

## From interoperability challenges to syncing opportunities: a pathway to global research

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## Interoperability is a key issue

The FEAST/UQ Symposium 2011<sup>5</sup> presented various figures and trends demonstrating an increase in the rate of the internationalisation of research across developed and emerging economies. By any standard, these results show a wealth of international collaborations between scientists having little or no problem conducting collaborative, and indeed interoperable, research. However these results also show the tempo of change has accelerated for both the increasing trends such as the rise of China and for the downward trends, especially during post-global financial crisis (GFC) recovery of most western nations. In this context, our global research machine is becoming more costly, mottled, risky, clumsy, and is under increasing political and community pressures to deliver tangible results. This paper examines the challenges hampering interoperability on a variety of levels – governments, funding and researcher mobility – and describes opportunities for improving these systems to allow for more effective global research.

This is the second Discussion Paper that reports on the deliberations of the recent FEAST/UQ Symposium 2011: *Enhancing interoperability in the emerging global research order*. The first paper, *The case for interoperability in global research*<sup>6</sup>, focussed on defining interoperability in global research, and examined the context surrounding it.

Full details of the Symposium, including speaker biographies and presentations, further reading material, and other resources are available from [www.feast.org/symposium2011](http://www.feast.org/symposium2011).

## Interoperability challenges

Policy and practical challenges are interwoven in most areas of research cooperation, and interoperability issues account for many of these. Some of the obvious practical challenges include intellectual property rights (IPR), material transport agreements (MTA), legal frameworks, bid synchronisation, common indicators (for peer review and ex-post evaluation), reporting requirements, and the

time difference and physical distance between collaborators.

The policy challenges include changing and unstable political and bureaucratic environments, a lack of consensus on priority for funding, the difficulty of developing comprehensive policies in a decentralised structure, and the inherent risk in international cooperation in research with regards to issues such as national competitiveness, national security, etc.

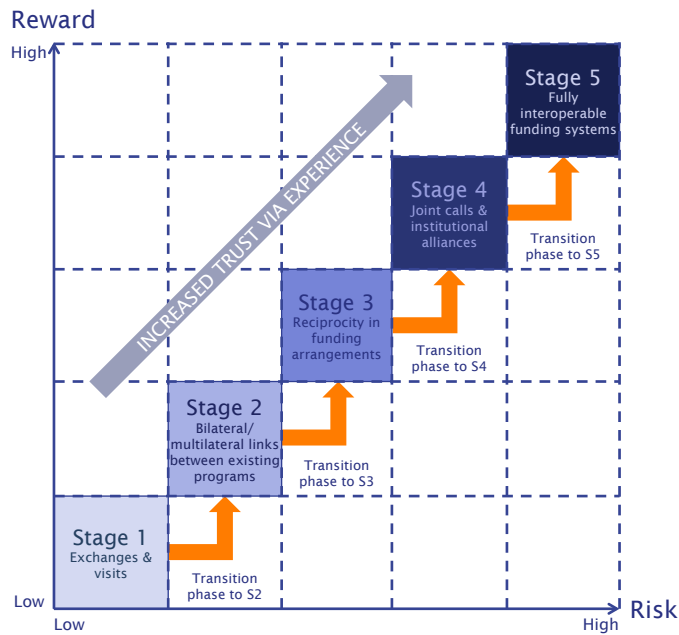
This discussion on interoperability has taken place at a time when science and innovation policies and funding are in a particular state of flux across the globe. Affecting all national policy discussions is the fallout from the GFC. Government funding for research and innovation is reducing or flat-lining in many countries. Political discussions about funding priorities and the role of research and innovation in the responses to the crisis are becoming increasingly polarised. Perspectives on how national budgetary constraints on funding should play out in the research and innovation domains vary widely across nations.

While there are a small number of significant programs that are endeavouring to achieve better interoperability, for example the European Union's Framework Programme<sup>7</sup>, for the most part the political and economic realities of current publicly funded research systems mean that ideal systems are unlikely to be achieved in the foreseeable future. Figure 1 depicts the typical stages of international collaboration, and the relative levels of risk associated with each type of activity, risks which can be significantly *minimised* by a long track record of engagement along with strong relationship capital (amongst researchers as well as amongst research managers and bureaucrats). In making the case for interoperability, the preconditions are a solid and mature partnership, and a favourable political environment. Additionally, there needs to be realistic expectations of the research areas where interoperability is desirable, and possible.

<sup>5</sup> <http://www.feast.org/symposium2011>

<sup>6</sup> FEAST Discussion Paper 6/11

<sup>7</sup> <http://cordis.europa.eu/fp7>



**Figure 1: Stages in international research collaboration by risk/reward<sup>8</sup>**

The remainder of this paper will discuss issues faced by international research endeavours in the current patchwork of research systems and propose solutions to better enable different research systems to become more interoperable with each other. In particular, we will look at:

1. Governance and policy development;
2. Funding program design and operation, and;
3. Mobility and partnerships.

## Governance and policy development

Science plays an important role across a broad range of social issues, including fundamental creation of knowledge. However, current trends to have science policy subsumed within innovation policy in many countries risk creating a scenario where innovation policy (inherently about national advantage) is privileged over science policy (noting that science is inherently global). Such a situation will mean that associated funding programs will be less favourable to international collaboration, and therefore the more purely local nationally competitive environment will be emphasised over the global connectedness necessary for science.

<sup>8</sup> AUS-ACCESS4EU Discussion Paper, *A framework for analysing bilateral research cooperation agreements relating to reciprocity*

Against this position there is a risk that decoupling science policy from innovation policy may result in less overall funding being available for science.

It may be undesirable to increase the interoperability of certain types of research activities. For example, being more permissive towards collaborations on dual use technologies (those important for both public and military applications) may increase national security risks. Even in countries that wish to build on science to strengthen their economies and their national security capabilities, it will be important for their science programs to be increasingly interoperable to enable their own scientists to more effectively access and participate in the global science community. In other words, effective competition may also require a high degree of cooperation to build interoperability.

An important aspect to improving national innovation systems, in an interoperable sense, is for governments to identify and implement mechanisms to enable local innovation actors to better access global science and global markets. This includes making strategic decisions as to the type of activities that will be supported domestically/regionally, and the types that will be sourced from, or shared with, international partners. This type of knowledge sourcing need not be confined to industry. It should include government as well as other organisations in the research sector.

Governments of course do not speak with a single voice on these matters. The domains of research, innovation and science may well fall under separate and competing political responsibilities, or be shared by different levels of government in a federal system. However, governments at various levels (national, state, regional, etc.) need to better understand when to put their resources into linking outward and when to sink investment into the local production of knowledge and innovation.

### *Developing the arena for government action*

Governments can be required to deal with some of the asymmetries between national systems so that research collaboration can take place without undue risk. For instance, some countries, such as China, require the signing of government-to-government research collaboration agreements (i.e. removing *barriers to entry*).

Governments can also improve the communication flow between countries concerning their respective research priorities, research capabilities and collaboration mechanisms (i.e. improving *imperfect information flows*).

Researchers collaborating across different jurisdictions often operate within incompatible legal frameworks, or at least national legal rules that are costly and complex to navigate. One of the major issues is differing intellectual property conventions and laws. Another obstacle is the proliferation of divergent research ethics regimes across different countries.

Investigator-initiated and -led research makes up the bulk of research activity, so the most effective and efficient role of government is three fold:

1. To remove undue restrictions on collaborative activities;
2. To intervene only where needed to improve conditions, and to support networking and mobility activities and the funding of infrastructure, and;
3. To promote and protect national interests – which may include promoting cooperation in some fields while limiting the scope in others.

In the political and economic context described above, government action and investment that will underpin this role must be guided by informed policies demonstrating conditions for success and impact. Therefore, better evaluation mechanisms and definitions of these conditions have to underpin effective interoperability. Practically, developing better metrics of R&D activity, then using these to feed information to governments or oversight bodies, could create a much improved standard of measurement of international R&D activity while helping to demonstrate the added value of interoperability.

These metrics would tackle the broad spectrum of R&D activity. For instance, many benefits from innovation do not come from protected IP or traditional technology transfer, but from side products such as codes and standards, which are critical to innovation and advancement in science at every level.

### Opportunity 1: CASRAI – Consortia Advancing Standards in Research Administration Information

One of the standards initiatives most relevant to this discussion is the Canadian *Consortia Advancing Standards in Research Administration Information (CASRAI)*. Its aim is to develop common definitions, open data standards and metrics related to research administration. Its initial focus is on Canadian university research, but the intent is to expand to include government and international members.

There are several committees within the consortium working in such areas as research personnel CVs (with flexibility for different purposes); research activity (e.g. funding applications, financial reports); and research impacts (e.g. outputs, outcomes).

These standards are not technology-based, fine-grained, or prescriptive. The aim is open interoperability with regards to the format, so as not to impose hardware or software restrictions. Hence, users may employ whatever platform best suits their institutional or national environment.

Major users define, then adopt, the conceptual model, which is as follows:

- Core international elements for key concepts (e.g. what is a “person”, a “project”, an “organisation”) that works for all partners
- “Extensions” that fit user’s circumstances of field, organisation, country, sector, region, etc.

For example, Canada will implement the global core, plus “Canadian extensions”.

One simple way of improving data collection is to insist that all publications should include the grant number, so that the research outputs from each grant can be easily measured.

Aligning this approach with better metrics of R&D activity, then using this to feed information to the OECD could create a much improved standard of measurement of R&D activity internationally. The report of the Expert Group on the Assessment of University-Based Research provides some reference material.<sup>9</sup> They also look into including the social impact of research. Assessing the social context of the knowledge economy is a relatively

<sup>9</sup> *Assessing Europe’s University-Based Research*

recent phenomenon and covers a broader description than is currently requested (the Netherlands Organisation for Scientific Research (NWO) is leading a pilot project in this area)<sup>10</sup>. This is especially important in view of tackling global research challenges. Consequently, research initiatives are established on a broad international scale that bring together various disciplines, as well as many countries, in areas such as food and water security, global health, and climate change.<sup>11</sup>

## Funding program design and operation

National funding programs can, in most cases, be utilised to participate in international research coordination and collaboration. Some of these programs are explicitly designed for bilateral or multilateral engagement; however, most are designed to cater for domestically conducted research only. This is not necessarily an impediment for researchers using these schemes for global work, but the design and constraints of the scheme will greatly impact the ease with which researchers can engage internationally.

For example, a lack of synchronicity between calls for proposal and grant funding can impede the coordination of research activities between different countries. Additionally, due to differing technical stipulations across nations and programs, including evaluation and/or reporting requirements, it is often the case that coordinated research proposals and reports need to be prepared and submitted multiple times or in multiple formats.

Many programs are becoming increasingly rigid, despite the clear need for enabling greater interoperability. One aspect of this is a trend in many programs to restrict the length of funded project. This is largely due to changing oversight regulations, for example in the governance of research and in the increasing levels of accountability being sought. Other factors that influence these trends include relatively short political cycles, the uncertainty of future public revenue, and an increased desire for public accountability for monies spent on research.

Whilst many nations have developed joint bilateral and multilateral programs, these require an enormous effort to establish and administer. Governments need to be clear as to what the purpose of such targeted funding is – whether chiefly diplomatic, trade related, for research or education. If the fundamental purpose is to promote research collaboration, other means may be more effective (for example, synchronised bid cycles). Conducting such joint funding programs introduces large administrative costs (in both time and money), such as large overhead costs for universities, which they cannot afford. For example, collaborative research and innovation centres, such as the Australian Cooperative Research Centres (CRCs)<sup>12</sup>, can take several years before all agreements and protocols between participating organisations and companies are in place.

Irrespective of such considerations, the process of moving to joint programs requires a long history of trust and collaboration, and well-established and experienced relationships, in order to achieve positive outcomes.

When we examine one of the main drivers for the interoperability of research as defined in FEAST Discussion Paper 6/11, that is the creation of nimble funding responses to emerging research, most major funding programs are simply too cumbersome. For example, currently it takes on average 9 months to finalise a contract with the Australian Research Council (ARC), and the negotiation phase for European FP7 projects can be far longer.

Given the practical difficulties of putting together large research collaborations, there are further challenges when teams take a multidisciplinary approach to problem solving. The cutting edge of new research is usually at the interface between disciplines. However, creating that interface, making disciplines more interoperable, is also a challenge. The issue of cooperation is not just cross-border but also cross-disciplinary. Some programs have explicitly incentivised such cross-disciplinary collaboration, for example the grants of European Research Council (ERC)<sup>13</sup>, but many do not yet target or support cross-disciplinary collaboration as a requirement for effective innovation.

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<sup>10</sup> Evaluating Research in Context (ERiC),  
<http://www.eric-project.nl>

<sup>11</sup> *Knowledge, Networks and Nations: Global scientific collaboration in the 21<sup>st</sup> century*

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<sup>12</sup> <http://www.crc.gov.au>

<sup>13</sup> <http://erc.europa.eu>

## Streamlining and exposing national funding programs

It is important to highlight deficiencies in individual national funding programs when they hamper international collaborations. This includes better definitions of success and impact, reducing red tape (despite increasing compliance requirements), and increasing the availability of funds for international collaborations by opening up existing programs – not necessarily by increasing the amount of funding available.

For example, as a result of such examination, and the Australian Government making an explicit commitment to internationalise funding and practice in 2008, the funding programs of the ARC have been significantly opened to international applicants.<sup>14</sup> There are no restrictions as to citizenship, or the number of grants to be awarded to non-Australian applications; however, each proposal must be lodged through an Australian institution.

While opening up of programs to international participation is desirable, each nation needs to decide on a sound strategic basis where to spend its money. It may be that if money for any particular funding system (e.g. in a smaller nation) went only to the best researchers and institutions, a large proportion of it would go abroad.

Global interoperability would benefit from each nation encouraging and supporting its researchers to become involved with major international initiatives and programs, and by then following up on this participation by providing feedback and input to those schemes (for example, the European Commission recently released a Green Paper seeking comment on matters that will influence the future of its enormous Framework Programme)<sup>15</sup>. Such input, however, cannot be offered without the benefit of direct experience with the programs.

Operationally, improved levels of interoperability in the way in which program owners conduct and evaluate calls can be gained by moving towards a greater

harmonisation of the different peer review systems of different countries.

## Opportunity 2: The SIRICA concept – a standard template for international research

The SIRICA<sup>16</sup> concept was developed within FEAST:

It is possible to construct vibrant and productive international cooperation by making it easier for such reciprocal relationships to be established and maintained. Finance Ministries need not be asked to sanction overseas payments. This is why FEAST has proposed inter-governmental liaison to develop a 'Standard International Research and Innovation Cooperation Agreement' (SIRICA) template. The SIRICA would be a generic legal template designed to significantly reduce the transaction costs and lead times (and risks) involved in establishing new reciprocity-based bilateral and multilateral cooperation agreements.<sup>17</sup>

Groups such as Australia's Group of Eight (Go8)<sup>18</sup> universities have been trialling such a template amongst themselves. Whilst the idea of such a template is attractive for overcoming some of the basic legal issues surround international collaboration, there are doubts about the feasibility of developing it. Organisations that have already developed their own templates, at great cost, may not be willing to undergo additional development.

## Mobility and partnerships

At the heart of all international research are the relationships between individual researchers, and their ability to communicate and collaborate effectively. Interoperability demands enhanced degrees of freedom and flexibility in order to reduce the barriers for mobility.

Given that most researchers will, at one time or another, spend time in another country being paid by a local grant, issues such as the portability of worker entitlements (e.g. retirement schemes and medical/social security) are a key issue to ensure that such workers are adequately supported throughout their working lives.

<sup>14</sup> [http://www.arc.gov.au/general/international\\_collaboration.htm](http://www.arc.gov.au/general/international_collaboration.htm)

<sup>15</sup> *From Challenges to Opportunities: Towards a Common Strategic Framework for EU Research and Innovation funding*, note that the request for comment closed in May 2011

<sup>16</sup> *Standard International Research and Innovation Cooperation Agreement (SIRICA)*

<sup>17</sup> AUS-ACCESS4EU Discussion Paper, *Enhancing reciprocity in international cooperation in research: issues and metrics*

<sup>18</sup> <http://www.go8.edu.au>

There is a decided lack of formal support for developing sustainable research networks. Most successful research collaborations have a long lead time, built on foundations of personal relationships and trust which can take many years to develop. New forms of communication – for example Skype and Facebook – can speed up the process, but researchers still rely on mutuality of interests, establishing face-to-face relationships, and bringing complementary skills and resources. Successful international research efforts nearly always result from long-standing collaborations, sometimes over decades. Indeed, it is precisely the longevity that has resulted from researchers developing trusted professional networks that allows them to pursue fully integrated and interoperable research activities that exhibit little or no risk to the funded activities. The European Commission, through the Framework Programmes and long established programs such as COST (European Cooperation in Science and Technology)<sup>19</sup>, have long emphasized the importance of fostering research networks in their efforts to integrate research and innovation endeavours across Europe.

As noted in the Australian Government's recent Research Workforce Strategy<sup>20</sup>, there is a growing discrepancy between the number of researchers entering the workforce, and the number exiting. This phenomenon of an ageing research workforce is of major concern in most developed nations. In Australia's situation, this shift is occurring despite high overseas student intakes at universities. In contrast, there is limited mobility by students of Australia origin. It is precisely for this reason, which is mirrored in many parts of the world, that the European Commission has established mobility programs for researchers (Marie Curie)<sup>21</sup> and students (Erasmus Mundus)<sup>22</sup>, which are designed to help overcome the inertial problems to mobility.

### *Building collaborative networks*

There is clear evidence that researchers' networking opportunities have led directly to developments that benefit science, the economy and the society at large. For example, the involvement of European researchers in laying the foundation for the Global System for Mobile

Communication (GSM) standard was developed as part of a COST Action.<sup>23</sup> Similar examples include ITU-R (International Telecommunications Union – Radiocommunication Sector) satellite formulas, and more recently the establishment of how many therapy centres will be needed in Europe for individual cell therapy delivery. Researchers will develop such standards, but need to network on a large scale to do that. This networking is explicitly funded in Europe primarily via COST, but surprisingly, such initiatives with a broadly based support network have not been implemented in Australia, Canada or the USA (although networking is supported in a number of specific and targeted research areas).

Individual institutions, networks and countries can build capability through the seconding of staff and regular lab visits. Often overlooked, however, is that this also holds true for non-research personnel. Encouraging and supporting the international exposure and connectedness of research managers, science policy bureaucrats, and other actors at the interface of research and government, will bring better understanding of the best practice initiatives in this area, as well as of the genuine challenges that can be addressed through practice and policy changes.

It is widely acknowledged that capability is also addressed by providing support for early career researchers to develop lasting international professional networks. This allows them to build relationship capital with international participants that will be crucial for later in their careers when they are engaged in more complex collaborations. It should be noted that due to the current assessment systems an individual's career is more driven by developing collaborations with established research communities, e.g. the USA and European countries, and to a lesser extent with emerging countries.

Many international relationships have been developed and are maintained by diasporas. Of particular importance are the Chinese and Indian diasporas in developed economies who maintain strong ties with researchers in their home countries. These relationships are a major factor in the development and maintenance of collaboration networks that have been building over the past several decades.

<sup>19</sup> <http://www.cost.eu>

<sup>20</sup> Australian Government Research Workforce Strategy, *Research Skills for an Innovative Future*

<sup>21</sup> <http://cordis.europa.eu/fp7/mariecurieactions>

<sup>22</sup> [http://eacea.ec.europa.eu/erasmus\\_mundus](http://eacea.ec.europa.eu/erasmus_mundus)

<sup>23</sup> COST, *The Mobile Phone turns 38*, April 2011,

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## Moving forward

The design of individual programs across the globe could greatly enhance interoperability by coordinating design efforts with counterparts, particularly on integrating interoperability concepts into programs, and striving towards overall simplification of program requirements.

Initiatives of the European Commission such as the BILAT<sup>24</sup> and ACCESS4EU<sup>25</sup> are established, in part, to explicitly highlight, promote and facilitate international researcher and country engagement via suitable mechanisms. These initiatives operate on a number of levels: government and program policies, strategic institutional matters, and researcher support. The success of this suite of projects has prompted discussion about structures capable of supporting broader (i.e. beyond Europe) engagement.

In Australia, the recent Parliamentary *Inquiry into Australia's international research collaboration*<sup>26</sup> discussed the possibility of establishing a permanent agency that would "... act as a conduit between Australian researchers and overseas research organisations and funding bodies."

This prompts the question of establishing a far larger, international, agency that would be responsible for the mediation and coordination of initiatives from different countries so that they become more interoperable by design.

### Opportunity 3: Standards and codes

Interoperability is far from a new concept. There are many major issues of international significance that have benefited from internationally agreed mechanisms. Such issues include telecommunications, air traffic control, nuclear safety, financial management systems, etc. These areas have all been made explicitly interoperable out of necessity, and offer exemplars of the scale of international agreement and coordination possible when nations agree on priority issues.

One of the lessons these initiatives offer is the benefit of involving major research bodies with the development of

international standards and agreements relating to research and research systems. It would be useful to learn from (and support) the continuing work of national and international standards agencies, as well as international technical and scientific bodies, as they cooperate in developing international standards across a wide range of areas which influence international research effectiveness, as well as many other areas of life.

For example, once standards are set, governments can determine the types of standards testing facilities that must be maintained locally, and also negotiate access to testing facilities in other parts of the world where those capabilities can cater for testing not supported locally.

## Conclusion

The digital revolution of the past two decades has without any doubt created a globally connected world. However this revolution has not been met by a totally open system. Instead, the system is a patchwork of open-source and proprietary hardware, software, ideas and networks. Global research will follow the same path. It will certainly not be an homogenous landscape but a construction of highly integrated science with local, regional and national interests. Faced with similar challenges, each country needs to:

1. Expose the benefits of interoperable research, by measuring risks, costs and value of opportunities;
2. Coordinate and develop interoperability mechanisms, for instance by starting from the examples outlined in this paper; and
3. Work with international partners to ensure a globally coherent discussion around these issues, including the identification of elements of national systems that should be interoperable.

Some countries, including Australia, need to make pragmatic moves in this direction because they are more susceptible to the growing risks of science insularity and to the maelstrom of opportunities offered by the emerging science powers. The recent decision by the US Congress to limit space science cooperation with China<sup>27</sup> reminds us that there are limits to what can and should be synchronised. It also confirms the importance for

<sup>24</sup> <http://ec.europa.eu/research/iscp/index.cfm?pg=bilat>

<sup>25</sup> <http://ec.europa.eu/research/iscp/index.cfm?pg=access4eu>

<sup>26</sup> Australian Parliament, *Inquiry into Australia's international research collaboration*, recommendation 18

<sup>27</sup> <http://www.spaceref.com/news/viewsr.html?pid=37024>

international science policies to communicate and work with radically diverse partnerships, including with the civil society, corporations, and diplomats.

We encourage bodies responsible for research to begin (or continue) the process of examining *interoperability* as a national and international mechanism for improving the quality of, and reducing impediments to, effective and important research and innovation activities.

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