SCIENCE|BUSINESS

THE VALUE(S) OF SCIENCE

An open inquiry into the ethics of Horizon 2020

With Europe's biggest-ever research programme, Horizon 2020, now underway, Science|Business gathered several leaders in European research, industry and policy to debate the ethical questions that may arise.

Their reflections, gathered here, are part of a Science|Business effort to spotlight the ethical dimensions of this vital new EU initiative.

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Editor
Richard L. Hudson, Science|Business

Rapporteurs of the meeting
Joanne O'Dea, Science|Business; and Diana Beech, University of Cambridge

Photography
Vivian Hertz

Design
Peter Koekoek

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Rue Belliard 197
1040 Brussels, Belgium
info@sciencebusiness.net
+32 2304 7577

A CONSCIENCE FOR EUROPEAN SCIENCE

When politicians discuss research policy these days, it can sound more like economics than science. That was certainly the case during the drafting of Horizon 2020, the European Union's new research and innovation programme. Throughout, the political focus in Brussels was all about creating jobs, not knowledge.

That approach, while politically correct at a time of austerity, has started to worry me. For I feel that, in a larger sense, when the EU 'invests' in research and innovation, it does so not just for the economy, but for society more generally and for the future of European ideals.

Take CERN, the famous particle accelerator below Geneva that recently made headlines for its observation of the Higgs Boson. It was set up after the War to try to unify research and science across Europe – to be a force for the peaceful exploitation of physics. Today CERN is about much more than particle collisions; it's about thousands of people from different backgrounds working together on common problems. They have an assumption that they're going to collaborate, for the good – of science, society, their discipline or whatever their higher ideals may be. They are, indirectly, agents for peace, originally in Europe, but now, with the participation of China, Russia and other nations, across the world.

This document reflects an ongoing effort to awaken greater public debate about these hard-to-quantify dimensions of science – its values, and its value. On 5 November 2013, at the Norwegian Mission to Brussels, a few dozen leaders in European science, industry and policy met to start the dialogue. This document reflects some of their thinking that day – but it is only the first step in a necessary journey which I invite you to join: Together, to work at developing a conscience for European science.

John V. Wood
Secretary-General
Association of Commonwealth Universities

Clockwise from top left: Discussion at the 5 November roundtable; Maria do Céu Patrão Neves, Member of the European Parliament; L. to R - Daria Golebiowska-Tataj, Governing Board Member, European Institute of Innovation and Technology (EIT), Researcher, Warsaw University of Technology Business School, Richard L. Hudson, CEO & Editor, Science|Business, John V. Wood, Secretary-General, Association of Commonwealth Universities, Diana Jane Beech, Research Associate, Faraday Institute for Science and Religion, University of Cambridge, Kamal Hossain, Director, Research & International, National Physical Laboratory, UK; L. to R. - Jim Dratwa, Head of Ethics in Science and New Technologies, Bureau of European Policy Advisers, European Commission, Atle Leikvoll, Ambassador of Norway to the EU (speaking), and Karin Markides, President & Chief Executive Officer, Chalmers University.

THE ETHICS PROJECT

The launch this year of Europe's biggest-ever research programme, Horizon 2020, marks a fundamental policy shift in Brussels – a greater emphasis on applied, goal-driven research and innovation. The reason for the change was debated for months in the European Parliament: to produce a 'return' for Europe's rising R&D budgets, whether measured by jobs created, industries strengthened or societal problems solved. But have the ethical implications of this policy shift been adequately debated?

Science|Business wants to re-raise some of these persistent 'questions of conscience,' and invite broader debate. They include:

- What is the value of public research funding? Is it to advance knowledge, solve problems, create wealth, or do something else entirely?

- Who should benefit from public research funding? Under what conditions may an individual researcher, company or university profit from the fruits of public research?

- How much freedom of action should we allow publicly funded researchers? How should scientific fraud, plagiarism or financial mismanagement be handled, and by whom?

- When people disagree on what research is permissible, who decides? Does EU funding require EU-wide uniformity, or can local mores prevail on research performed locally?

- If taxpayers are funding the research, to what extent should they decide what's studied? Can science be more democratic? Who's the judge?

Of course, these are many other questions one could ask. Especially since World War II, the ethical dimensions of research have been fully debated by philosophers of science. The A-bomb was the most powerful demonstration of the real-world consequences of ostensibly fundamental research. Today, the scientific enterprise is vast, rich and powerful. In the EU, nearly one in 100 workers are classified as R&D personnel – and, depending on the country, somewhere between 16 per cent and 26 per cent of all jobs in the economy are based on generating or exploiting knowledge.[1] As a group, the rich countries of the world are spending 2.4 per cent of their gross domestic product on research – with a few, such as Finland, passing 4 per cent.

With this growth have come ethical problems – some clear-cut, some more difficult. This document explores some of them. We are not proposing answers, left or right, secular or religious, liberal or dirigiste. Our interest is solely in stimulating more debate on them. Horizon 2020 is the EU's biggest-ever research programme: €79 billion, over seven years, to create knowledge, strengthen strategic science and technology sectors, and solve some of society's greatest problems. It makes the EU the second-biggest non-military science funder in the world, after the US National Institutes of Health. Yet it includes some fundamental policy directions that, as the programme proceeds, need repeated re-examination in Brussels. Through 2014, Science|Business is publishing occasional essays on these questions. We welcome your comments.

Richard L. Hudson
CEO & Editor
Science|Business

SCIENCE – THE GOVERNANCE PRIMER

"All men by nature desire to know," wrote Aristotle in the Metaphysics; and to him, acquiring knowledge was necessary to a successful life. Of course, in our age, we give the task of seeking knowledge a job description, and dish out grants to those who wish to fill it – but the fundamental idea remains part of Western society: Knowledge, and how we get it, is vital to all of us, whether in the wisdom it creates, the satisfaction it affords, or the gadgets and medicines it enables. Naturally, then, there's a long history of debate and, increasingly, published codes and laws affecting how we get knowledge, and under what circumstances.

Herewith, an overview of the key legal documents affecting the governance of research in Europe.

From World II onward

It was just after World War II that the modern business of legislating for scientific ethics gathered steam. The first international effort, the Nuremberg Code, was borne out of the atrocities of human experimentation in the Second World War. Although it did not carry the force of law, the document, drafted in 1947, enunciated such fundamental principles as informed consent and voluntary participation in scientific experimentation.

This was followed by the World Medical Association's Declaration of Helsinki in 1964, the first significant attempt by the medical community to regulate its research; and the revisions of the text, including the most recent version from October 2008, act as bookmarks in the history of research ethics - such as the introduction in 1975 that "concern for the interests of the subject must always prevail over the interests of science and societies." While not legally binding, this policy statement is morally binding on physicians and has acted as a foundation for best practices in the community.

Beyond these foundational documents, international efforts have continued to refine and develop guidelines for best research practices. These efforts have focused on two overarching categories. One is the socio-ethical context of research: the choice of subjects to be investigated, the consequences of research, the duty of care towards research objects, etc. The second is the conduct of researchers: honesty, accuracy, fairness, etc.

The European Commission laid down rules for the first, socio-ethical context of research that it funds through its Framework Programmes. But many international efforts have concerned themselves with the second issue, research conduct. Generally speaking, three practices have been widely recognised as harmful to science and society: fabrication, falsification, and plagiarism. There is greater diversity of opinion on certain other research practices, such as how to handle data and the scientist's responsibility to publish results. But it is widely acknowledged that a common understanding of good scientific conduct would benefit international collaboration.

Research ethics in the European Union

The European Charter of Fundamental Rights, the EU's key human rights legislation, was adopted in 2000 and attained full legal effect with the passing of the Lisbon Treaty in 2009. All European legislation must now conform to the principles of the Charter, including European research policy.

Several principles in the Charter are relevant to research ethics, both in terms of the wider socio-ethical context and in terms of researchers' conduct, including the protection of the right to integrity in medicine and biology and the protection of personal data, as well as the explicit protection of academic freedom: "The arts and scientific research shall be free of constraint," reads Article 13.

The EU has also laid down its own rules regarding the research it funds, with both Framework Programme Seven and its successor, Horizon 2020, precluding the funding of human cloning for reproductive purposes, the modifying of human genetic heritage (unless related to cancer treatment of the gonads) and the creation of human embryos solely for research purposes or for stem cells. But on other controversial topics, such as research on human stem cells, the EU takes a deferential approach, yielding to the legal framework of the relevant member state. The bottom line is that no activity will be funded in a country where such research is forbidden.

All proposals for EU research funding are evaluated both on their scientific merit and on their ethical and social impact. After an initial scientific evaluation, projects requiring special attention are sent to a panel of multi-disciplinary experts, who conduct an Ethics Review. The most important concerns for the Commission are informed consent, research on human embryos and foetuses, dual use, animal research, and research involving developing countries.[2]

Guidelines for good research practice

It has long been recognised that minimum ethical standards and guidelines at institutional level are conducive to responsible research. But amidst the increasing internationalisation of research projects and the drive to grow and improve the European Research Area, research organisations and the EU have stepped up attempts to harmonise these principles.

In 2005, the European Commission adopted the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers – a set of best practice guidelines specifying the roles, responsibilities and entitlements of researchers, funders and/or employers. As well as promoting responsible research, it is hoped that this harmonisation will remove the brain drain of scientists away from southern and eastern Europe.

Under the Charter, researchers enjoy freedom of thought, expression and choice of research methods, while being required to adhere to ethical practices and professional standards, such as avoiding duplication and plagiarism. Researchers should ensure, in compliance with their contractual arrangements, that the results of their research are disseminated and exploited, or, if appropriate, commercialised.

In 2010, the European Science Foundation (ESF) and the Federation of All European Academies (ALLEA) together launched the "European Code of Conduct for Research Integrity,"[3] which aims to present a Europe-wide agreement on a set of principles and priorities for the research community.

According to this document, the main principles of scientific integrity include: honesty, reliability; objectivity; impartiality; openness and accessibility; duty of care to research participants and subjects; fairness; and responsibility for the scientists and researchers of the future. Violating these norms leads to research misconduct, including: fabrication; falsification; plagiarism; failure to meet clear ethical and legal requirements; and improper dealing with infringements.

Research practices are more difficult to reach a consensus on, as they differ from country to country and institute to institute, but the ESF and ALLEA code of conduct compiles a list of basic standards:

■ Data practices – Data should be stored in secure and accessible form, documented and archived, and placed at the disposal of colleagues.

■ Research Procedures – Research should be designed and conducted in ways that avoid negligence and haste, and minimise the impact on the environment. Researchers should respect confidentiality of data and trust. Researchers should properly account for funding received.

■ Responsibility– All research subjects should be handled with respect and care. The health, safety or welfare of a community or collaborators should not be compromised.

■ Publication related conduct: Results should be published in an open, transparent and accurate manner, at the earliest possible time. Undeserved authorship or credit is unacceptable. Financial and other support for research should be acknowledged.

■ Editorial responsibility - An editor or reviewer with a potential conflict of interest should withdraw from involvement or disclose the conflict to the readership. Reviewers should provide accurate, objective, substantiated and justifiable assessments, and maintain confidentiality.

WHAT'S THE VALUE OF SCIENCE?

Science has a value, we all agree; but how we define it, or rather fail to do so, says as much about our modern world as it does about science, itself.

Policy makers often start from what Luc Soete, rector magnificus at Maastricht University, calls the macroeconomic point of view: measuring inputs into science, such as expenditures on research and development (R&D), and subsequent outputs, such as GDP. That can be broadened by counting also research jobs, grants, publications, patents, exports and trade flows, but it ultimately adds up to economically measurable growth. Econometricians then go on to estimate things like elasticities, multipliers, externalities – attempting to measure the impact that one euro or pound of public research spending has on the broader economy. There are several problems with this approach, however. One is that it tends to focus the mind on short-term, measurable inputs and outputs – totally missing the long term, greater values that may take a few centuries to become obvious. How, for instance, would an 18th century economist have measured the value of Newton's work in celestial mechanics? A more recent example, in 1971, from the Nobel Prize winner who co-discovered the structure of vitamin C:

> "Basic research may seem very expensive. I am a well-paid scientist. My hourly wage is equal to that of a plumber but sometimes my research remains barren of results for weeks, months or years and my conscience begins to bother me for wasting the taxpayer's money. But in reviewing my life's work, I have to think that the expense was not wasted. Basic research, to which we owe everything, is relatively very cheap when compared with other outlays of modern society. The other day I made a rough calculation which led me to the conclusion that if one were to add up all the money ever spent by man on basic research, one would find it to be just about equal to the money spent by the Pentagon this past year."
>
> — Albert von Szent-Györgyi[4]

The value trap

This trend, to 'econometrising' science, has been accelerated by the phenomenal growth and specialisation of science. Over the past half-century, says Ioannis Tsoukalas, a Greek physicist who is a member of the European Parliament, "doing science has evolved from solitary work in a lab to an environment of big funding, and to what we now call 'big science'- which does not necessarily imply 'great science.'" Increasingly, he says, the scientist is just another person "making a living out of his profession – from a man of virtue to a member of a community of professionals." And if going to the lab is, economically speaking, not much different than pleading a lawsuit or making a movie – then why should a politician not simplify the funding decision to one of return on investment? Some kinds of research will have higher value than others, because they have a potentially higher return; fund those, and let the others starve, goes the logic. And by the same thinking, a university is just another kind of economic organisation, which can be optimised to produce economic benefit. Education, preservation of knowledge, frontiers of science – bah!

Of course, when the economic argument is reduced to this level of absurdity, most of us would reject it. Karen Maex, dean of sciences at the University of Amsterdam, argues that universities must continue to do academic research with value for society, not the economy; in her opinion, the latter is the job of industry partners. And some fret that the modern diversion of university resources to economic rather than pure scientific output carries a heavy price: Pavel Exner, a member of the Scientific Council of the European Research Council, wonders if we are

gradually seeing a decline in truly novel ideas in science. Is the creativity of science diminishing?

But the economic argument has several other problems. One is that it sets up science for failure, politically. In order to fight for funding, scientists argue their work has economic value – which then encourages the politicians to treat them as they would automakers, farmers or any other economic unit in society: Measuring value for money. Inevitably, when the finance ministries realise that they were over-sold on the economic promise, there will be a backlash.

And in the European political context, this creates a special problem: It makes science just another purveyor of economic benefit the fair distribution of which can be carved up by the EU member-states. Historically, observes Jim Dratwa, of the European Commission's Bureau of European Policy Advisors, EU research policy has been plagued by simplistic notions of "juste retour," that each member-state will get back from the EU as much as they pay into it. The unsatisfactory solution: treating research policy as a zero-sum game and just another way, like farm subsidies or financial regulation, to broker the best deal one can get.

Finance ministers "don't want to fund research; they want to buy research," observes Anton Anton, former Romanian science minister. "If they buy, they want to get something."

The missing variables

Another problem with the economic argument is that much of what science produces is intangible – inherently hard to measure, and likely to be missed in any balance sheet. "If you take Google, Facebook – which have a value (socially) beyond the economic value – you would say we live in a much more valuable society today, we are much richer" than conventional measures would suggest, says Soete. "The economic value is disconnected from the real value."

And the calculation doesn't necessarily get easier as it gets closer to applied, and farther from basic, research.

Kamal Hossain, research director for the UK's National Physical Laboratory, notes that his institute provides essential measurement infrastructure for the UK – "needed by a whole range of industries as well as society in general. Even there, the government tends to measure our success by measuring the economic return. Governments aren't often taking into account the improvement our work brings to the quality of life of the citizens, e.g., lives saved, well-being, safer and more effective treatment of patients, improving security and thereby offering greater piece of mind. More needs to be done to widen the basis for measuring the impact of our research"

So what is the value of science?

"For me it's quite clear: Publicly funded research has to benefit society," says Peter Tindemans, Secretary-General of the Euroscience scientific association, and for a decade coordinator of Dutch research and science policy. "That often goes through the means of industry, and that's fine. But in the end, it has to benefit society."

How you measure that benefit will depend on the personal values you start with. But the resulting equation – if one is even possible – would include a broad range

of variables related to the value of a clean environment, a healthy population, individual fulfilment, and much more beyond "jobs and growth" alone. And because so much of this is based on our individual and collective values, the need for citizen involvement in science policy-setting is high. Society will value science in proportion to science's contribution to the other things society values – creating an endless, logical circle that only a democratic society can resolve satisfactorily.

"Society is interested in what scientists do now," says Anne Glover, Chief Scientific Adviser to EC President José Manuel Barroso. While society certainly does care about economics, what's of increasing importance to many is economic sustainability – adding an ethical dimension to the equation. "People do understand that science, engineering and technology is a real opportunity, and in a sense is the only future for Europe, and elsewhere."

The scientific-industrial complex

The question of defining the value of science to society is based on the assumption that research must generate extra value – value beyond its mere existence. But this was not always the case, says Ioannis Tsoukalas, a Greek physicist and member of the European Parliament.

"We need to think about the evolution of science from an absolute idea to a social tool for development, and its use as an instrument for solving societal problems," he says. "We also have to think of the evolution of scientist from a curiosity-driven human being inquiring scientific truths by vocation, to a man making a living out of his profession; from a man of virtue to a member of a community of professionals, functioning according to programmed or organized group morality."

He notes that former US President Dwight D. Eisenhower predicted this evolution in 1961 – partly as a result of the mounting influence of public funding on science. "The prospect of domination of the national scholars by Federal employment, project allocations, and the power of money is ever present," Einsenhower said, "and is gravely to be regarded…. Today, the solitary inventor, tinkering at his shop, has been overshadowed by task forces of scientists in laboratories and testing fields."

Tsoukalas considers these words from over 50 years ago to be "an adequate prophesy of what has evolved." The notions of academic capitalism, the societal liability of scientific research, and the purposefulness of scientific inquiry are common place today, he said, making the task of defining and explaining the broader value of science to society even more pressing.

WHO PROFITS?

So here's the set-up. Two doctoral students develop a cool way of calculating the popularity of pages visited by people surfing the Web. They patent it. They're smart, and the VC money rolls in – and one day they float their company on the market. They make billions. Their old university, privately owned but heavily reliant on public funding, gets a $300 million windfall out of it. Some years later, the company – now a multinational behemoth – starts getting accused by politicians of parking revenues in low-tax countries, reducing how much it pays back to the government that indirectly helped fund its founding research. Fair, or foul?

The case is real, of course: Google, begun by Larry Page and Sergei Brinn at Stanford. And however you judge it – certainly, there's nothing illegal in any part of this story – it's an increasingly common situation. Facebook began on another private university campus (Harvard), using a computer network partly funded by the taxpayer. Most of the epochal DNA research now reshaping medicine world-wide was funded primarily by the US government, with some help from European governments; and now it's the pharmaceutical companies who convert that research into clinically tested medicines that earn them enormous profits.

The fact is, private individuals and companies get rich on the fruits of their intellectual labour; that's part of what drove them to invent, and for the most part Western society views that as fair. These inventors pay lawyers massive fees to prevent others from stealing their ideas – again, with the approval of most of society. But what obligation do those researchers have to pay back to the society that funded their work?

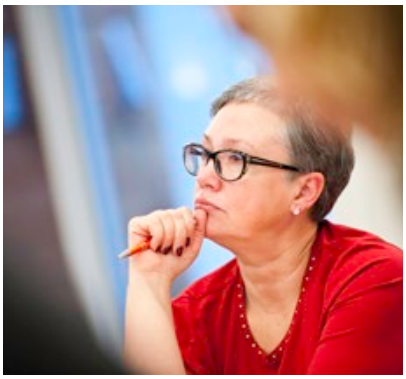
An interesting counter-example to Google is suggested by the ERC's Exner, a Czech. In 1959, two Czech chemists, Otto Wichterle and Drahoslav Lim, published a paper in Nature: "Hydrophilic gels for biological use." It was the start of soft contact lenses. Their research was state-funded, under the old Communist regime. Of course, they could have become billionaires – but that notion was unconscionable. In fact, when the intellectual property was ultimately sold to the West for development, Wichterle was cut out of the deal. "Parliament changed the law so that he couldn't get too rich," recalls Exner. He isn't advocating that approach: "Please don't follow this example." But it is representative of an entirely different spectrum of possible attitudes towards private profit from public research.

The point: As government research programmes turn more towards applied research and innovation, the question, 'who profits?' will become more common. Indeed, Horizon 2020 includes funding for innovative small companies to get grants just to develop their business ideas. Some might call that industrial, rather than science, policy.

Mandeville's bees

The puzzle – private gain from public funding – reminds Maastricht's Soete of "The Fable of the Bees," a famous, and at the time controversial, poem by the 18th century Anglo-Dutch philosopher Bernard Mandeville. The argument: A nation, like a colony of bees, can be most prosperous if each citizen is free to pursue their own self-interest – in Mandeville's example, each bee gathering pollen on its own, to the unintended benefit of the entire hive.

His poem describes one such productive but vice-ridden hive – whether representative of England, the Dutch Republic or elsewhere isn't clear. After a while an angry God steps in and suppresses the bees' self-interest and makes them all 'virtuous'. Result: The hive gets poor. The moral:



"Bare Virtue can't make Nations live
In Splendour; they, that would revive
A Golden Age, must be as free,
For Acorns, as for Honesty."

"The Mandeville poem highlights that human behaviour is driven by personal vice, and that sometimes the pursuit of this personal vice leads you to public good," Soete says. The application to science is clear. "You could argue that it is the private vices of scientists – their individual obsession and interest in the unknown, their desire for discovery, their longing for reputation and acclaim – which ultimately result in a public good: the progress of science, exactly as Mandeville predicted." So too, it follows, with their interest in financial gain.

Indeed, Exner says, the problem in Europe is too little profit for the individual researcher, not too much. "Should we be worried that people become rich from publicly sponsored research? In Europe, the problem is quite the opposite from the US, where people are (more) eager to start spin-off companies." Indeed, so far is this from being controversial now, that he notes that the ERC recently started a programme, Proof of Concept, specifically to encourage more researchers to take their research ideas into the marketplace. The private profit motive – whether financial or intellectual – is well accepted.

Except, consider this case: The steep prices that drug majors were charging for AIDS medicine, developed from publicly funded research. After a public outcry, the US and some European governments in the 1990s regulated the prices in their home markets. Then, a global campaign got underway to make the drugs affordable in Africa and other poor regions that needed it most; again, the industry yielded. Now this has become a pattern – for anti-malarials, antibiotics and other vital medicines most needed in poor regions. Public opinion still supports these anti-profiteering policies. But now public health authorities have another fear: That the business of new antibiotics, or drugs for poor-country diseases, is no longer offering enough incentive for the private companies to

The role of the organisation

A unique development of modern research is the public-private collaboration – and the specific rules for how it is organised.

Marten Steen, a partner in Swedish VC firm HealthCap, emphasises the "importance of network organisations to transform science into great innovations." To make sure that money is well spent, research in the EU would benefit from more network thinking and clusters where academia, start-ups and corporates collaborate.

In life sciences the patient is the starting point and the doctors can easily define the medical need and frame the problem that should be solved. Startups are often spun out of academia with an idea to solve a medical need - and it is often when the startup, in collaboration with larger companies, has access to the hospital and patients to test and optimise the treatment that there is a complete translation from science to innovation.

This kind of collaboration, networking and transparency is very important to make sure that scientific discoveries and learning are shared so that the same mistakes are not repeated. This fosters good science conduct and ethics, he says.

bother developing them. So is that another case of Mandeville's bees forced into unproductive virtue, or just an unintended consequence of an inefficient medicines market?

Or, consider another case: private publication of public research results. In the past, the standard business model in scientific publishing was that private companies or learned societies selected papers for publication in specialist journals – and then charged the university libraries steep subscription fees to read the journals. The rationale: It costs money to edit and produce the journals wisely, and the reader should pay for it, the same as with any publication. But in the past decade, most Western research funders have rebelled and imposed various methods of "open access" forcing that, in one way or another, the papers are available freely. The rationale: Why should the state pay twice for these papers – first when funding the research and second when funding the university library that stocks them? That's the rule now in Horizon 2020. "We had a long discussion in the European Parliament on open access in Horizon 2020,"says MEP Tsoukalas. "The main idea is that the scientific result, being heavily funded by the public, shouldn't be protected for business applications."

Devil in the…

Clearly, your basic values and ideologies will affect how you view these cases – and so as a practical matter, the research world has developed an elaborate and constantly changing set of procedures for balancing public and private interests. For instance, consider the frequent arguments over intellectual property that arise among private companies and universities – a legalistic way of asking 'who profits?'

"You can engage in protracted debates about the notional value of IP," but there are many pragmatic solutions possible, says Robert Sorrell, vice president of public partnerships at BP. One, he says, is the idea of a non-dilutable share in a university spin-out company, which has been proposed in the UK. It solves a common problem: The university receives a non-dilutable stake in the spin-out at the beginning, encouraging the exploitation of the IP in the first place. The university's share cannot be diluted and it then receives a return on from the equity at a later stage.

This kind of practical compromise among competing interests – applied to intellectual property, governance, research priorities – is what makes the modern research enterprise so productive. It is part of the "ecosystem" of research, says Bernard Vergnes, former CEO and Chairman of Microsoft Europe. "It's an ecosystem, where research exists in a location with business and finance close by – Silicon Valley, Cambridge, Leuven Science Park, where we build an environment where research is not alone. That gives a lot of results much faster than if research stays in its corner."

It is "a balancing act" between industry and academia, agrees Monica Marinucci, director for the research industry at Oracle EMEA. "It is crucial to create an environment that favours interaction and exchange, where players can understand each others' drivers and goals. This is what will hopefully lead to a new economic model, and a new way of thinking about who benefits."

CAN WE TRUST THEM?

In 2010, over 13,000 researchers from more than 43 countries signed a petition calling on the European Commission to stop being so bureaucratic about the way it keeps tabs on its grantees – no more time sheets, less pointless accounting, fewer and less-intrusive audits. Stop driving good scientists away from Europe, was the cry. Instead, the "Trust Researchers" Initiative called for a system of research funding based on mutual trust and responsible partnering.

Sounds great – but the EU's accounting controls for research began in part because of a funding scandal with a research commissioner that, in 1999, precipitated the resignation of an entire Commission. In response, a well-regarded bureaucrat who had cut his teeth on combatting agricultural fraud was brought in to reform the research machine. Alas, the resulting controls haven't been fully effective. In May 2011, Italian authorities exposed an international network that had gamed the system to secure more than €50 million in EU funding for scam research projects. And the situation today? The Commission, now concerned more about inefficiency than fraud, has promised a simplification in Horizon 2020. No more time sheets, for starters.

The rules for grant accounting change as often as the political climate. Some years it's harsh; other years less-so. In research, of course, the need for accountability of some kind is clear. Researchers are spending public money, and it must be shown to have been spent as promised. Taxpayers don't let farmers or pensioners take state money without a pile of paperwork, so why should they let scientists do so? Likewise, the disturbing frequency of research fraud and plagiarism suggests some kind of oversight is needed to guard against misconduct. Research is now a massive enterprise, with its fair share of fools and scoundrels.

But the counter-argument for trust is passionately made. Good science, it is said, cannot be ordered up at will. "The whole reason we're doing it is because we don't know the answers," says Sorrell of BP. Scientific success requires many things at once: effort, persistence, resources, training, talent, dedication – and luck. There will be failures; that's why it's called research. A public funder, like a venture capitalist, should aim for a good, diverse portfolio of projects. Rather than obsess over details, it should design the system to favour success overall – thereby enabling genius. "We won't get vision, imagination and innovation without trust," says Glover, the Chief Scientific Adviser.

So once again, the answer to this dichotomy – trust v. accountability – is in finding a practical balance on the basis of experience rather than ideology. That balance starts with picking the grantees properly, argues Kurt Deketelaere, secretary general of the League of European Research Universities. The ERC's success so far stems from its open, refereed, pan-European competitions for grants; it now boasts five Nobel Prize winners. Yet a 2013 progress report on the European Research Area found that several countries are still investing in R&D on a non-competitive basis; that needs to change, he says.

Another practical solution: judge research by the outcome, not the input. When applying for a grant, researchers should think about the impact and added value that they hope to generate, rather than the euros or man-years they will consume. As a researcher, says Hossain of the UK National Physical Laboratory, "you need to ask yourself: can you make a difference and try to work out how you might achieve this ? If you have done that, then it becomes easier to determine how successful you have been in the project. Often, researchers are content simply to meet the project deliverables based largely on the principle of measuring activities and simple outputs rather than outcome"

For all of this, a special responsibility falls on universities – to train researchers for success, inculcate a sense of ethics, and manage the system on a daily basis. Karin Markides, president of Chalmers University of Technology, describes it as a virtuous circle. A university that trusts and supports researchers attracts the greatest scientists. They produce great science. And then they feel a sense of responsibility that great work continue at the university – in their own labs and that of others. That attracts more greatness, and the circle continues.

The result is a culture for great, and responsible science. And it is maintained by the interplay between the top-down governance of the university, and the bottom-up inclinations of the individual researcher. Of course, universities must work to maintain this virtuous cycle, and policy makers should help them. But the bottom line for her: "Trust is a basis for excellence."

Universities as game-changers

The responsibility for raising public awareness about science is particularly relevant for universities in receipt of large public grants, said Karin Markides, president of Chalmers University of Technology. "When a university gets big funding, it should be able to answer the question of how to build public awareness," she said.

While individual researchers need to reflect on how their project can make an impact, governance is needed to create an overarching system of values. "Otherwise we would have a really wild garden of values in Europe," she says. Universities are ideally placed to develop such guidelines, but they need an incentive to do it; and this could take the form of an explicit requirement in publicly funded projects.

"Why don't we ask universities to build governance in different aspects to take care for culture change when they are given so many resources for projects? That's such a simple, yet important thing to do in the European landscape."

Pavel Exner, Vice-President of the Scientific Council, European Research Council, Ioannis A. Tsoukalas, Member of the European Parliament, Anton Anton, Professor, Department of Hydraulics and Environmental Protection, Technical University of Civil Engineering of Bucharest, former Romanian Minister of Education, Research and Youth; Karin Markides, President & Chief Executive Officer, Chalmers University; Anne Glover, Chief Scientific Adviser to President José Manuel Barroso, European Commission (speaking), and Elzbieta Szelag, Professor & Head of the Laboratory of Neuropsychology, Nencki Institute of Experimental Biology; Robert Sorrell, Vice President for Public Partnerships, BP.

WHOSE MORALITY?

One ethical casus belli in modern science is human embryonic stem cell research. In 2009, three Italian scientists unsuccessfully tried to stop the government from excluding it from an €8 million funding programme. "We have a constitutional right to appeal against a public funding call that limits our freedom to do scientifically valuable research that is legal in our country," one of the researchers, Elena Cattaneo of the University of Milan, said at the time.

In theory, the EU's human rights legislation, the European Charter of Fundamental Rights, would seem to support them: "The arts and scientific research shall be free of constraint."[5] But, much like freedom of speech or assembly, this provision is not without limits. Horizon 2020 will follow the line of its predecessor, Framework Programme Seven, in excluding all proposals related to the creation of human embryos solely for research purposes or stem cell procurement, as well as human cloning for reproductive purposes. But it doesn't stop there. For other types of stem cell research that are otherwise authorised, the Commission still will not fund it in a member-state that prohibits it locally. Thus, it will fund certain kinds of stem cell research in Britain or Sweden, where local law allows; and it will not fund the same research in Poland, where local law forbids. The upshot: a legal patchwork – and a great deal of complexity.

Ethical disputes like this are increasingly common in science – with the outcome depending on where you live. German and French attitudes towards animal experimentation are very different from those in Britain. Nuclear energy research is booming in France, hugely unpopular in Germany. GMO development, nanotechnology, use of DNA databases – all are areas for disagreement around the EU. So whose morality wins?

The answer so far: a bit of a muddle. Europe is a mix of cultures, religions and heritages, some argue; and this diversity is to be celebrated rather than eliminated by ethical diktat from Brussels. But, others argue, ignoring the internal EU contradictions is no solution, either. "If you postpone a thorough discussion on controversial issues, such as stem cell research, then they may come back at a moment you don't expect them to – for instance, when an inventor is applying for a patent. As longs as democratic policymakers circumvent firm decisions on ethics and research policy, examiners at the patent office may be confronted with ethical questions regarding the results of stem cells research. These are questions examiners are not educated nor willing to deal with," warns Esther van Zimmeren, a University of Antwerp professor.

Deketelaere of LERU goes further: "We need more Europe. If we want to compete, the last thing we need to do is act as 28 players under the EU umbrella."

In the end, the best solution may be somewhat unsatisfying to all. For many areas of scientific ethics, taking an "either-or" position is unhelpful, says Maria do Céu Patrão Neves, a Portuguese member of the European Parliament and professor of philosophy. Instead of falling into a dualistic model of thought, in which a part of reality is lost, the EU should seek an intermediate way, a balanced position, although minimalist: identify in each dispute those minimal positions on which all member-states can agree and build up from there.

"Rather than debating who should win out, we should look for a balance between the two interests," she says. "If we choose to prioritise only one, then we risk losing all the other valuable interests. It's about a balancing act, looking for the minimum."

CAN CITIZENS DECIDE?

In formulating Horizon 2020, the European Commission came up with a list of seven "societal challenges" on which it will focus much of its research funding for the next seven years.

It's a politically correct list: climate change, coping with an ageing population, finding secure energy and food supplies, creating an "inclusive" society. But how was the list made? And once made, how was the money divided among the different challenges? Likewise, Horizon 2020 includes six "flagship" research projects – on the order of €1 billion each – for specific tasks related to the challenges: create a computer model of the entire human brain, for instance. Again, who decided that, and not another project, should get a lion's share of funding while other projects languish?

What if it had been all decided by an open vote – by everybody? That's a question Glover, the Chief Scientific Adviser, wonders about now. After all, the decision involves publicly funded research on topics that matter to all, but different people will see the priorities differently. As taxpayers, "they're paying for the research, and the accountability is to them. So ethically they should decide in an informed way," she says.

Citizen involvement is a matter of fairness and expediency, say many. For starters, involved citizens can actually do science themselves: Astronomy benefits greatly from the thousands of amateurs around the world who like to look at stars, and voluntarily log their observations and calculations on observatory Websites. An engaged citizenry also strengthens society: "Research, and the competence and insight it brings, contributes to securing legitimate democratic institutions," says Hallvard Fossheim, director of the Norwegian National Research Ethics Committee for the Social Sciences and Humanities.

Voices for science

To really bridge the divide between science and society, it is not enough for the public to "buy into" the value of research, says Jim Dratwa, of the European Commission's Bureau of European Policy Advisers. Somehow, we must find a way to involve citizens, not in just "the end of the pipeline" of science, but also the up-front policy decisions that shape the pipeline.

"The real question is not how we can ask the public to accept science, but rather: how can we involve them in shaping the research agenda?"

In 2011, the EU launched an experiment in citizen participation in science policy. The Voices project organised citizen workshops across the EU – 99 meetings, in 23 languages, with 1,000 participants.

They were focus group meetings – a standard tool in marketing research, with professionals moderating a discussion among a small group of consumers to explore their attitudes. The project, run by Ecsite, the European network of science centres and museums, plumbed popular opinion on the reuse and recycling of waste – "waste as a resource," for input into the Commission's science policy-making process.

But if the people are misled by pressure groups, confused by the media, or beguiled by demagogues? Can we expect the average voter to decide on as charged a topic as animal testing, when they are likely to hear only one, populist

side of the argument appealing to sentiment, not reason? If most Europeans think climate change is an urgent problem, and most Americans do not, surely they can't both be right – so why would we decide a research programme on climate change by popular vote? If research budgets were simply decided by referendum, notes Fossheim of Norway, there is a risk that the winners will be, not the best scientists, but the best communicators. "We are at the mercy of the media and pressure groups when citizens are allowed to make decisions as to what is funded," says Jos Peeters, CEO of Belgian venture capital firm Capricorn Venture Partners.

Then that, say some, makes it the responsibility of scientists to teach the public, not ignore it. Vannevar Bush, President Roosevelt's hugely influential science advisor in World War II, argued that point 60 years ago. It's not enough for a scientist to do science; he or she must also explain it to a wide world: "He who would tell us with the authority of scholarship a complete story of why we exist, of our mission here, has a duty to speak convincingly in a world where men increasingly think for themselves. Exhortation needs to be revised, not to weaken its power, but to increase it, for men who are no longer in the third century."[6]

Thus, universities have a special role. They should include communications in the training of a young researcher. And public funders should require that researchers think about the communications and impact of their work. "Public grants should be given not only on the basis of research excellence but also on the ability to influence culture and understanding between stakeholders," says Markides of Chalmers.

This involves "a paradigm shift in what it means to be a researcher," from lone scientist to "networking intellectual" connecting with colleagues and the wider public over social media, says Daria Golebiowska-Tataj, a member of the Governing Board of the European Institute of Innovation and Technology. Another manifestation: online university courses – so-called MOOCs – that can bring scientific discourse to millions of people around the world. This is, as some have coined it, the day of the "iProfessor."

There are still other solutions possible. Train the media in science. Use crowd-sourcing to get people to vote, with their own money, on what they think important for public research. Emulate in other fields the way patient pressure groups, in medical research, have creatively campaigned for research support.

"We have all the tools available for citizen involvement," Glover says. "What we lack is imagination" to wield them.

IN CONCLUSION…

However we may idealise it, science in the 21st century is no longer viewed as purely a quest for knowledge. Through the 19th and into the 20th centuries, the ingenuity of man to apply science to warfare became gradually clear – whether through the development of better firearms in the American Civil War, of chemical weapons in World War I, or Nazi eugenics and atomic research in World War II. The latter, in particular, was a watershed. In that war, said J. Robert Oppenheimer, leader of the US Manhattan Project, physicists lost their innocence:

> "Despite the vision and far-seeing wisdom of our wartime heads of state, the physicists have felt the peculiarly intimate responsibility for suggesting, for supporting, and in the end, in large measure, for achieving the realization of atomic weapons. Nor can we forget that these weapons as they were in fact used dramatized so mercilessly the inhumanity and evil of modern war. In some sort of crude sense which no vulgarity, no humor, no overstatement can quite extinguish, the physicists have known sin; and this is a knowledge which they cannot lose."
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> From "Physics in the Contemporary World," Arthur D. Little Memorial Lecture at M.I.T. (25 November 1947)

Dramatic wording, to be sure. But it does reflect a fundamental change in the role of science in society, as the scientific enterprise has grown in scale, scope, impact and cost. "We now know that all the research and knowledge we generate can be used somehow, somewhere," says Patrão Neves, the philosopher MEP. With World War II, she says, "science stopped being an absolute value where all means were justified by the ends, and was recognised as an instrument for achieving different goals."

We can see this in Horizon 2020. It is explicitly non-military in purpose – but the entire programme is written to achieve such non-scientific goals as climate mitigation, improved healthcare and economic growth. True, a third of the budget goes to "excellence" in science – cutting-edge, fundamental research; but even that is justified, politically, as means to the economic ends. Scientific breakthroughs funded by the European Research Council are not valued in themselves; politically, they are cannon-fodder to charge the guns of industry with products, services and ideas that we simply can't imagine yet – but still, very fancy cannon-fodder.

This forces some reflection on how a society should apply its ethical norms to science. Patrão Neves observes three ways in action today.

1. Society imposes limits on what science can do – for instance, restricting stem cell or GMO research, often driven by media

2. Society formulates normative rules for action – not so much banning an activity, as directing it towards a specific goal. This is the way most of Horizon 2020 is working, through the priorities it sets for research

3. Society sets the tone for what is viewed as right in science – an educative action, like teaching young researchers that plagiarism is bad

The implication of this is clear: Society, like or it or not, is responsible for how science proceeds – so we may as well face up to the challenge.

"If science is not an absolute value in itself, then the goals for scientific research have to be established elsewhere," she says. That means our democratic institutions must stay engaged in science policy – and there is a role, direct or indirect, for citizens to play in the science policy arena: "Science today cannot be separated from ethics."

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LIST OF PARTICIPANTS

Gérald Achermann, Biology Lecturer, ETH Zürich

Anton Anton, Professor, Department of Hydraulics and Environmental Protection, Technical University of Civil Engineering of Bucharest; former Romanian Minister of Education, Research and Youth

Diana Jane Beech, Research Associate, Faraday Institute for Science and Religion, University of Cambridge

Jean-Claude Burgelman, Head of Unit, Relations with Stakeholders, DG Research and Innovation, European Commission

Vanessa Campo-Ruiz, Science Officer to the Chief Executive, European Science Foundation

Kurt Deketelaere, Secretary General, League of European Research Universities

Jim Dratwa, Head of Ethics in Science and New Technologies, Bureau of European Policy Advisers, European Commission

Pavel Exner, Vice-President of the Scientific Council, European Research Council

Hallvard Fossheim, Director, The National Committee for Research Ethics in the Social Sciences and the Humanities (NESH), Norway

Anne Glover, Chief Scientific Adviser to President José Manuel Barroso, European Commission

Daria Golebiowska-Tataj, Governing Board Member, European Institute of Innovation and Technology (EIT); Researcher, Warsaw University of Technology Business School

Helene Ingierd, Director, The National Committee for Research Ethics in Science and Technology, Norway

Kamal Hossain, Director, Research & International, National Physical Laboratory, United Kingdom

Richard L. Hudson, CEO & Editor, Science|Business

Kimmo Koski, Managing Director, Centre for Scientific Computing, Finland

Atle Leikvoll, Ambassador of Norway to the EU

Karen Maex, Professor in Materials Physics and Nanoelectronics, KU Leuven

Monica Marinucci, Director for the Research Industry for Europe, Middle East & Africa, Oracle

Karin Markides, President & Chief Executive Officer, Chalmers University

Sarah Moore, Science Officer for the Social Sciences and the Humanities, European Science Foundation (ESF)

Herman Nys, Professor & Director of the Centre of Biomedical Ethics and Law, KU Leuven

Joanne O'Dea, News Editor, Science|Business

Žaneta Ozolina, Professor, Department of Political Science, University of Latvia

Maria do Céu Patrão Neves, Member of the European Parliament

Jos B. Peeters, Managing Partner, Capricorn Ventures

Laura Pontiggia, Policy Adviser, European Research Council

Vincent Reillon, Senior Scientific Officer for the Physical, Chemical and Mathematical Scientific Committee, Science Europe

Didier Schmitt, Scientific Adviser & Foresight Coordinator, Bureau of European Policy Advisers, European Commission

Panagiotis Siozos, Science and Policy Adviser to Ioannis A. Tsoukalas, Member of the European Parliament

Luc Soete, Rector Magnificus, Maastricht University

Robert Sorrell, Vice President for Public Partnerships, BP

Mårten Steen, Partner, HealthCap

Elzbieta Szelag, Professor & Head of the Laboratory of Neuropsychology, Nencki Institute of Experimental Biology

Peter Tindemans, Secretary General, EuroScience

Ioannis A. Tsoukalas, Member of the European Parliament

Esther van Zimmeren, Research Professor, Faculty of Law, University of Antwerp; Senior Research Fellow, Centre for Intellectual Property Rights, Faculty of Law, KU Leuven

Bernard Vergnes, Chairman, European Executive Council

John V. Wood, Secretary-General, Association of Commonwealth Universities

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