

Assessing and supporting impact

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Outline

- Roles of science
- Routes of impact
- Implications

- Who should assess and support?
- And how?

- Two case studies

- Conclusions

Impact of science and research

- *Impact within science* and ***impact beyond academia***
- A complex phenomenon
 - Impact on what?
 - Well-being, prosperity, environment, companies, society, individuals, ...
 - When?
 - Tomorrow, next year, in 5 years, in 25 years
 - Where?
 - Regionally, nationally, in Europe, globally, ...
 - ...
- The same research can have many types of impact

Roles of science

- Science and research serve as a basis for
 - our understanding of the world
 - improving wellbeing, wealth and prosperity
 - decision-making: evidence-based policy
 - development of professional practices
 - higher education
- Of course, not the only possible list of roles
- It is useful to differentiate between different roles of science and research
- And to make the different roles visible

The roles of research in

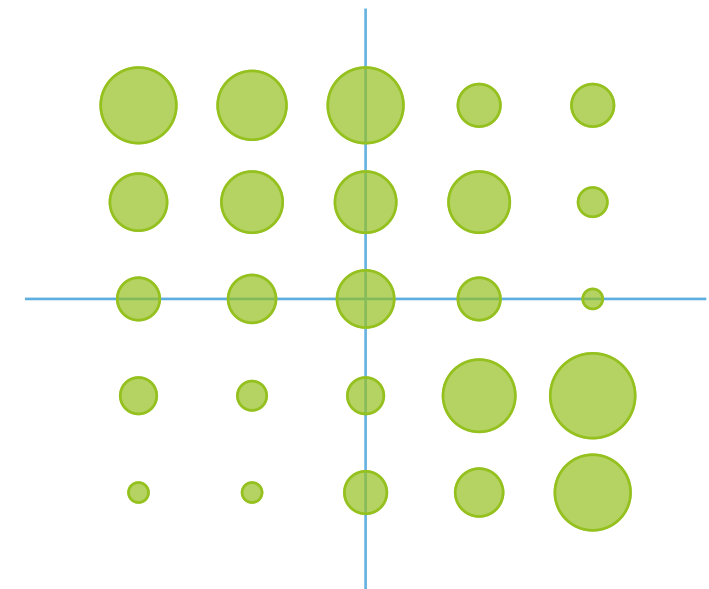
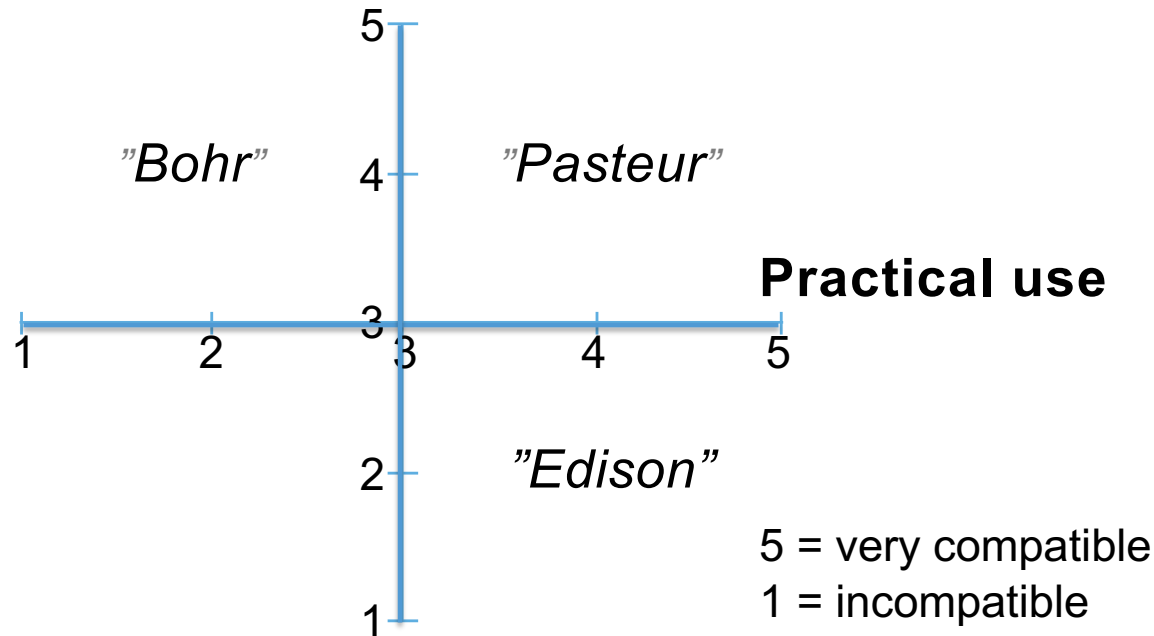
- History?
- Ecology?
- Mathematics?
- Clinical medicine?
- Computer science?
- Etc.

Views of researchers on their research objectives

Example: Ecology and evolutionary biology

Note variation!

Fundamental understanding



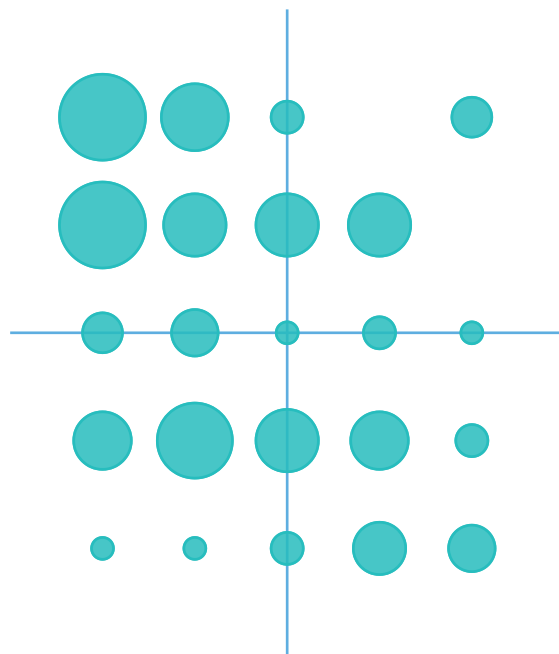
Stokes' quadrant model of scientific research

(modified from Stokes, D. 1997: *Pasteur's quadrant: Basic science and technological innovation*. Brookings Institution Press, Washington, D.C.)

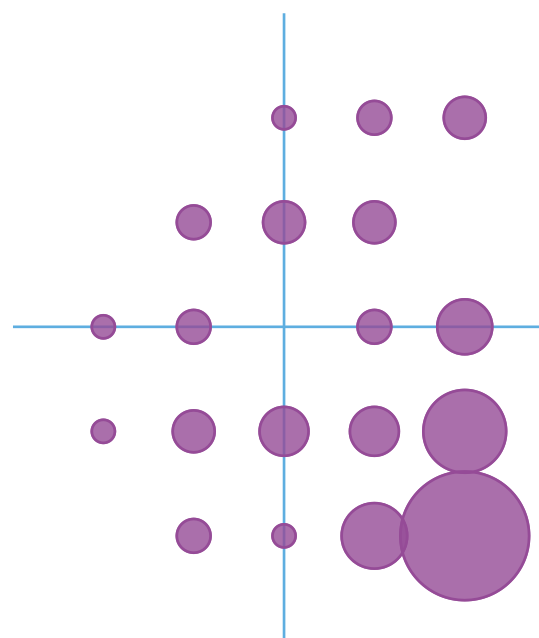
Source: Academy of Finland's survey on the broader impacts of research on society, 2016.

Ecology and evolutionary biology (n = 153)

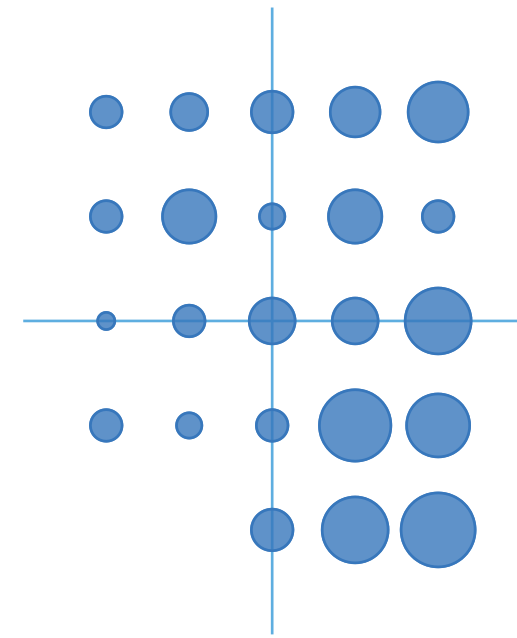
Views of researchers on their research objectives in three other fields



History (n = 115)



Medical engineering and health technologies (n = 83)



Materials science and technology (n = 146)

Source: Academy of Finland's survey on the broader impacts of research on society, 2016.

Impact is not a new thing

- The people who established a faculty of medicine probably had some form of impact in mind
- Research and impact
- Different types of impact are connected to different roles of research and science

Impact is not a four-letter word

- Different roles, different types of impact
- Talking about impact does not mean dismissing basic research
- The traditional linear model of innovations makes this assumption
 - Basic research → applied research → innovation → products
- In reality a complex web of interactions between theory and applications
- Basic research and impact are not incompatible

Maxwell's equations

- A prototypical example of how pure thinking and basic research produced something which turned out to be useful?
- “James Clerk Maxwell’s 1861 work on electromagnetism, which unified scientific fields, was driven as much by technology as by abstract theorizing.”
- “Rather than a stately progression from abstract theory to solid application, it was the product of a web of markets, technologies, labs and calculators in the workshop of the world.”
 - Simon Schaffer, Nature 17 March 2011

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{B} = \mu_0 \left(\mathbf{J} + \epsilon_0 \frac{\partial \mathbf{E}}{\partial t} \right)$$

Excellence and impact

- Are they contradictory? No
- In many research fields excellence is influenced by the potential impact beyond academia
- E.g., medical research
- When judging the quality or excellence of research, the potential impact of the work has a role
- Impact beyond academia as part of excellence
- Of course there are areas in which excellence is not influenced by considerations of impact

Main routes of research impact

- What are the ways in which the research has impact?
- Three main routes:
 - ***Transfer of research results***
 - *The results move*
 - ***Cooperation and interaction***
 - *Ideas move* between researchers and people outside academia
 - ***Through educated, competent people***
 - *People move* between academia and the rest of the society
- The same routes can have impact through various routes

Main routes of research impact: examples

- Exercise: think of some research area which you know well
 - What are the routes of impact that are important for that area?
 - Is the division into three useful?
 - Are there other important routes?
-
- ***Transfer of research results: Results move***
 - ***Cooperation and interaction: Ideas move***
 - ***Through educated, competent people: People move***

Main routes of research impact: an example

Data analysis and machine learning

- Impact through research results
 - Very rare to have a single result that would have great impact
 - Common through packaging of a whole technology
- Cooperation and interaction
 - Very common route of impact
- Educated, competent people
 - Dominant way of interaction

Implications for research and innovation policy

- If impact comes from results, support technology transfer
- If impact arises from interaction, support interaction
- If impact comes from people, support mobility

- Interaction and mobility!

Assessing and supporting impact

- Impact is not a four-letter word
- Who should assess and support impact?
 - Universities, funding agencies, ministries
 - Different roles
- How should it be done?

Assessing and supporting impact

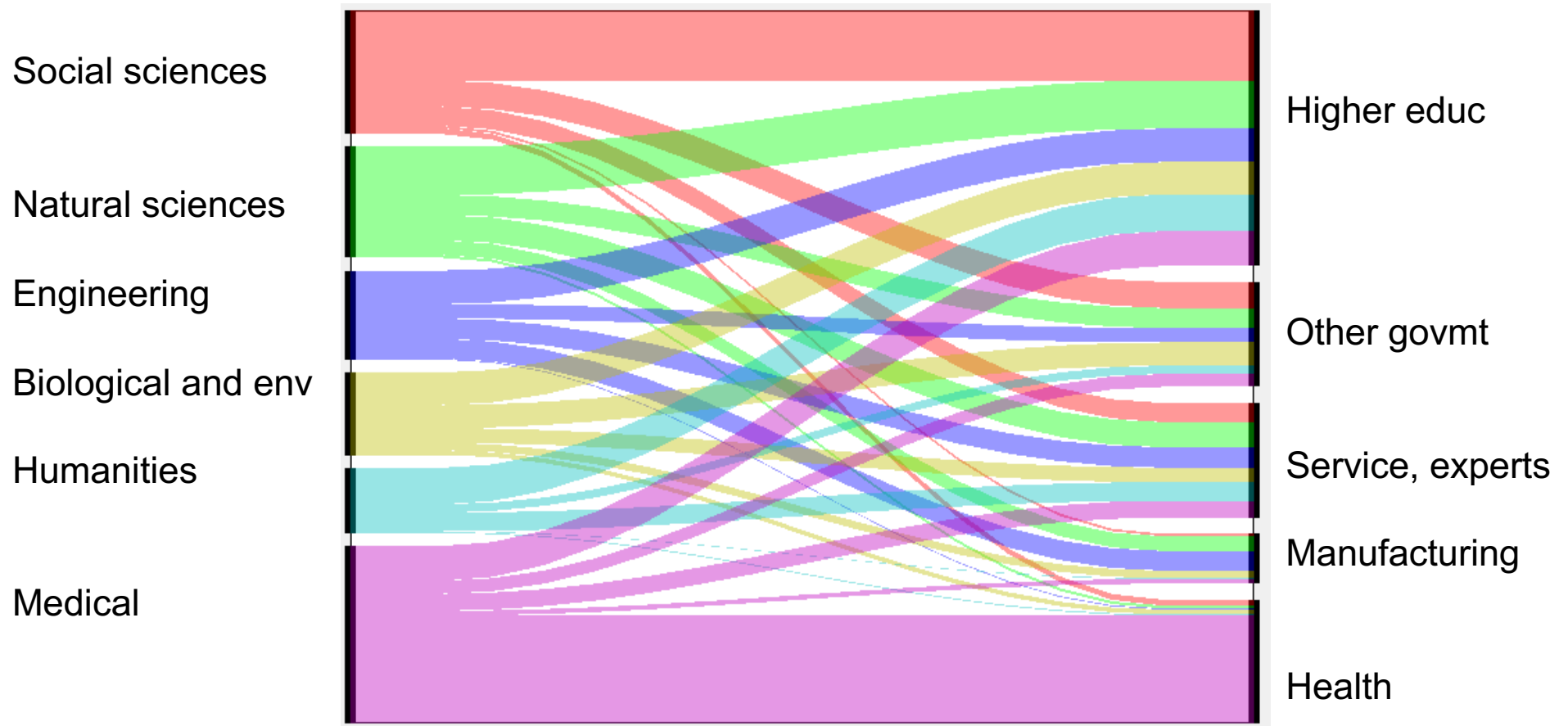
- Impact has many routes, forms, timelines, areas, etc.
- The routes of impact give some hints on what aspects one should look at

Possibilities

- Individual indicators often capture only a single route, form, or timeline
- Baskets of indicators
- Peer review

Example: where are the Ph.Ds?

- Impact through competent people
- A good way of looking at impact of research and education
- Which sectors of society do the Ph.Ds work?
- About 23,000 Ph.D.s in the workforce in 2016 in Finland



How many Ph.D.s in other sectors per one in higher education?

Discipline of doctoral degree	HE	Gov	Experts	Manuf.	Health	Total
Natural sciences	1,00	0,42	0,52	0,30	0,06	3 957
Engineering	1,00	0,43	0,61	0,59	0,03	3 174
Biosciences and environmental sciences	1,00	0,71	0,45	0,23	0,14	2 943
Medical and health sciences	1,00	0,37	0,49	0,14	3,10	6 324
Social sciences	1,00	0,37	0,27	0,03	0,08	4 416
Humanities	1,00	0,23	0,51	0,02	0,03	2 337
All fields	1,00	0,41	0,45	0,20	0,48	
Total	9 072	3 732	4 098	1 794	4 383	23 244

Baskets of indicators

- Many (most?) universities do this (right?)
- A collection of useful indicators on topics that the university considers important
- See how they develop
- Use in funding universities? Use in allocating funding to faculties?

Peer review for assessing impact

- Roles of science, routes of impact
- Need to take differences between areas into account
- But also have to understand other areas
- Want to avoid comments like "for a department of MM, the impact is world-class"
- Impact case studies & peer review (REF)
- Added value: it is useful to have to write down what one thinks the impact is
- Examples
- Excellence and impact – different panels, or different parts of the same panel
- Case studies

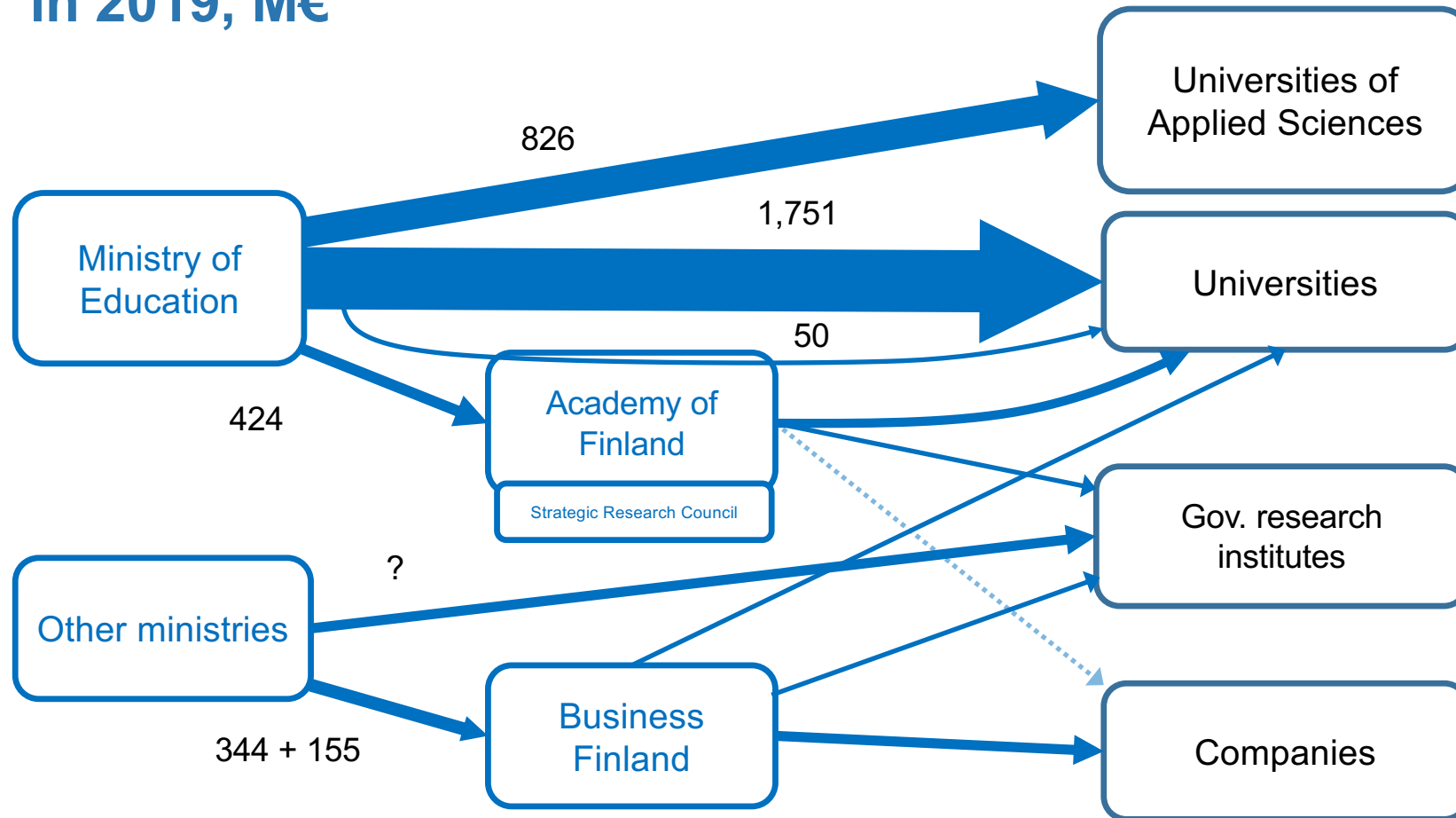
Assessing and supporting impact – who?

- Who should support impact? Universities, funding agencies, ministries
- Universities are the key institutions
- What are the important decisions?
- "At the university we make only two types of important decisions: who to take as professors and who to take as students"
- The decisions made in hiring have a strong influence on impact
- Hiring excellent researchers
- It's all about people!

Supporting impact in universities

- Universities as the key institutions in supporting impact
 - Inside universities:
 - Recruiting excellent researchers vs.
 - Recruiting excellent researchers who also are curious about impact
 - The latter often results in better scientific impact, as well
 - Supporting by funding
- vs.
- Supporting by appreciation
 - Who are the stars?
 - Examples

Public funding of research and higher education in Finland in 2019, M€



In addition, private foundations (~ €200m) and EU funding (~ €150m)

Supporting impact – funding agencies

- The role of funding agencies
- Good assessment and understanding of impact is needed

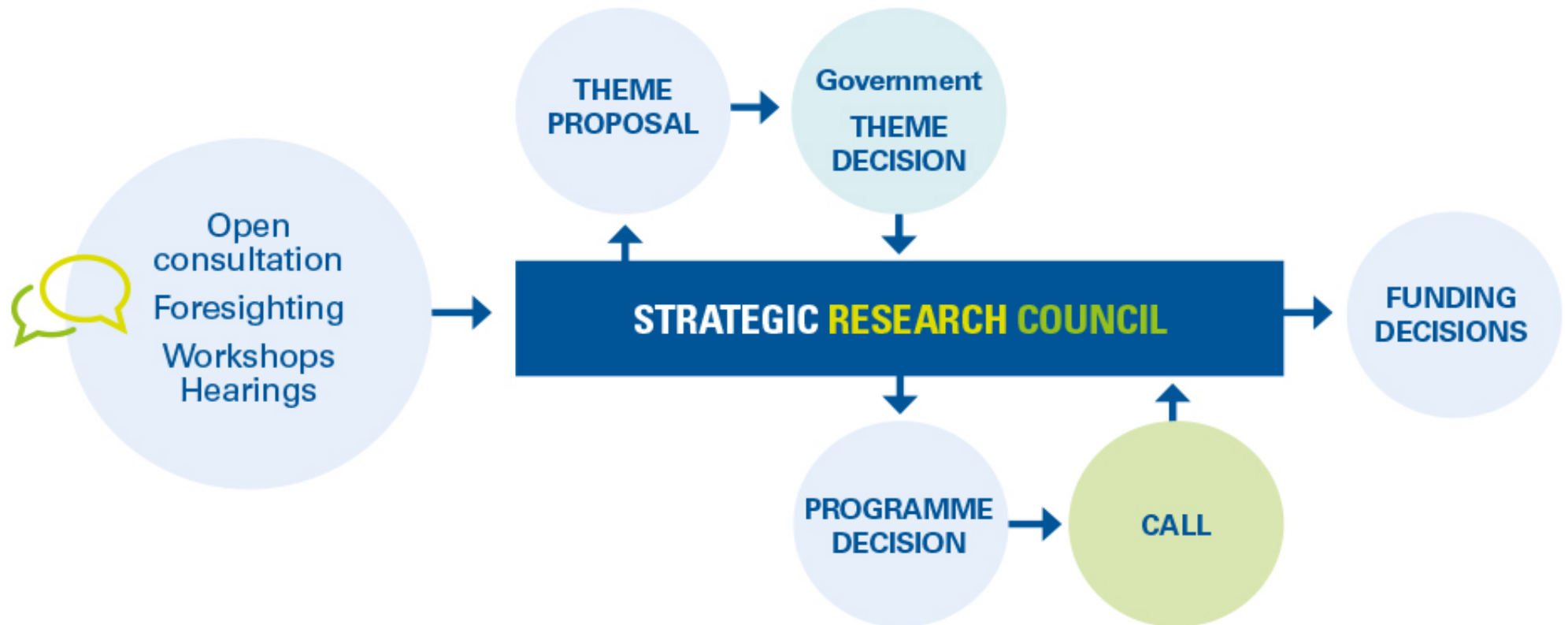
- Strengthen technology transfer
- **Increase interaction**
- Increase mobility between sectors

- Two case studies from Finland – increasing interaction is an important component
 - Strategic research (not a good name)
 - Finnish flagships

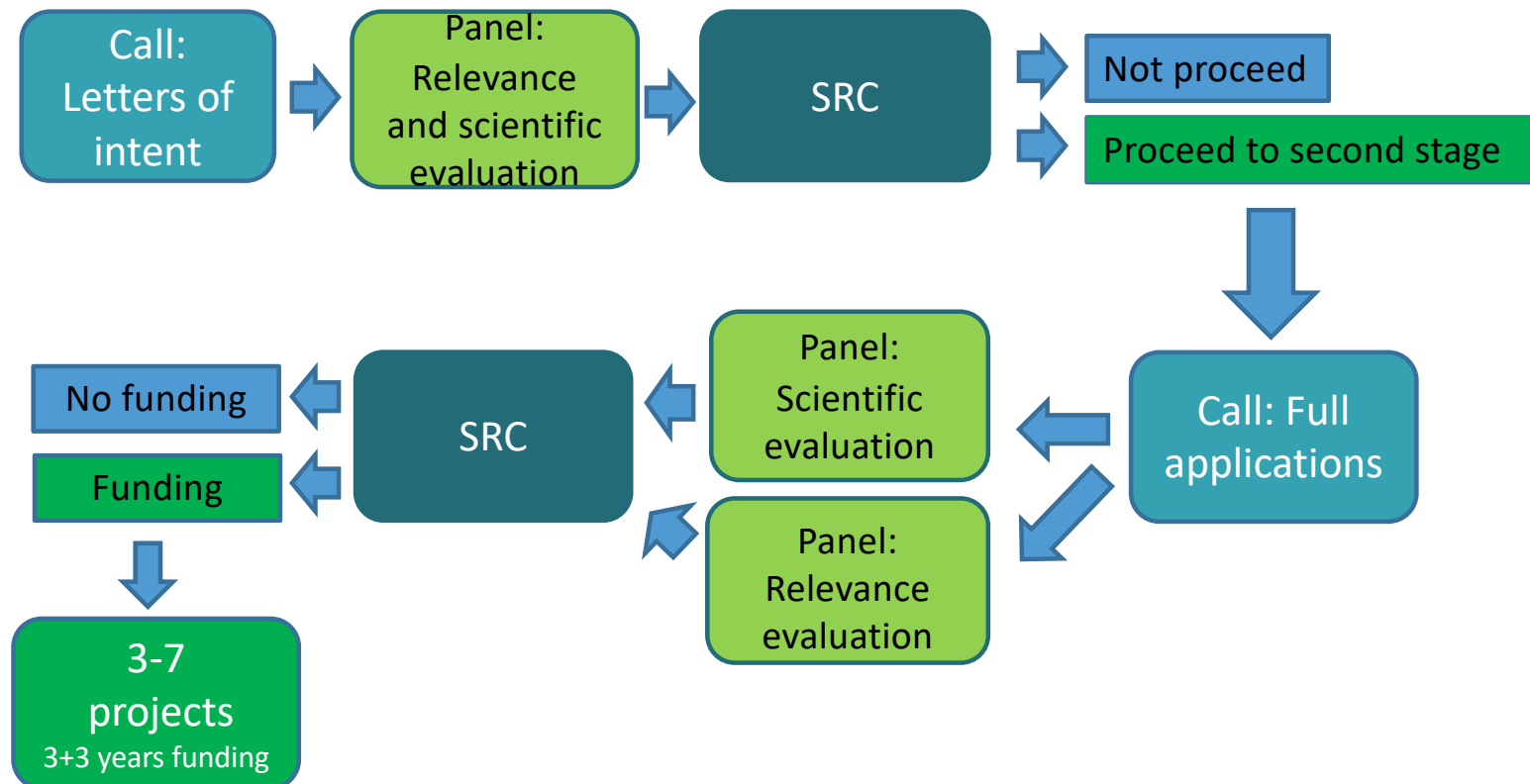
Strategic Research Council

- Established in 2014
- Goal: high-quality research on themes relevant to evidence-based policy
- Enhancing the use of research in decision making
- Annual funding appropriation 55 M euros
- Procedure:
 - Bottom-up: suggestion for high-level themes research community → council → government
 - Top-down: decision on high-level themes → council, which decides on the programs
 - Bottom-up: applications, peer review, decisions by the council
- Multidisciplinarity a requirement and a criterion for funding
- Strong weight on *interaction* (interaction plan)
- Funding based on societal relevance, impact and research quality with equal weight
- Mainstreaming public engagement and transparency

Themes, programs, and projects: bottom-up, top-down, bottom-up



Decision-making process (funding decisions)



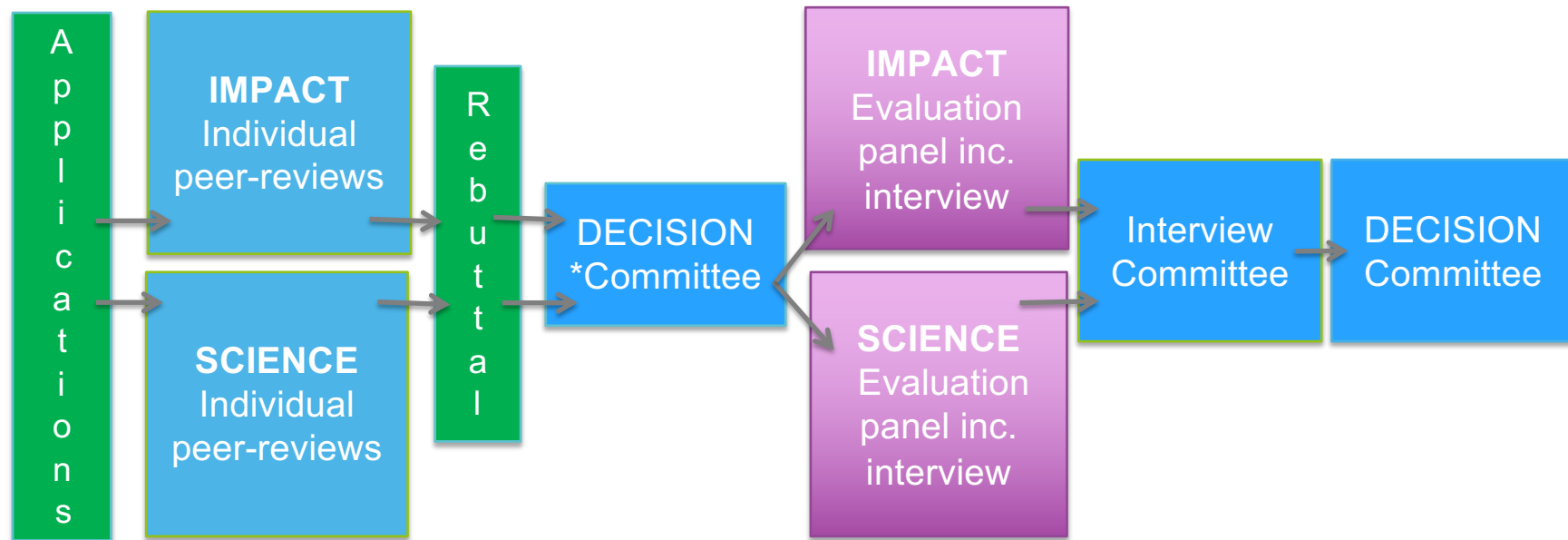
Finnish flagship programme

- Basic criteria
 - Excellent science
 - Already demonstrated large societal impact
 - Capability for renewal
 - Commitment of the host organization
- Funding
 - From the Academy of Finland approximately 4 M€/year/flagship
 - Host institution(s): 2-3 x the above
 - 8 years, with review after 2 years
- Evaluation: many steps
 - Peer review: individual reviews; excellence and impact panels; interviews

Designed with
universities

Evaluation Process

20th June 1st phase: July-Aug. Mid-Sept 2018 2nd phase: 24-26 Oct. 30 Nov. Dec 2018/Jan 2019



*Committee is nominated by the Board of the Academy of Finland

Evaluation criteria

SCIENCE

- Scientific quality of the past research and competence of the key researchers
- Scientific quality and implementation of the research plan
- Ecosystem, governance and host commitment
- Overall assessment

IMPACT

- Demonstrated impact in support of economic growth and/or society
- Expected impact and implementation
- Ecosystem, governance and host commitment
- Overall assessment

Flagship Programme – funding and selected projects

- Funding from the Academy of Finland: about 4 million euros per year per flagship
- Commitment of host institutions: 6 times the Academy funding

Selected projects

- 6Genesis – 6G-Enabled Wireless Smart Society & Ecosystem
- FCAI – Finnish Center for Artificial Intelligence
- FinnCERES – Competence Centre for the Materials Bioeconomy
- iCAN – Digital Precision Cancer Medicine Platform
- INVEST – Inequalities, Interventions and New Welfare State
- PREIN – Photonics Research and Innovation

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By the numbers

- 5: The five roles of science
- 4: Impact is not a four-letter word
- 3: The three routes of impact
- 2: The two important decisions at universities
- 2: Support interaction, support mobility
- 1: The universities are the key
- 1: It's all about people