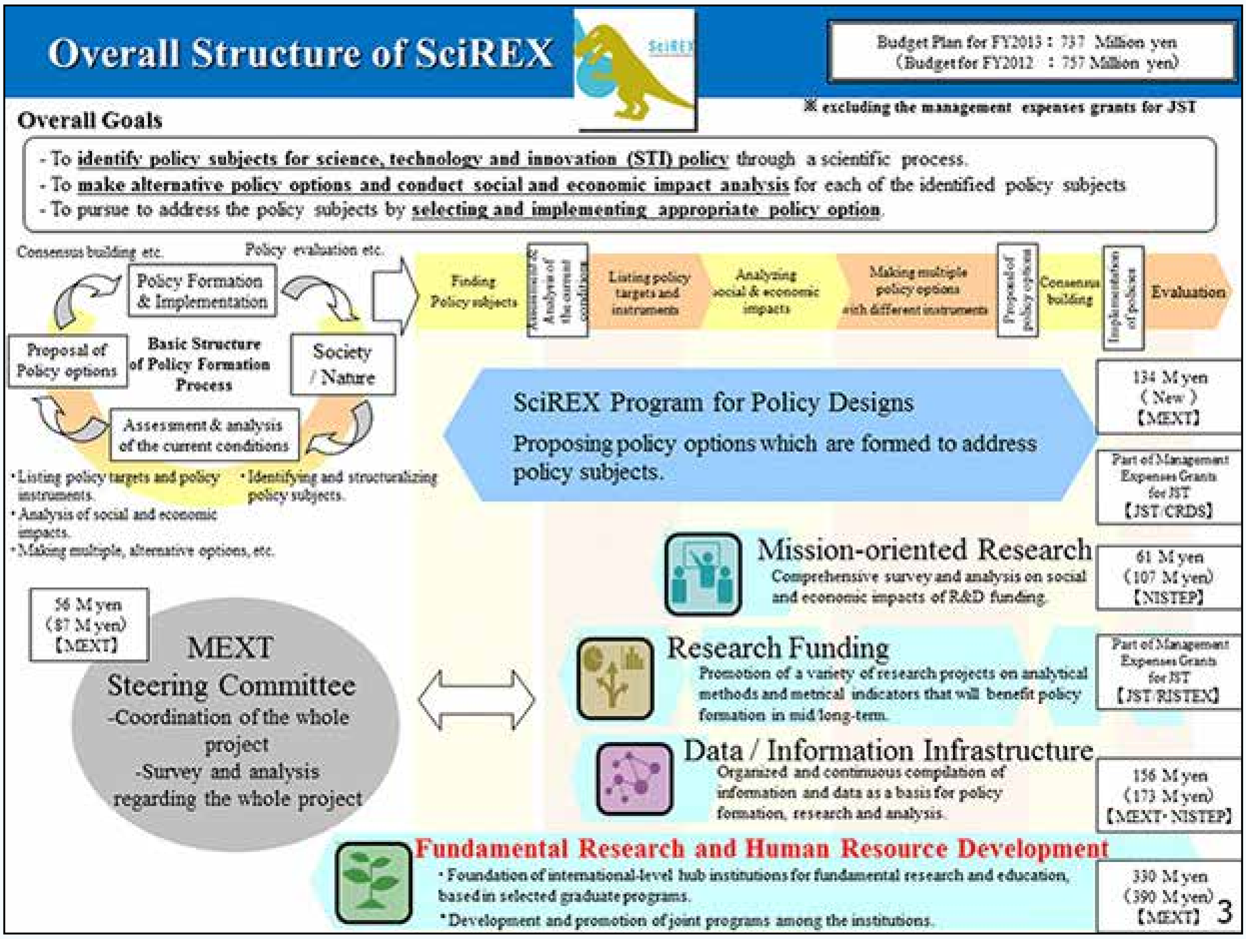
Graduate School of Engineering
Professor
Kazuyuki Motohashi

Graduate School of Public Policy
Associate Professor (Project)
Masahiro Matsuura

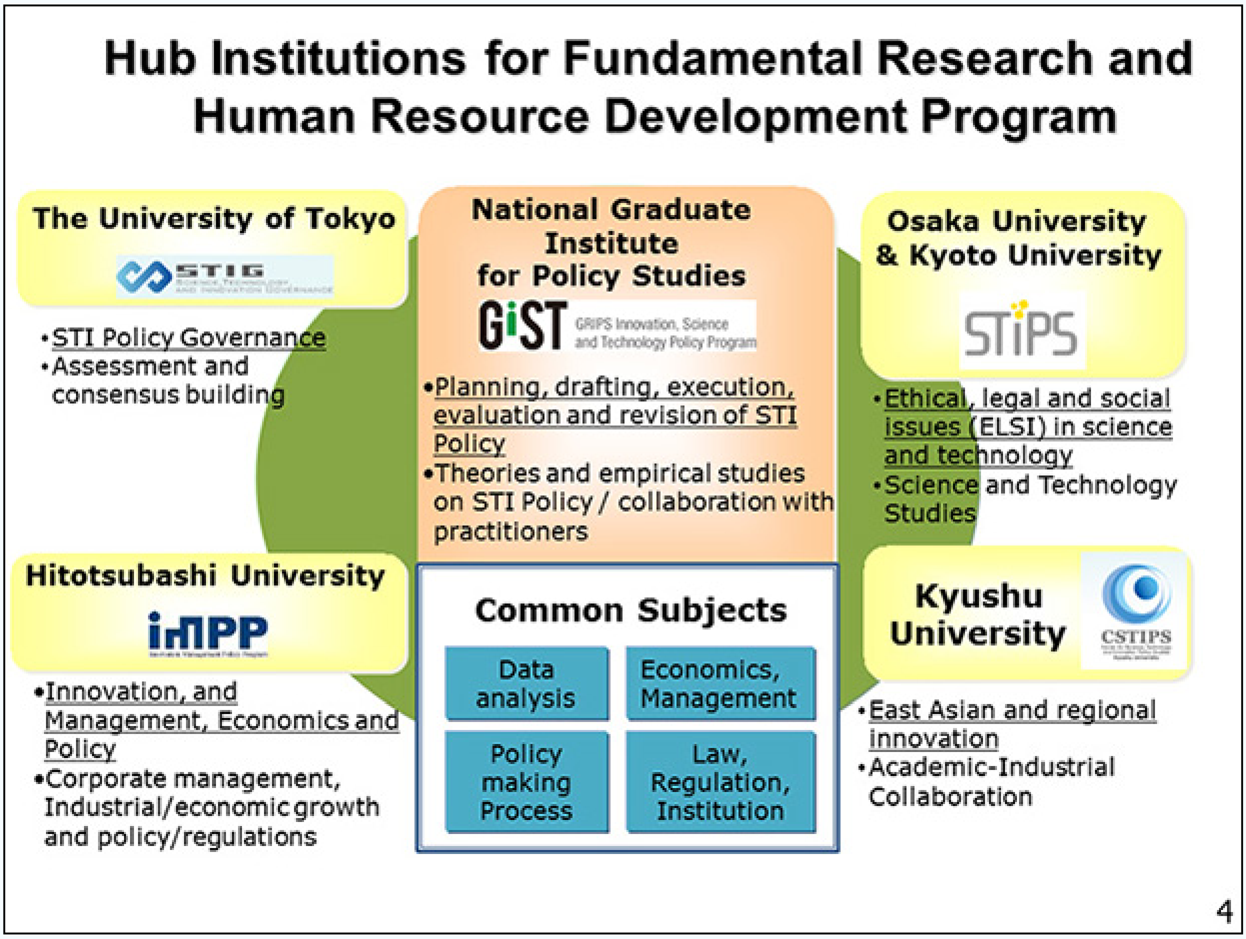
Development of STPP Program in GraSPP and related Institute

- 2004: Establishment of GraSPP
- 2006 - 2014: SEPP Program (Sustainability of Energy/ Environment and Public Policy) by corporate sponsors
- 2007 - 2011: I2TA (Innovation and Institutionalization of Technology Assessment) by JST/ RISTEX
- 2008- : Sea Alliance by Nippon Foundation
- 2010-: Space Development and Public Policy by JAXA
- 2012-: HTA (Health Technology Assessment) by a corporate sponsor
- 2012-: STIG

- 2008-2013-: PARI (Policy Alternatives Research Institute: University Think Tank) - Technology Governance Research Group, Complex Risk Governance Research Group



Overall Structure of SciREX
SciREX
Budget Plan for FY2013 : 737 Million yen
(Budget for FY2012 : 757 Million yen)
※ excluding the management expenses grants for JST
Overall Goals
- To identify policy subjects for science, technology and innovation (STI) policy through a scientific process.
- To make alternative policy options and conduct social and economic impact analysis for each of the identified policy subjects
- To pursue to address the policy subjects by selecting and implementing appropriate policy option.
Consensus building etc.
Policy evaluation etc.
Policy Formation & Implementation
Proposal of Policy options
Basic Structure of Policy Formation Process
Society / Nature
Assessment & analysis of the current conditions
・Listing policy targets and policy instruments.
・Analysis of social and economic impacts.
・Making multiple, alternative options, etc.
・Identifying and structuralizing policy subjects.
Finding Policy subjects
Assessment & Analysis of the current conditions
Listing policy targets and instruments
Analyzing social & economic impacts
Making multiple policy options with different instruments
Proposal of policy options
Consensus building
Implementation of policies
Evaluation
SciREX Program for Policy Designs
Proposing policy options which are formed to address policy subjects.
134 M yen (New) 【MEXT】
Part of Management Expenses Grants for JST 【JST/CRDS】
Mission-oriented Research
Comprehensive survey and analysis on social and economic impacts of R&D funding.
61 M yen (107 M yen) 【NISTEP】
Research Funding
Promotion of a variety of research projects on analytical methods and metrical indicators that will benefit policy formation in mid/long-term.
Part of Management Expenses Grants for JST 【JST/RISTEX】
Data / Information Infrastructure
Organized and continuous compilation of information and data as a basis for policy formation, research and analysis.
156 M yen (173 M yen) 【MEXT・NISTEP】
56 M yen (87 M yen) 【MEXT】
MEXT Steering Committee
-Coordination of the whole project
-Survey and analysis regarding the whole project
Fundamental Research and Human Resource Development
・Foundation of international-level hub institutions for fundamental research and education, based in selected graduate programs.
・Development and promotion of joint programs among the institutions.
330 M yen (390 M yen) 【MEXT】
3



Hub Institutions for Fundamental Research and Human Resource Development Program
The University of Tokyo
STIG
・STI Policy Governance
・Assessment and consensus building
National Graduate Institute for Policy Studies
GiST GRIPS Innovation, Science and Technology Policy Program
・Planning, drafting, execution, evaluation and revision of STI Policy
・Theories and empirical studies on STI Policy / collaboration with practitioners
Osaka University & Kyoto University
STiPS
・Ethical, legal and social issues (ELSI) in science and technology
・Science and Technology Studies
Hitotsubashi University
IMPP
・Innovation, and Management, Economics and Policy
・Corporate management, Industrial/economic growth and policy/regulations
Common Subjects
Data analysis
Economics, Management
Policy making Process
Law, Regulation, Institution
Kyushu University
CSTIPS
・East Asian and regional innovation
・Academic-Industrial Collaboration
4

STIG Education and Research Program

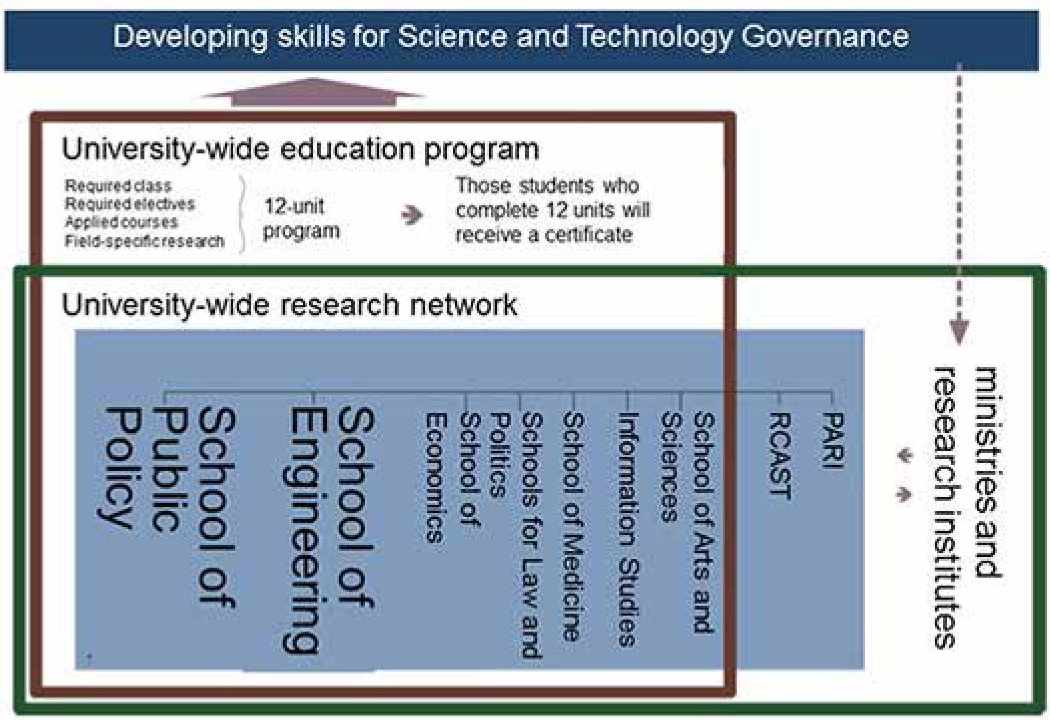
STIG is one of the University of Tokyo's *interdisciplinary education programs**. Our goal is to offer a specialized graduate-level education in STI governance.

STIG focuses on the educating future leaders in the field of science and technology governance with expertise in the science, technology, and innovation (STI) policy-making *processes* in various fields of practice, as well as the methods of preparing *evidence* for drafting and implementing STI policies.

*University of Tokyo offers nine interdisciplinary education programs as of 2014.

5

STIG framework



6

Completing the STIG program

Core practicum (req.)
Case Study (Science, Technology and Innovation Policy)

Basic courses (elective)
(a) Policy processes and institutions
(b) Evidence-preparation techniques

Applied courses
Cultivate advance skills in policy processes, institutions, and evidence-making techniques

Field-specific research courses
Expand practical skills by providing contextualized knowledge specific to each field of practice

Core practicum (req.)	2 units
Basic courses (a) (elective)	2 units
Basic courses (b) (elective)	2 units
Basic, applied, and field specific research courses	6 units
Total	**12 units**

Six graduating students completed the STIG program in March 2014!

7

Course Listings

Required class
- Case Study (Science, Technology and Innovation Policy) (E)

Required Electives

Basic courses A: Policy Processes and Institutions
- Policy Process
- Negotiation and Consensus Building
- Science and Technology Policy and Industrial Policy
- Science, Technology and Public Policy (E)

Basic courses B: Evidence Development Methodologies
- Practice Session for Economic Evaluation of Public Policies
- Quantitative Methods for Management and Policy Analysis (E)
- Risk Impact Assessment
- Economic Analysis of Innovation (E)
- Innovation System Engineering (E)

Electives

Applied courses
- Case Study (Assessment and Management in Policy Process)
- Advancing Regulatory Science
- Case Study (Technology Assessment)
- Regulation Policy
- Intellectual Property Management
- Public Communication of Science and Technology
- Science and technology planning theory Ⅱ
- Global Business Strategy and Policy (E)

Field-specific research courses
- Advanced Energy Technology Management and Policy
- Space Development and Policy
- Marine Science and Technology Policy
- Case Study(Government Modernization I (Open Government))
- Case Study(Government Modernization Ⅱ (Governance of Government Information Systems))
- Special Lecture in Global Health Policy I (E)
- Special Lecture in Global Health Policy Ⅱ (E)
- Health Technology Assessment
- International Transportation Policy
- Aeronautical Engineering, Politics, and Industry
- Law and Medicine

8

Students registered with the program

2013: 92 students

2014: 77 additional students
(69 in spring and 8 in fall semesters)

Currently:
153 students

Guidance of STIG in April , 2013

Guidance of STIG in April, 2014

Career after finishing the program

[Six students completed the program in 2013]

- Ministry of Education, …
- East Japan Railways
- MRI Research Associates (consulting)
- Future Architects Inc. (consulting)
- JNC Inc. (chemical manufacturer)
- Still looking for a job

Policy Platform Seminars

- The STIG program offer a series of lectures on ad-hoc basis for our students as well as for the communities of practitioners and researchers.
- So far 29 seminars have been organized in three years.

- Total number of attendants are 1437 people.

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Policy Platform Seminars

Year 2012

1st: STI Policy (47)
2nd: Energy policy (200)
3rd: Nuclear safety policy in Asia (148)
4th: Reform and EA at the US federal agencies (100)
5th: Space policy and governance (80)
6th: International maritime governance (21)

Year 2013

7th: Innovation management (23)
8th: Science diplomacy (37)
9th: Transition management (50)
10th: Young officers in Kasumigaseki (45)
11th: Environmental financing (20)
12th: Innovation through design (25)
13th: Technology transfer at the US universities (25)
14th: Global health (57)
15th: Risk regulation in the EU (55)
16th: International negotiation on global warming (30)
17th: S&T policy around the world (22)
18th: IT infrastructure service (68)

Year 2014

19th: The effect of international movement of researchers (55)
20th: Research Portfolio Management (49)
21st: Medical device R&D in Asia and the US (58)
22nd: Competitive research grant and research productivity (36)
23rd: Ocean Research (22)
24th: Nuclear for peace and nonproliferation (32)
25th: Young officers from METI (21)
26th: Governance and social space in Fukushima (16)
27th: Black-swan startups (10)
28th: Pharmaceutical industry (62)
29th: Transition management (23)

( ) is a number of participants in the seminar

12

SciREX Summer Camp

The MEXT's SciREX program organizes annual "Summer Camps" every year in order to bring together faculty members and enrolled students from five hub institutions (GRIPS, Univ. of Tokyo, Hitotsubashi Univ., Osaka/Kyoto Univ., and Kyushu Univ.). The summer camp allows each institution to share its recent developments as well as the students to expand their network with fellow students across the country.

2013: "Big Projects" in Tsukuba City
(organized by GRIPS)
2014: "Depopulating Society" on Awaji Island.
(organized by Osaka/Kyoto Univ.)
2015: "Industrialization and STI" in the Nagoya/Chukyo region.
(organized by Univ. of Tokyo)

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International Symposium

- March 1-2, 2012: "Reforming Science Technology Innovation Policymaking Process and Human Resource Development"
- March 8-9, 2013: "Using Evidence and Human Resource Development for Science, Technology and Innovation Processes"

- October 2, 2013: "Governance of Science, Technology and Innovation: Current Challenges and Policy Options" (co-organized by five SciREX hub institutions)
- November 28, 2014: "Making the Most of Science and Innovation through Better Governance"

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Fellowship for Evidence-based Policy

In collaboration with Rathenau Institute (Netherlands) and Karlsruhe Institute of Technology (Germany), we have organized the "fellowship for evidence-based policy" seminar in Tokyo. It aimed at developing a global network of decision-makers in the field of STI.

- Lectures and discussions by experts and practitioners about the accident at the Fukushima-Daiichi nuclear power plant and other disruptive emergency elsewhere.
- Workshops on the role of science, the relationship between decision-makers and scientists, science communication, and ways of dealing with uncertainties.
- "Master classes" on media-relationships, team-building, and dealing with stakeholders.

The next fellowship seminar will be held in Brussels on 9th and 10th of February, 2015! http://www.rathenau.nl/ebp

October 3-4, 2013 in Tokyo

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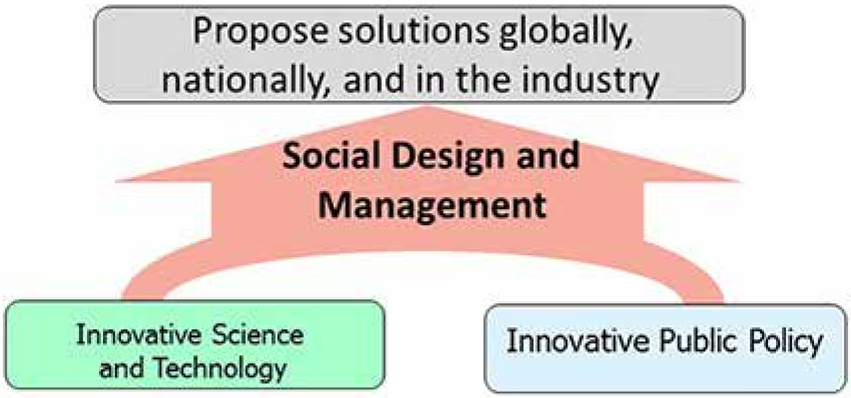
Program for Leading Graduate Schools

Global Leader Program
for Social Design and Management
The University of Tokyo since 2013

16

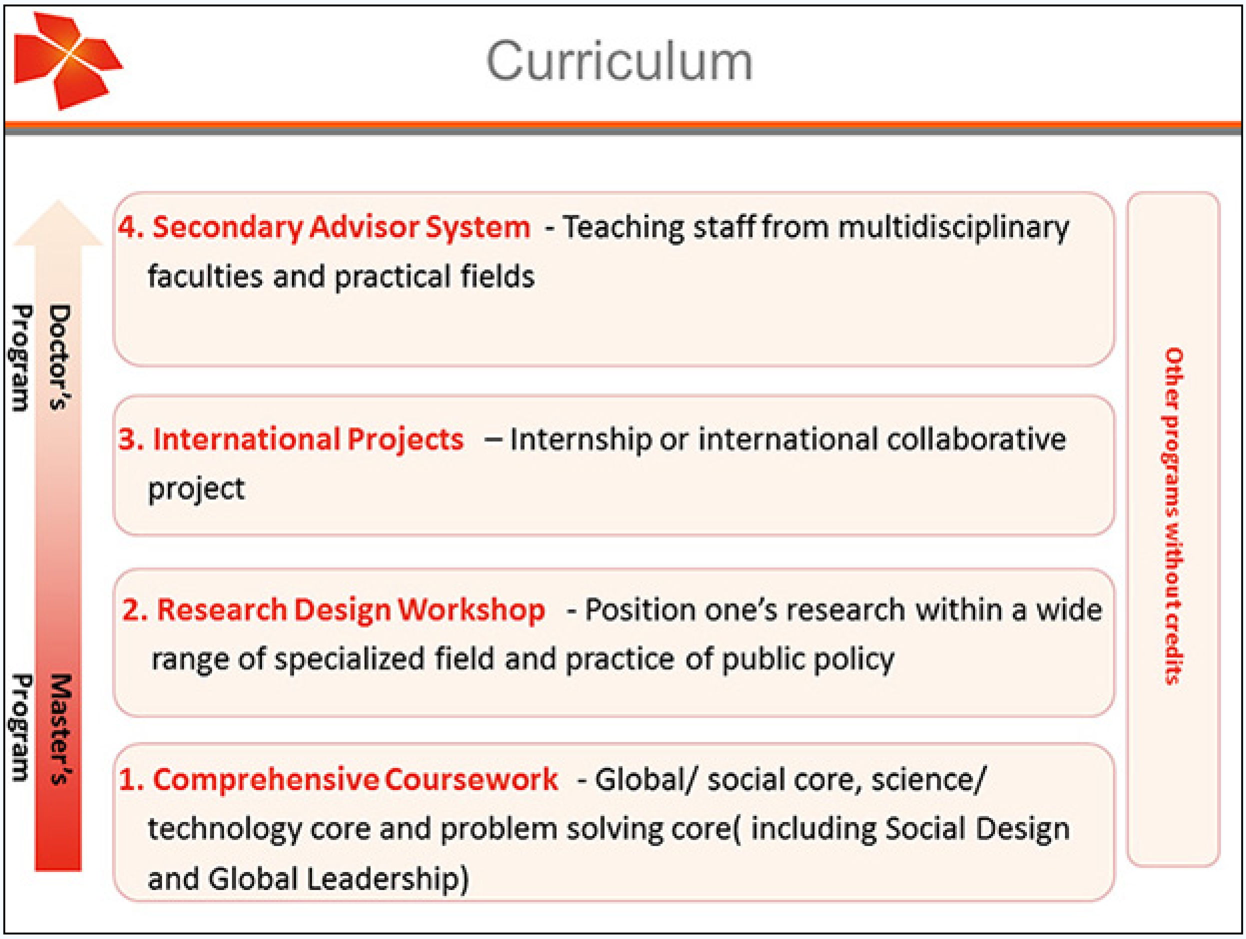
Social Design and Management
A focused interdisciplinary learning approach

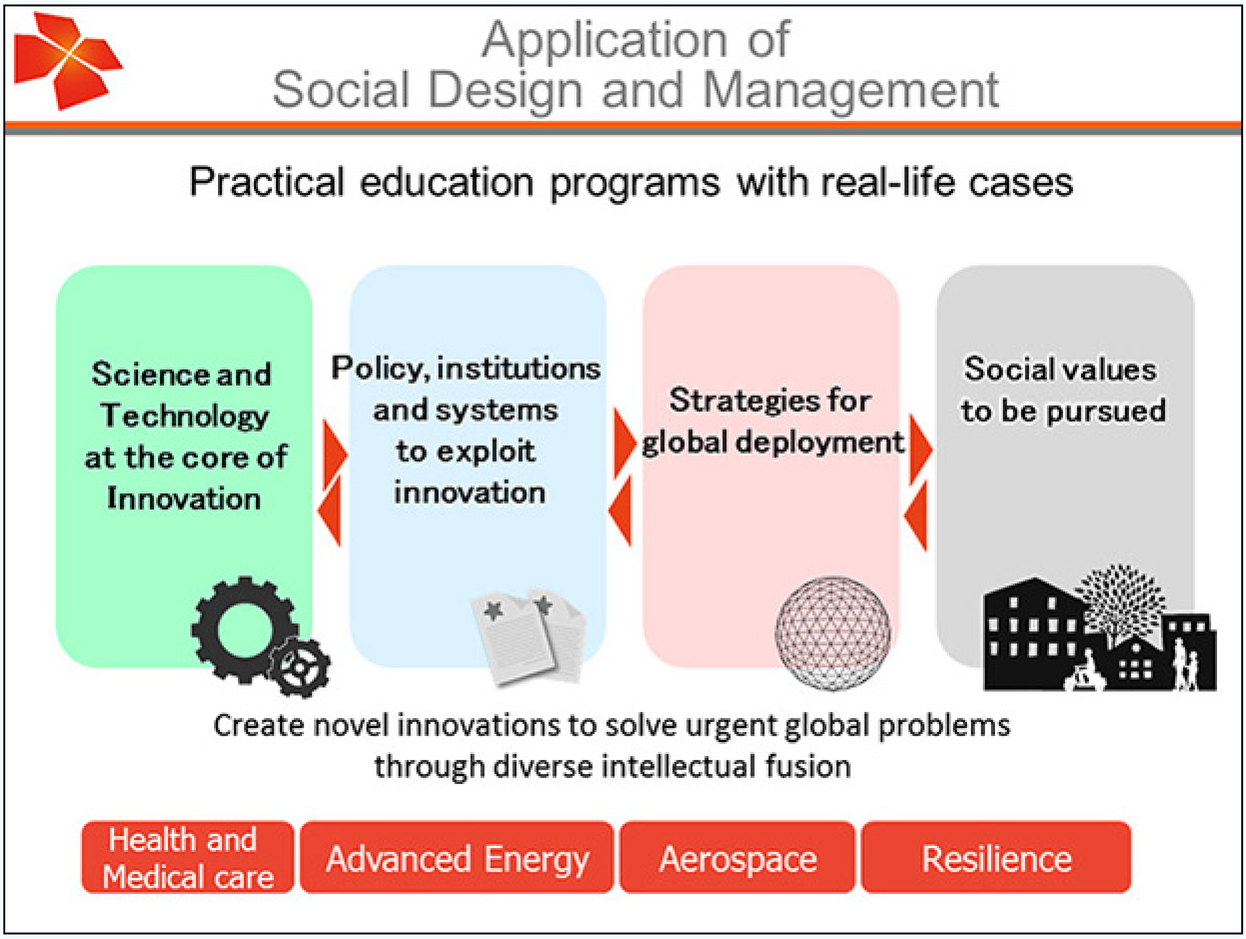
- Technology alone cannot solve problems in our society
  - Social context needs to be appreciated
- Policy or institutions alone cannot solve problems
  - Advanced technology to be used, to design and plan policies/systems
- Identify problems in the society through global perspective with comprehensive knowledge and expertise, to design and propose integrative solutions by combining innovative technology and public policy collaborating with diverse stakeholders



Competencies "Social Design and Management" students

- Fundamental capability
  - Capacity for problem identification and solution, basic knowledge and high ethical standard, curiosity, communication skill, leadership
- Expertise
  - Discipline based education, globally leading edge researches
- Multidisciplinary perspective
  - Interdisciplinary perspectives, based on science, technology and social science
- Design and planning skills
  - Agenda setting, problem definition, integration of technology and institutional options
- Practical skills
  - Project management skill, problem solving skills


Curriculum
4. Secondary Advisor System - Teaching staff from multidisciplinary faculties and practical fields
3. International Projects – Internship or international collaborative project
2. Research Design Workshop - Position one's research within a wide range of specialized field and practice of public policy
1. Comprehensive Coursework - Global/ social core, science/ technology core and problem solving core(including Social Design and Global Leadership)
Doctor's Program
Master's Program
Other programs without credits


Application of Social Design and Management
Practical education programs with real-life cases
Science and Technology at the core of Innovation
Policy, institutions and systems to exploit innovation
Strategies for global deployment
Social values to be pursued
Create novel innovations to solve urgent global problems through diverse intellectual fusion
Health and Medical care
Advanced Energy
Aerospace
Resilience

Participating Schools/Departments

(Interdisciplinary project of science/technology and liberal arts, 9 Schools, 21 Departments)

- Graduate School of Public Policy
- Graduate School for Law and Politics School of Legal and Political Studies
- Graduate School of Economics Finance, Studies of Contemporary Economy, Economic Theory
- Graduate School of Engineering Department of Civil Engineering, Department of Mechanical Engineering, Department of Precision Engineering, Department of Aeronautics and Astronautics, Department of Electrical Engineering and Information Systems, Department of Systems Innovation, Department of Chemical System Engineering, Department of Nuclear Engineering and Management, Department of Technology Management for Innovation
- Graduate School of Agriculture and Life Sciences Department of Global Agricultural Sciences, Department of Agricultural and Resource Economics
- Graduate School of Frontier Sciences Department of Medical Genome Sciences
- Graduate School of Medicine School of International Health, Social Medicine
- Graduate School of Information Science and Technology, Information and Communication Engineering
- Graduate School of Interdisciplinary Information Studies Department of Interdisciplinary Information Studies

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