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Revisiting research management for innovation

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Abstract
Currently, the Australian government is boosting research and development to advance innovation: seven national priorities have been identified to focus the process [1]. Overall the Super Science Initiative provides a $1.1 billion capital boost for critical areas of scientific endeavour, including space science and astronomy, climate change, marine and life sciences, biotechnology and nanotechnology [2].This is a significant investment into cutting-edge research infrastructure.

Hosting Australia’s only research reactor and a suite of accelerators, the Australian Nuclear Science and Technology Organisation, ANSTO, has been allocated funding for infrastructure as part of this initiative. ANSTO is a government research agency that is recognised as an international centre of excellence in nuclear science and technology for the benefit of Australia. As a large-scale facility with user programmes, ANSTO has established partnerships on national and international level, but the new initiatives provided by the government give impetus to revisit our current research structure and output in research with respect to managing our partnerships, attracting new talent and defining our output criteria. This paper will discuss the experience gained reviewing our system and how to face the challenges of fostering competitiveness on the one hand, but aiming for collaboration on strategic issues on the other hand in order to ensure that research outcomes are translated into new and improved products.

References
[1] Powering Ideas – an innovation agenda for the 21st century,
http://www.innovation.gov.au/Section/Innovation/Pages/PoweringIdeasAnInnovationAgendafortheF21stCentury.aspx
[2] Super Science Initiative Factsheet
http://www.innovation.gov.au/Section/AboutDIISR/FactSheets/Pages/SuperScienceInitiativeFactSheet.aspx

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Introduction

It is widely accepted that investing into research is a driver of innovation. Taking a narrow point of view, innovation represents knowledge transfer, turning a scientific outcome into a commercial product, frequently via patenting the idea. Jiang et al. state that innovation should be considered from a knowledge-base perspective, including knowledge sharing, essentially "knowledge as a necessity for innovativeness" (Jiang 2009 and references therein). With this in mind, innovation can also consist of creating new processes or taking a new approach to established structures. The latter view of innovation, an indirect form of wealth creation, is the line taken in this paper, using an Australian institution as an example.

About a year ago, Australia defined its research strategy under the banner of innovation: "Powering Ideas – an innovation agenda for the 21st century" (Carr 2009), which sets out the Australian government's agenda for the next ten years. In this context, innovation is not only understood as investment into research infrastructure, but also as investment in reform and renewal, setting priorities, improving skills, increasing innovation in business and boosting collaboration. In the following, we discuss Australia's situation and in particular the approach taken by the Australian Nuclear Science and Technology Organisation (ANSTO) in striving for more innovation. Firstly, we discuss how strategic planning is a useful tool, especially in view of the use of high-tech equipment for research. The next section tackles the importance of knowledge management and metrics with regards to research output. This leads us to look into the prospects of benchmarking ANSTO against other institutions. Here, we compare ANSTO with the Paul Scherrer Institute in Switzerland considering the different features of the organisations. This comparison shows that collaborations in research are crucial, and we present how ANSTO encourages new collaborations. Finally, we discuss the various findings and what this implies for ANSTO.

The Australian situation concerning research and innovation

Powering Ideas (Carr 2009) is a document based on a number of reports and presents national innovation priorities including skills and research capacity, and tackling innovation issues not only for business, but also for the public sector. On the one hand the booklet is a review; on the other hand it shows the future directions of the government's priorities and governance in order to advance and stimulate innovation.

The seven priorities are (Carr 2009):

> "Priority 1: Public research funding supports high-quality research that addresses national challenges and opens up new opportunities.
> Priority 2: Australia has a strong base of skilled researchers to support the national research effort in both the public and private sectors.
> Priority 3: The innovation system fosters industries of the future, securing value from the commercialisation of Australian research and development.
> Priority 4: More effective dissemination of new technologies, processes, and ideas increases innovation across the economy, with a particular focus on small and medium-sized enterprises.
> Priority 5: The innovation system encourages a culture of collaboration within the research sector and between researchers and industry.
> Priority 6: Australian researchers and businesses are involved in more international collaborations on research and development.
> Priority 7: The public and community sectors work with others in the innovation system to improve policy development and service delivery ".

Although the publication is presented by the Department of Innovation, Industry, Science and Research (DIISR), it takes an overarching approach towards the various governmental departments. In order to coordinate the various portfolios and bodies with respect to research, science, technology and innovation, a forum, the ‘Coordination Committee on Innovation’, was created that assists in information sharing, monitoring progress, linking to international partners and raising issues. This is an ongoing effort that systematically looks into increasing Australia’s innovative potential, including commercialisation, skills and capacity building.

Since *Powering Ideas*’s launch a year ago, we have seen a number of initiatives that were not only presented by DIISR, but were also channelled through other bodies, such as the Department of Education, Employment and Workplace Relations, the Treasury or the Australian Research Council. The initiatives included special funding, surveys, (country-wide) consultations and reports with strategy and policy follow-ups.

Fiscal year	2005/6	2006/7	2007/8	2008/9	2009/10
% total government expenditure	2.42%	2.46%	2.34%	2.26%	2.75%
Total government support in Mill. AUD	5,876.6	6,377.5	6,567.0	6,875.2	8,587.1

Table 1: Summary of major Australian government support for science and innovation (DIISR-budget 2010). This includes funding for major government research agencies (e.g. CSIRO, ANSTO), business enterprise sector, higher-education sector (e.g. Australian Research Council), multisector (e.g. cooperative research centres, health).

As this paper is specifically looking into ANSTO, we will present here only information that is relevant to this organisation. In May 2009, the Australian government announced the ‘Super Science – Future Industries’ initiative (Carr 2009) investing about AUD500 million into research infrastructure for biotechnology, nanotechnology and information communications technology (the overall Super Science Initiative provides AUD1.1 billion funding for areas, such as space science and astronomy, marine and climate science, and future industries). This is a considerable increase in investment for science and innovation (see Table 1) compared to previous years. It came at a critical time to counterbalance the global recession and is intended to ensure that Australia will have the future basis for high-skill and high-wage jobs. As Frank Heemskerk recently pointed out

“One may invest into resources to obtain knowledge, but once you have it, it can be reused and grow in value when shared. Therefore it creates positive returns; an effect neglected by classical economics theory” referring in particular to value creation through research management (Heemskerk 2010). Obviously, the Australian government initiative has been very well received by the research communities as it demonstrates the government’s commitment to innovation.

New research infrastructure at the Australian Nuclear Science and Technology Organisation (ANSTO)

One of the beneficiaries has been ANSTO with AUD62 million for additional neutron-beam instruments for the OPAL research reactor and an upgrade of the Centre for Accelerator Science. ANSTO is unique in the Australian research environment: it hosts the only nuclear reactor in Australia, a research reactor for neutron-beam research and for irradiation of materials, including the production of radioisotopes.

ANSTO is a research institute in DIISR, and thus part of the Australian government. In fact, it is subject to the provisions of various Commonwealth Acts - the principal Act being the Australian Nuclear Science and Technology Organisation Act 1987 which details the organisation's functions, powers, board, chief executive officer's duties, staffing, finance and other roles and responsibilities. Located south of Sydney with close to 1,000 staff, ANSTO has not only a research reactor, but also accelerators and cyclotrons. Its unique capabilities are used for research into climate change, environmental issues, advanced materials, radiopharmaceuticals, etc.

ANSTO’s research reactor is a relatively recent investment (replacement): the OPAL reactor became critical in August 2006 and was inaugurated in April 2007 by the prime minster in office at the time, just after the previous reactor was shutdown in January 2007 after almost 50 years of operation. The new reactor has a state-of-the-art layout with a neutron-guide system that has allowed the establishment of a suite of neutron instrumentation in an adjacent building to the reactor. This research-reactor concept was designed with the possibility to add more guides and instrumentation. Due to this design, ANSTO was ready to make use of this new investment and build more neutron-beam instruments. There was significant experience available to build more instruments, as the first suite of instrumentation became recently operational (in the course of 2007 and 2008). We will not go into more details on this, as instrument construction in itself relates essentially to project management and not research, but it should be pointed out that the government closely monitors the progress as there is the incentive of spending the allocated funding within a 4-year period. Although there is no immediate output in science, new skills will emerge from this because ANSTO builds new instrumentation that has not been available before in Australia. This shows that large-scale infrastructure for research needs some strategic planning in order to drive innovation.

Strategic planning

In the long term, a new piece of infrastructure is built for new research, ultimately leading to new products, processes and possibly new markets. When talking about research, what springs to mind are the experimental results, and consequently publications – essentially the more immediate outcome. However, indicators of productivity might lag behind, because substantial projects take a few years before they provide research outputs (the construction of ANSTO's research reactor took about 5 years, not including the planning period); nevertheless, there could be some technological spin-offs during the construction period based on the new concepts and designs. Also, this demonstrates, when it comes to research, long-term planning is vital, especially when dealing with high-tech equipment, such as accelerators and reactors.

In Australia, as in most other countries, funding is allocated on a yearly (fiscal) basis, but has an underlying 5-year strategic plan. At present, the new 5-year plans are in preparation and are due in 2010 (note that Australia's financial year goes from 1 July to 30 June of the following year). At present, ANSTO is not only looking into its 5-year planning, but also its 15 to 20-year strategy. In view of the required 5-year strategy and with the arrival of a new chief executive officer (in March 2009), the opportunity arose to review ANSTO's situation and position in national and international contexts with respect to identifying challenges and opportunities ahead. The idea was to provide an internal forum that brainstorms and reassesses the organisation's activities using available studies that have looked in more detail into the future. There is plenty of information available, e.g. a study from the European Union on *the world in 2025* (EC 2009) and also the Organisation for Economic Co-operation and Development (OECD) provides reports tackling a variety of aspects (OECD 2009), e.g. 'education at a glance', to name a few.

For our discussions, we undertook 'scenario planning' that is well established in the private sector (e.g. Shell):

"There is no single, determinate future, instead, there are a thousand possible futures. Building scenarios is the process of sifting, sorting and combining these possibilities into a few stories. These stories must be relevant …, plausible …, consistent …, surprising… Scenarios thinking is an open, exploratory process." (Erasmus 1999).

We had a number of workshops discussing which areas are relevant and which would require a further analysis. The following areas were selected:

- Population and Health
- Geo-politics, society and culture
- Climate, environment and water
- Energy and resources
- Knowledge, skills and communication
- Economics
- Nuclear waste

Evidently, this list represents topics of concern to ANSTO. As Erasmus stated the discussions turned out to be a "process of creating new, distinct images that describe future worlds", but in addition it

"forces participants to create a new language that is adequate to the new situation" (Erasmus 2009).

Discussions took place in groups of 10-15, bringing together people with different backgrounds in the organisation. It was a beneficial experience demonstrating that face-to-face communication is really important. As dialogue was dependent on the mindset of participants the success of a meeting was not always straightforward - sometimes a narrow, problem-oriented approach could not be avoided. For a great number of people it was much easier to deal with the present and past, and thus not everybody was geared up to think about future scenarios. Despite these aspects, we can consider these debates an effective endeavour, especially in view that they brought people from across the whole organisation together into one room. Vasileiadou et al.'s study on use of email and meetings shows that face-to-face meetings contribute positively to all types of productivity (Vasileiadou 2009). Another positive effect is to provide the opportunity of finding a common language, interacting and even producing joint documents as Erasmus indicated (Erasmus 2009). One of the conclusions from the knowledge and skills group gave impetus to addressing knowledge management issues with respect to research output.

Knowledge management and metrics

The discussions showed that ANSTO lacks a fully developed knowledge management strategy. Access to data is not easily available and inconsistent across the organisation, including information on research output. This includes research publications as one of the standard indicators used in research management. ANSTO's research is essentially organised in institutes that cover the following scientific areas: environment and climate change, materials and engineering, neutron scattering, and radiopharmaceutical research. Some of the institutes might follow the academic university-model looking at output of publications in peer-reviewed journals and their impact factors, whereas others provide more services, working with industry, and therefore, have a different output with little or no publishing in the open literature. In addition, there are IP issues, for example patents, that need to be taken into account.

This is not an uncommon situation and from discussions with other institutions we know that it is a sensitive issue, especially when we come to comparing the various research fields and their impact. Apart from debates about impact factor, there are discussions how inclusive our collection of research output should be. Should a repository include conference talks and proceedings, powerpoint presentations, media articles and so forth? Consequently, there is also interest to produce different types of collection: overall; per institute; per subject area, etc. Clearly, a knowledge management tool is required that provides a number of functionalities; and it is important with respect to reviewing the impact of the organisation as a whole or in parts. Compatibility with standard bibliometric tools as used for peer-reviewed journals is an obvious further requirement.

As a research organisation ANSTO is not part of the higher-education institutions, and therefore, does not participate in the Australian Research Quality Framework. However, we are involved in research collaborations and ANSTO's scientists participate in the peer-review process as experts, and this provides a natural link to follow the national research framework. How good are bibliometric impact studies when compared to peer reviews is a question that can lead to animated discussions amongst scientists. Abramo et al. (Abramo 2009) present a survey in which they compare the results of Italy's triennial research evaluation with a bibliometric approach. Their study investigated the extent to which bibliometric methodology can complement and integrate peer review, especially in view of the fact that a bibliometric study is comparatively inexpensive, time-saving and detailed. They found that in natural sciences there was a significant overlap in the results of the two approaches. And as they pointed out this is not surprising:

"There is, after all, no reason to believe that an evaluation of an article's quality by two experts nominated as part of a national evaluation exercise would be better than the evaluation by international referees on behalf of the journal in which it is published and of the peers who then cite the article." (Abramo 2009).

Abramo et al. conclude that research productivity, both in quantitative and qualitative terms, can be measured by the bibliometric approach which results in significant cost and time savings compared with peer review. However, other research outputs, such as patents, proceedings, and so forth, and any other facets, including socio-economic impact of research activities, still require assessment by peer review. Neuhaus et al.'s study supports Abramo et al.'s statement on bibliometric studies, but emphasises that the frame of reference is important for research-performance assessment (Neuhaus 2010). They looked at average citation rates of research articles and found that

"citation habits differ considerably not only between fields, but also within fields" (Neuhaus 2010). Output of research groups at ETH Zurich, Switzerland, were compared using the Science Citation Index (SCI) and sections of Chemical Abstracts (CA). In over 20% of the cases the normalisation with SCI resulted in poorer rating than with CA. Their conclusion is that:

"bibliometric studies of research groups are useful but should be interpreted with great care." (Neuhaus 2010).

Our world is becoming full of metrics and the question arises as to whether we lose the overall picture by quantifying all of our output and by looking into too many details (Giridharadas 2009). Giridharadas cites Joseph Stiglitz, a Nobel Memorial Laureate in Economic Sciences,

"metrics are valuable tools but were in danger of squelching other ways of perceiving. In this world in which we are so centered on metrics, those things that are not measured get left off the agenda. You need metrics to fight a metric." (Giridharadas 2009).

To a large degree, metrics confirm the already known leaders in an established area, as opposed to leadership in new areas and emerging disciplines. For example, when we look at the league tables of higher-education institutions (ARWA 2009, THES 2009), we find more or less the same universities in the top in both ranking listings. However, going further down the list, we find much more variation. Rankings look into a defined field with little attempt to take into account the interdisciplinarity of science. Following a classification model leaves no room for latent classes, and subsequently this can lead to a methodological fallacy and circularity. Essentially, the mainstream approach gets manifested with metrics, but new ideas and novel, non-standard approaches might be left unrecognised, and hence, we might lose out on identifying innovative thinking. Nowotony et al. (Nowotony 2002) extend this observation and state that knowledge production is no longer this simple and that nowadays knowledge needs to be put in context of the knowledge society:

"Contextualization means that (unknowable) implications as well as the (planned or predictable) applications of scientific research have to be embraced. … Contextualization which contains, or is accompanied by, such a 'human element' is more likely to take subjective experience seriously. … Universities will need to be adaptable organizations (and comprehensive institutions?) rather than specialized organizations (or niche players?)".

Although ANSTO is not a university, our research output makes us a player in knowledge production. Clearly, we need some metrics in order to get some measures of our output. Therefore a knowledge-management system is a pivotal point in assessing performance, but it can only help to a certain extent. It plays a supporting role in an evaluation as part of a peer review.

ANSTO has quadrennial reviews of its institutes, essentially one of the institutes will be scrutinised each year. The review board includes national and international scientists from the research/technology areas that are assessed. In practical terms, the review-board members receive information in advance; then they spend several days at ANSTO meeting and discussing with the scientists concerned before they write their report with their evaluation, including recommendations to the chief executive officer. The first such review has only recently taken place, and therefore this paper cannot provide any further information about its performance and effectiveness.

Our discussion on metrics and subsequently reviews shows that ANSTO wants to know where it stands, and especially our funding bodies are interested whether their investment represents adequate value. Clearly, it will be useful to find institutions that operate in a similar context as ANSTO. Brandenburg (Brandenburg 2006) says

"benchmarking is a deliberately self-focused activity of higher-education institutions with the final goal of improving their own performance in defined fields". Although ANSTO is not a higher-education institution there are a number of parallels to research institutes as we could see earlier. Considering the Paul-Scherrer Institute (PSI) in Switzerland as a benchmark seems to be a reasonable choice, as it is an institution that operates in a similar context to ANSTO.

Benchmarking – comparison with Paul Scherrer Institut (PSI)

Why PSI? Like ANSTO, PSI is part of a federal system, called the ETH Domain (ETH – Eidgenössische Technische Hochschulen), together with the other members being the two Swiss Federal Institutes of Technology (technical universities), ETH Zurich and EPFL Lausanne, and three other research institutes (PSI 2008). A management board, the ETH Board, has the mandate to implement science policy and allocate funding set out by the federal council and federal parliament following a 4-year strategic plan.

Compared to PSI, ANSTO is more directly linked to the federal government (frequently called the Commonwealth) as it is part of DIISR, and there is an ANSTO Board that oversees ANSTO's development. DIISR looks after a number of other institutions, including the Commonwealth Scientific Industrial Research Organisation (CSIRO), which is with over 6,500 staff Australia's largest research institute. Apart from CSIRO and ANSTO, the DIISR's web site (DIISR 2010) refers to over 15 other portfolios. DIISR has no direct link to higher-education institutions as in the Swiss federal structure, but DIISR holds the portfolio of the Australian Research Council that provides research funding to higher-education institutions.

Federally funded research organisations run unique facilities as we can see not only in Australia, but also in Switzerland. Nevertheless, there might be different underlying approaches to the operation of the two institutions, and thus, as pointed out by Nowotony et al. (Nowotony 2002), their contextual setting has to be considered. PSI's focus is more on fundamental science with strong partnerships with universities for education and training, whereas ANSTO's role is much more directed towards providing expertise in nuclear techniques to the government. With its unique role in a country that also has high resources in uranium there are many policy implications on an international and also regional scale in the Asia-Pacific area that need to be considered. ANSTO is therefore regularly consulted on a number of policy issues concerning nuclear technologies and naturally has staff following up on these specific points of interest. This aspect should not be neglected when we compare ANSTO and PSI.

	ANSTO	**PSI**
	in 2009	*in 2008*
Funding body	DIISR - federal	ETH Board - federal
Foundation	established by the ANSTO Act in 1987	established in 1988 - merger of the Swiss Institute for Nuclear Research and the Federal Institute for Reactor Research
Budget	216 Mill. AUD (76% federal)	300 Mill. CHF (80% federal) (1 CHF is about 1.1 AUD)
Facilities	Neutron source (research reactor), accelerators, cyclotron	Neutron source (steady-state spallation source, synchrotron, accelerator for proton therapy
Measuring stations (on	10	40

large-scale facilities)		
Total staff	985	1,300
Female	27.8%	22.3%
Employee type		
Research	*23.2%*	*33%*
Technical & engineering	*52.1%*	*53.3%*
Employment programme	*4.7%*	
Administration	*20%*	*6.7%*
Information technology		*7%*
Postgraduate students	29	300
Scientists lecturing at universities	15	80
Publications	229	950
Users	370 (in over 1,300 visits)	Over 2,000
Country population in 2008	21.4 Mill. Australians	7.6 Mill. Swiss

Table 2: Facts and figures for ANSTO (ANSTO-highlights 2010) and PSI (PSI 2008).

In staff numbers, ANSTO has about ¾ of PSI with a slightly higher proportion of female staff, but in contrast PSI has 10% more researchers than ANSTO. This can be understood from the Swiss overall investment into science. Although Switzerland has only $^{1}/_{3}$ of Australia's population it invests almost $^{2}/_{3}$ more into research: in Australia 0.46% of the Gross Domestic Product (GDP) were government appropriations for research and development in 2008, whereas in Switzerland they were 0.72% of the GDP (OECD-Figures 2009). We find again similarities between the two institutions in terms of instrumentation as both institutes have a neutron source and accelerators; PSI has in addition a synchrotron light source, a muon source and an accelerator for proton therapy; these are the only such facilities within Switzerland. This displays a rather comparable picture to ANSTO with its nuclear uniqueness in Australia and also with regards to the overlap in research areas (see Table 3):

PSI	**ANSTO**
Energy and Environment	Environmental research
Structure of Matter	Neutron scattering
Health	Materials engineering
	Radiopharmaceutical research

Table 3: Research areas at PSI (PSI 2008) and ANSTO (ANSTO 2009).

With its higher number of researchers (about twice as many), it is not surprising to find that PSI has a much higher publication output (Table 2) than ANSTO, but the difference is higher than you would anticipate. There is an additional aspect that should be taken into account: although ANSTO has similar facilities to PSI there are much fewer instruments available at present, as the neutron-beam instruments have just became operational. In addition, ANSTO has much fewer measuring stations with about 10 compared to 40 at PSI. The availability of fewer instruments, and consequently fewer users, certainly accounts for a much smaller number of publications. As ANSTO is building-up its facilities, PSI is more or less at steady state with the PSI neutron, muon and synchrotron light-source facilities fully operational.

A more significant difference is that PSI has almost 10 times more students than ANSTO and many more scientists lecture at universities. We might consider that this is due to ANSTO's local situation; however PSI's distance to Zurich's universities is similar to ANSTO's with respect to Sydney. The major difference is the readily availability of good public transport in Switzerland compared to Australia. Is it that PSI's embedding into the ETH domain makes it easier to link to ETH Zurich? Without doubt, ETH Zurich is its main partner, but markedly, PSI puts significant efforts into education and training. PSI indicates that mainly joint projects with universities and industry form the underlying support of this successful talent and skill development (PSI 2008). ANSTO has recognised its weakness in education and is currently intensifying its relationships with universities with respect to education and training. However, Australia has a somewhat unique arrangement with respect to nuclear education and training. About 50 years ago, it set up the Australian Institute of Nuclear Science and Engineering (AINSE) that facilitates access to the special facilities at ANSTO by universities and other tertiary institutions (AINSE 2010). Comprising about 40 member institutions in Australia and New Zealand, AINSE arranges for training of researchers and also awards studentships. Thus, AINSE is ANSTO's primary partnership.

Research collaborations

Our benchmark with PSI shows that it is important for ANSTO to invest into collaborations in order to foster talent and to increase the number of skilled researchers. We find that universities set up international alliances in order to counterbalance the increasing competition in higher education: they learn from each other, share expertise and experience and through this, each individual institution develops and learns about the differences in culture and functioning of its partners and consequently, creates new synergies (Büttner 2005). This incentive is also recognised by the Australian government that sets international collaborations as one of its priorities (Carr 2009) in order to stimulate research and boost innovation. ANSTO has just recently renewed its cooperation agreement with the Commissariat a l'Energie Atomique (CEA) in France for ten years, and is fostering more collaborations negotiating with other centres in Asia, Europe and the USA.

Apart from strategic collaborations with institutions, there is the possibility of using merit-based access models as a vehicle to encourage collaborations – a rather standard practice in the case of large-scale facilities, because it provides a more open process of developing collaborations. It is a world-wide approach although each institution has a slightly different set up. Whereas PSI has a number of committees for different subject areas whose members meet to assess the applications, in the USA, the large-scale facilities, for example the NIST Center for Neutron Research (NIST 2010), tend to have an online review. These on-line reviews are then evaluated by a single committee that meets and assesses who should get beam time. For ANSTO, the US model fits rather better as a basis of its neutron-beam assessment than the European model. It is not only the shorter distances in Europe compared to Australia that make meetings rather easy; it is mainly the density of neutron experts in Europe that facilities the model. Europe has over 4,000 users (McGreevy 2010), whereas Australia has more than ten times less. An on-line system thus makes much more sense, also in view of recruiting international experts for the reviewing.

It should be noted that the European user community comprises over 25 countries. The Swiss Neutron Scattering Society is small with 200 members (SGN 2009) compared to the Australian Neutron Beam User Group that counts over 330 members (ANBUG 2010), however, in terms of population size Australia should have about 600 members. In a way, Europe dominates the neutron-scattering scene, because there is a long-standing tradition that has developed a close network that is supported by the EU for the last five years. Only in 2008 was a network set up in the Asia-Pacific region with the foundation of the Asia Oceania Neutron Scattering Association (AONSA). Australia and ANSTO play a major part in this international development, because the IAEA (International Atomic Energy Agency) endorsed ANSTO as a Collaborating Centre for Neutron Scattering Applications. This is a significant asset for ANSTO in view of promoting neutron scattering and subsequently engaging in research collaborations including international linkages.

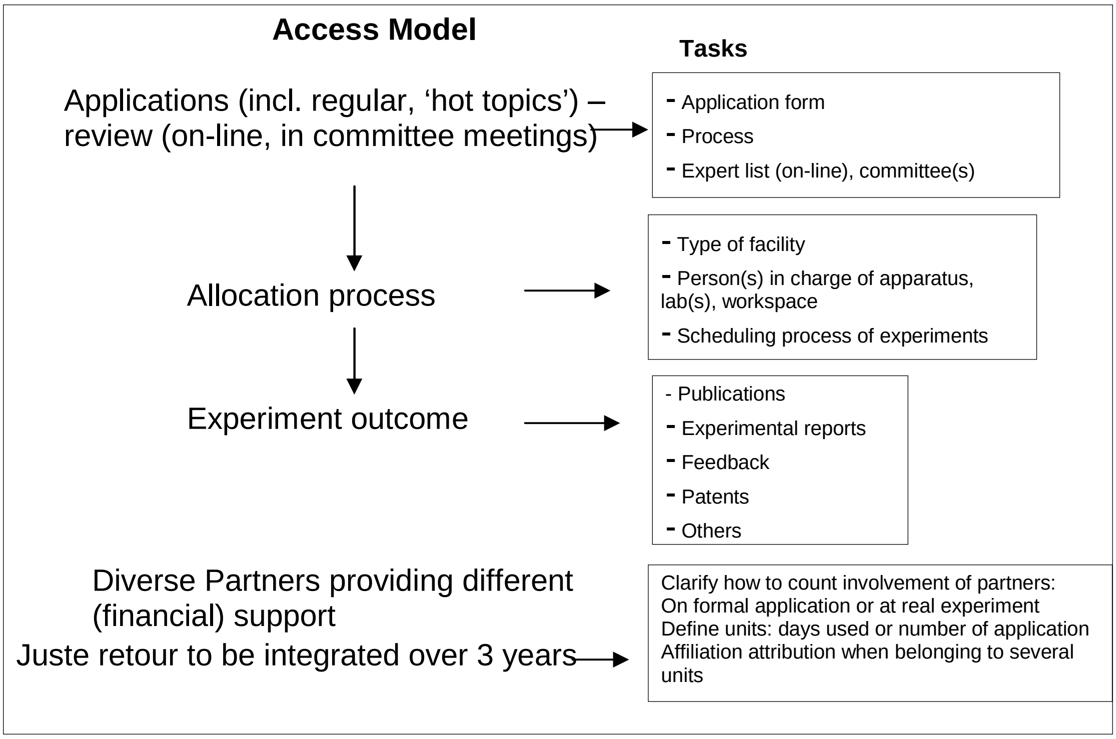

Figure 1: Example of a merit-based access model for use of facilities: Applications are assessed if the requested experiment will receive the required assets for being carried out. Fair return of experiments might be considered in case of involvement of different partners providing various contributions.

The use of a merit-based access model is a standard approach for large-scale facilities, including those operating neutron-scattering instrumentation. Figure 1 shows a general access model to facilities that uses a merit-based scheme. Our previous examples of neutron sources have a single owner of the facility, but with multiple funding, this model might be slightly different. Actually, for internationally operational institutions with large-scale facilities (e.g. the European Synchrotron Radiation Facility – ESRF, CERN – European Organisation for Nuclear Research) it is rather standard to have different contributors who look for a fair return of their input, called 'juste retour' in the figure. In any model with several partners, national or international, it is worthwhile to discuss the benefits for each partner at an early stage. In view of broadening its collaborations, ANSTO considers various models and looks into setting up the necessary functionalities (see tasks on right side of Figure 1). Access to facilities is an important issue because it links with the scientific world outside the institution by providing a transparent mechanism, how collaborations are chosen. In addition, it provides an opportunity to be responsive to the needs of the determining community. In general, there are applications followed by a review and allocation of time. At an early stage it should also be made clear to applicants what is expected before and after the experiment. Essentially, there are a number of tasks that need to be worked out in detail depending on the particular set-up available and agreements made between investing partners.

In the case of ANSTO with facilities unique in the country, a good access model not only allows for developing closer links to partners, but also fosters the growth of the community. With this view in mind, ANSTO decided to introduce merit-based access to the recently created 'ANSTO Life Sciences' and their facilities. This new research centre consists of four groups, i.e. radioisotopes & cyclotrons, research & innovation, molecular imaging and integrative biology, replacing the Radiopharmaceutical Research Institute. A major reason for this change has also been the evidence that smaller research groups are more creative in research (Heinze 2009). Heinze et al. also point out that organisational restructuring looking for scientific diversity should go hand-in-hand with reviewing spatial arrangements to enrich the creativity (Heinze 2009). Further, they found that social arrangements, e.g. lunch and coffee-taking patterns, play an important role, especially in fostering communication opportunities across departmental boundaries. In addition, extramural collaborations have a much greater benefit for scientific progress than was previously assumed. Heinze et al. conclude in their paper:

" The size of research groups should be considered an important management objective for effective research governance… large groups and hierarchical structures are barriers for creative research... scientific research activity has been confronted with a high level of distrust, and this distrust is visible in the widespread use of performance indicators …" (Heinze 2009).

In a way, this reflects our earlier discussion on publications and peer review: any performance system needs to be looked at in context; straight numbers are not the ultimate goal. Heinze et al. recommend teams of about 6 members. They emphasise that recruitment and leadership play another important role in establishing creative research groups. This falls in line with Goodall who studied how different leaders affect a university's performance (Goodall 2009). Goodall shows that a university's research performance improves if, a number of years earlier, an accomplished scholar has been hired as president. There are four arguments for having a noted scholar as leader: more credibility as a leader; more expert knowledge provides a deeper understanding of the core business; establishment of a quality threshold; and signalling of an institution's priorities internally and externally to potential new recruits, as well as donors and media.

Discussion and Perspective

Innovation in research was at the onset of our discussion. For organisations like ANSTO with high-tech equipment, there is a clear incentive to undertake long-term activities even though (research) output might not appear to be of immediate scientific productivity. Despite similar structures in place at ANSTO and PSI, we find contextual differences leading to rather different trajectories of the organisations. With its focus on fundamental science, PSI has strong partnerships with universities for training, and hence creation of new skills and new opportunities. Due to the Australian situation, ANSTO has an important role as policy advisor in providing expertise in nuclear techniques, and therefore research productivity increases in a smaller degree. Moreover, ANSTO is at a point where it is building new instrumental capacity, and consequently, it currently lags in its research output.

Increasingly, ANSTO is taking steps to stimulate more creativity in research. Recently, one of the institutes was restructured into smaller research groups. This concept of ANSTO Life Sciences is a step towards creating more diversity, as it also looks into access models with a view to engaging in more collaborations not only externally, but also internally. Gigerenzer points out that people adapt to their environment and therefore not only the brain and mind, but also the structures of the physical and social environment have influence on our behaviour (Gigerenzer 2007). He explains that we all develop our personal rules of thumb, often unconsciously evolved to make quick decisions. These rules get absorbed into the organisation and may linger after the leader has moved on. Also Goodall (Goodall 2009) illustrates the effect of leadership on the performance of an organization: scholarly led institutions establish a quality threshold and have a signalling effect internally and externally enhancing the significance of their institution beyond scholarly values. Gigerenzer suggests using rules of thumb to create new patterns as

"the spirit of an organization is a mirror of the environment the leader creates" (Gigerenzer 2007). In his view, the successful performance of an interdisciplinary research group depends on the creation of an environment that supports this goal. Like most ordinary people, researchers tend to identify with their ingroup and thus historically grown disciplinary borders are most likely to hinder progress. He suggests coming up with a set of rules that is acted upon, but not verbalised, when setting up new groups. In his case, this included close spatial arrangements, simultaneous recruitments (if possible), daily social gatherings, shared success and open doors (Gigerenzer 2007). The study by Heinze et al. (Heinze 2009) found a similar pattern for successful groups.

The broader literature shows that a more holistic approach is required to stimulate creativity and thus innovation. For ANSTO, this raises the issue of looking towards a more academic culture. While the restructuring of an institute is a rather big undertaking there are less drastic actions that can be beneficial in achieving the overall goal. As a result, we have created a young researcher club, consisting of postdocs, PhD students and young researcher newcomers, that meets once a month. This is not only about learning about the others' research, but it also provides the opportunity to get to know each other, and share of experiences. In addition, we have introduced the ANSTO Distinguished Lecture series with speakers of international standing that address subjects of scientific and societal importance for the general public. The lectures are well attended – but it is particularly gratifying to see that they provide an opportunity for staff to attend a work function jointly with family members.

"Cultures consist of the shared cognitive and material items that forge a group's identity and ensure its survival. Culture is created, shared and transmitted through communication", say Nixon and Dawson (Nixon and Dawson 2002). One of our targets should be a recreation of the ANSTO culture.

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