



Evaluation and recommendation of approaches to foster interdisciplinary research at Aarhus University

Introduction

Aarhus University invited an international review panel of three researchers with experience in the field of interdisciplinary research to evaluate the approach of establishing interdisciplinary research collaboration in order to identify good practices and to present recommendations on how to encourage future interdisciplinary collaboration at Aarhus University.

Interdisciplinary Research Centres (IRCs) is an internal funding scheme of Aarhus University (AU) targeted at the development of international competitive research centres driven by collaboration between at least two of the university's faculties: Arts, Health, Science and Technology and Aarhus School of Business and Social Sciences. Five centres were established in 2012 and received funding for a period of five years until the end of 2016.

The IRCs were assessed through an internal midterm evaluation in 2015 by the university's committee for research and external collaboration on the basis of the first two annual reports for 2012 and 2013.

The overall purpose of this review was to evaluate the approach of establishing interdisciplinary collaboration in order to identify good practice and to present recommendations on how to stimulate more interdisciplinary collaboration at Aarhus University. The assessment was intended to build on the approach taken by the five centres, but not to evaluate the individual performance of each centre.

Approach

The review panel visited Aarhus University for a two-day meeting (23-24 February 2017).

Prior to the visit the evaluators had received the following documents:

- the call text for establishing interdisciplinary research centres at Aarhus University
- applications for establishing the centres in 2012
- international reviews of the applications
- annual reports from the centres
- midterm evaluations of the centres

During the visit, panel members met heads of the interdisciplinary centres, some other centre members and members of the university senior management team. Each centre director gave a short presentation that addressed:

- bullet points of the centre’s mission/goals, and an update on activities and results achieved towards each of these goals
- a brief report on the main challenges encountered with the interdisciplinary approach. (What tools and methods did you use to address these challenges and to strengthen the interdisciplinary approach. What has worked well? What didn’t work? What kind of barriers, if any, have prevented you from realizing the full interdisciplinary potential? How did the interdisciplinary investment allowed them to realise that they could not have achieved in any other way?)
- an explanation of how the interdisciplinary projects have been embedded in the organisation to ensure long-term sustainability

This was followed by approximately an hour-long discussion with the panel.

At the end of the two-day meeting, the panel gave a short oral presentation of their findings to centre directors and senior management.

General Observations

The definitions of “interdisciplinary research (IDR)” or “interdisciplinarity” are many, varied and contested. For the purposes of this review, it is reasonable to adopt the following definition of the US National Academies of Science but this definitional aspect was not something that the review panel debated to any great extent:

“Interdisciplinary research (IDR) is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.” (National Academy of Sciences et al. 2005: 188)

The panel was clear that interdisciplinary research should be motivated by a purpose and not be an end in itself. However, the panel found that the purpose for funding the IRCs was not well elaborated at the start of the funding initiative.

Two common purposes for such interdisciplinary funding initiatives are (i) to develop breakthrough research or (ii) to address “real world” problems (“the world has problems, but universities have departments” Brewer 1999, p. 328). A clearer specification of the purpose(s) of the funding initiative would have helped to clarify each centre’s strategy both for their own research agendas as well as for future funding sources to ensure sustainability. In the case of problem solving research, the involvement of actors from outside academia (“transdisciplinarity”) becomes as relevant as the interdisciplinary collaboration.

The challenges of IDR are well documented in the literature, not least because the majority of world-leading, research-intensive universities are still organised along disciplinary lines. This means that academic identities, as well as reward and recognition systems, are irrefutably discipline focused.

The IRC initiative provided internal university funds to support interdisciplinarity that is rarely seen, thereby creating a space to explore the potential richness of both interdisciplinary research and teaching. This resulted in a number of very enthusiastic scholars who were either able to develop further their capabilities, or learn for the first time about the innovative power of IDR during the

centres' lifetime. The goal of this review is to help ensure that this expanded capacity does not disappear now that the funding has finished.

Recommendations

Best practices and recommendations on how to encourage and motivate researchers across research areas to engage in interdisciplinary collaboration

Strengths

Leading faculty have realised that collaboration between disciplines can lead to greater discovery and this has been a great driver. The IRC initiative has provided the opportunity to build new collaborations and hence, new areas of research within the university. A nucleus of faculty leaders has assembled other investigators and practised an inclusive process of identifying areas of targeted research; forming road maps with long term projections leads to success; forming partnerships with other schools is a booster; seed funding is an important enabler of undertaking high risk-high reward projects.

The centres have enabled investigators, who otherwise will not connect, to collaborate and develop new projects, yet, we heard from some centre directors that the first 1-2 years were devoted to drafting directions and less to pursuing collaborative projects (while budget is not carried over). Thus, the process of creating new centres *in the future* might need to be revisited, such as starting with a pre-phase of funding to develop initial networks used for meetings/brain storming, seminars, workshops and then compete for a centre status and funding.

Some of the centres have developed shared research questions and a shared language over the first years of the project, besides the other duties they had to fulfil. It is well known that intensive discussions are needed to thoroughly understand a different discipline's approach to research and to see how approaches can be combined. Seed money just for collectively developing an ID proposal (cost for networking, meetings and doing the synthesis work) could help with that problem-framing phase. If the research intention is more applied problem solving, then further societal actors would also have to be involved in that process.

Areas for further development

Future such funding initiatives should ensure clarity of purpose. Some of the people to whom we spoke seemed unclear about what the expectations were: was sustainability required from the outset or was this introduced later, others had an expectation that funding would continue beyond five years. Overall, it was less clear whether the goal of IRCs was to build a new research culture at AU or to develop sustainable research. Senior management could have been clearer about what success would look like or - better - asked applicants to define what success would look like in their own research context.

A further learning point when discussing motivations for ID collaboration is to remember that IDR should not seek to encompass "everything": having a strong research focus can be key to success.

As we discuss below, encouraging and motivating IDR within institutions also requires a "whole institution approach". That is not to say that the entire institution has to become interdisciplinary, but that there has to be commitment to such initiatives throughout the management structure.

Best practices and recommendations on the management qualifications and the appropriate organisation of interdisciplinary research centres

Strengths

A cohort of research leaders and university managers has now learned from this experience and can go on to apply this learning in different institutional settings and future projects. This learning can be augmented by significant literature and other resources, some of which are detailed at the end of the report.

Areas for further development

- What is the best model for leadership - a single leader, co-leaders or a leadership group? If we “practice what we preach” in an interdisciplinary centre does this need to be reflected in shared leadership? Centres co-led by investigators from two disciplines who have expertise in IDR seems to be beneficial (or an investigator with expertise in two fields). How feasible is this within current university structures?
- “Philanthropy-dedicated leadership” is key to success. Some faculty leaders seem discouraged by uncompensated effort dedicated to building the interdisciplinary centre
- Having a Management or Advisory Board with external members although useful, varied among centres
- We heard about budgetary issues and the challenges of annual funding cycles. For new interdisciplinary centres it can take time to establish, for example recruitment may take longer than anticipated. This may call for a different funding profile
- Experience tells us that it takes time to establish new interdisciplinary initiatives and to then achieve outputs that are truly interdisciplinary. A five-year timescale is quite optimistic.
- This initiative did not seem to be supported with money for buyouts: “The Pro deans were supportive except when we needed to talk money”
- Co-location of staff within the same or adjacent buildings is desirable for community building; physical space is particularly important when building ID collaborations “IDR requires a lot of hanging out”
- A strong commitment from all schools is needed. Our discussions point to a gap in the middle tier of university management: while the senior management wishes to support IDR, some deans were seen as less supportive
- Cross-institutional ID centres require universities to rethink how they manage their finances e.g. should budgets or overheads be shared between schools, how can schools be compensated if they lose teaching resources. This is a particular concern when colleagues seek to share PhD students across schools (see also below)
- IDR is well known to be the first aspect of university research to be cut when budgets are restricted

- IDR projects can often be enabled by e.g. a centre manager, a data manager, a communications specialist or focused teams such as Education. Some types of research also require particular types of technical support. Many external project grants will not fund such positions
- Consider the benefits of formal workshops on building leadership skills for ID research leaders

Recommendations on activities that stimulate interdisciplinary collaboration and create synergetic benefits and scientific added value

Strengths

As described above, the main motivation is typically to develop a new area of research that crosses disciplines. Activities such as seminars and summer schools fostered exchange and development of ID project ideas and seed funding to launch projects was a useful instrument for building networks of researchers across faculties within the centres. In some cases, collaboration between centres triggered real interdisciplinarity and the development of projects that bridged disciplinary paradigms although this was limited by the funding timescale.

Areas for further development

- A peer support network among Centre directors may have accelerated developments and led to a better shared understanding of, for example, appropriate agreed metrics
- More generally, centre members could have been facilitated to exchange experiences and learn from each other about how to navigate ID challenges: even if working on different topics, they were using the same 'method' (interdisciplinarity) and encountered the same challenges (e.g. common language after 3 years, publishing together, etc.). Such exchanges would have helped to see how others solved a similar ID problem and encouraged shared, organisational learning
- Getting the right balance between "organic growth" of interdisciplinary research and overt management is challenging: IDR cannot be forced and the panel was told "sometimes the process of negotiating a shared research agenda can feel like a compromise". Again, this points to the extra time required to form new, genuinely interdisciplinary collaborations
- Connect more to literature/experiences on interdisciplinary research. Most centres were not familiar with the literature on the theory and practice of interdisciplinary research and the Science of Team Science. Reading some of that literature, inviting speakers or including reviewers with such expertise could have helped to handle well-known challenges of interdisciplinarity. Such self-reflection could also have helped to see where the interdisciplinary approaches developed at Aarhus could have been shared with the wider research community in order to inform the practice of IDR internationally
- Tools and methods: Several toolboxes and guidelines exist on how to deal with the typical challenges of ID research and teaching. Using these guidelines could have accelerated the ID learning process that members of the centres experienced, potentially making them more productive sooner

Best practices and recommendations on how to ensure that interdisciplinary collaboration contributes to education, talent development and knowledge exchange

Strengths

An impressive number of courses at all levels were created and an impressive number of young researchers were moved forward in their career.

Areas for further development

- The training of interdisciplinary PhD students at Aarhus needs to be rethought. Current institutional structures present a barrier to ID PhDs as there is not currently the possibility to be registered with two graduate schools. PhD students still affiliate with their department rather than an interdisciplinary Centre; supervision across faculties was problematic; barriers between faculties with respect to internal PhD grants; no free flow of internal fellowship grants across faculties
- If we are going to encourage ID PhDs then it is incumbent upon institutions to ensure that there is a career track available for them (postdocs, tenured positions)
- The goals for interdisciplinary education were unclear and starting up courses across faculties is complex (see Lyall et al., 2015)

Recommendations on how to measure the success of interdisciplinary research centres in terms of e.g. impact, citations, publications and external funding

Strengths

The following characteristics have been variably identified in different centres: joint outreach; generate new innovative knowledge; interdisciplinary publications (recorded as co-authored by two disciplines or more compared to one discipline); multidisciplinary teaching (new courses and educational programs); Degree of collaboration (social network analysis); international partnership

Areas for further development

- Definition of ID as also pertinent to outcomes: There was no clear definition of ID and of a centre's goals for achievable milestones. Consequently, metrics specific to ID achievements were lacking
- Some deviation from traditional metrics is often required in the case of IDR centers, not least because significant milestone publications can come later if time is being devoted to building a new ID centre (see Hall et al. 2012). Other IDR entities have resorted to careful monitoring of publications, grants, abstracts etc. that are co-authored by at least two disciplines on a topic directly relevant to the research area on which the center is focused, compared to such metrics authored by individually led labs/groups in the center (see Ravid et al., 2013)
- At university level, there is need for defining at the start an agreed set of expectations across all centres to be able to carry out individual and comparative evaluations (when budget is tight), with flexibility to add/subtract expectations (incl. less tangible ones, such as mentoring junior faculty), depending on the centre

- When judging new ID proposals, additional, appropriate criteria are needed: projects could be asked to explain what they mean by ID; what problem they wanted to address and why their combination of disciplines was the right way to do so; what they wanted to integrate and what method/approach to integration they sought to use; and how will they measure outcomes
- The challenges of raising external funding for IDR are well documented. Sometimes you need to be quite creative in “repackaging” research to make it more attractive to funders. Having the safety net of the IRC grant has facilitated this (see Coleman D. et al. 2013)

Recommendations on how to ensure long-term sustainability of interdisciplinary research collaboration

Strengths

The centres have attracted an impressive amount of external funding.

Infrastructure would have been difficult to fund without AU funding.

Clear direction related to the process of fostering collaborations and research project development; Bottom up approach concerning project initiation, and selection pending review by a qualified advisory board within the centre; a process that allows ideas to be exchanged and considered among faculty.

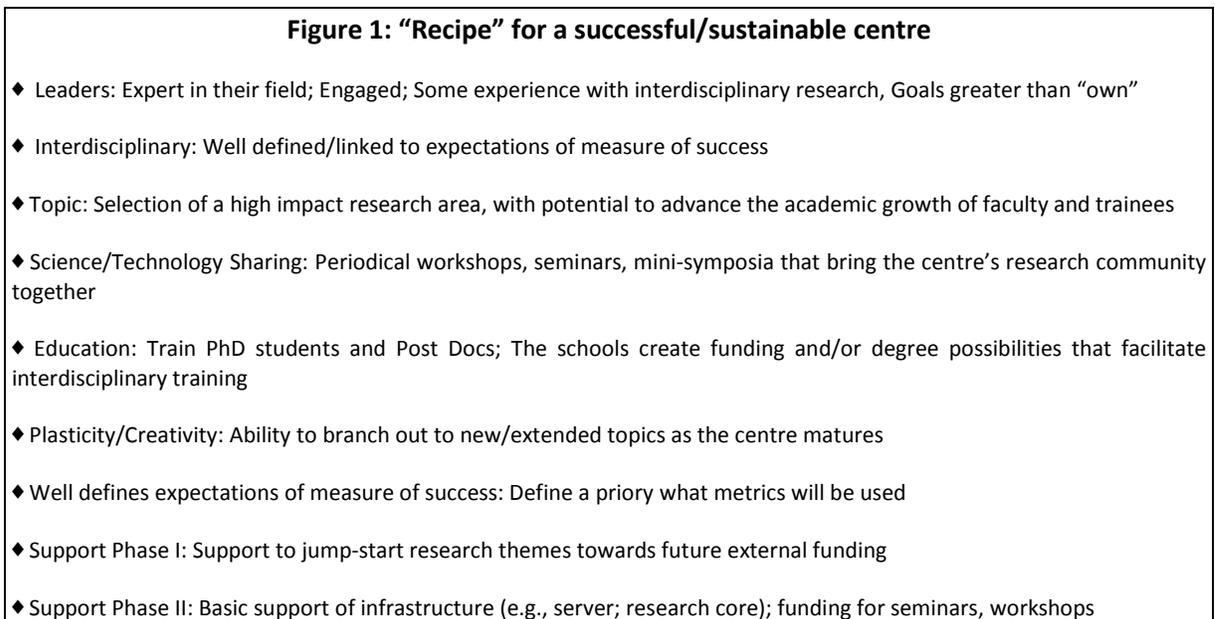
A key outcome of this initiative is a group of researchers who know they can work together in future. So the most important outcomes might be the learning that this funding has enabled and the development of longer lasting networks. The IRC grants allowed for reflection on what it means to do IDR and provided spaces for more open discussions: “the money opened doors and strengthened our negotiating position with institutions”.

Areas for further development

- Clear expectation: It was not clear whether there would be funding for the centres after the five years. Clarifying the expectation would have been a necessary condition for the centres to set priorities; Continued yearly support that is contingent upon yearly review/scoring by a panel of investigators should be aligned with expectations
- Funding ID projects: It does not seem to be easy to get funding for jump starting ID projects. Could the university in a next phase allocate money to fund collaborative projects? Such funding might take the form of PhD grants that are ID; scoping studies for postdocs who can then bid for own grants; seed money to support seminars and workshops which are important for cohesion; funding for other forms of infrastructure that is difficult to raise externally
- Consider a different process of establishing a centre to ensure sustainability: Start with funding selected pre-centres in form of Interdisciplinary Networks, and further select from these the most promising/successful ones (well defined expectations) for future centre development (“we spent most of the first year figuring out what we wanted to focus on, and could not carry over money allocated for the first year”)

- Increase capability for interdisciplinary networking: Consider creating a university-wide, managed/updated Investigators' Profiles (updated publications, grant support, key words of expertise) as means of identifying other experts/collaborators
- Leadership across centres might ensure long-term sustainability: Consider appointing a faculty member (part time activity of one of the center's leaders or such) as leader of an Interdisciplinary office to oversee reviews of all centres, performance, help with new initiatives, etc.
- Consider centralizing centres' funding through the university rector and/or deans, to avoid uneven, somewhat changeable distribution of resources
- External funding to support sustainable research beyond the five years granting period; some university funding to support seminars, workshops, and in some cases also an Infrastructure (e.g., Server, Instrument) that are not typically funded by external grants
- Seek other sustainable sources of support: encourage centres to build partnerships with Pharma and industry as source of funding and greater discovery; Consider using expertise (e.g., technology, service) developed within a centre to develop a university research core services as an income source
- Centres may act as a gateway for international scholars and staff new to AU to establish themselves by enabling them to build connections. Existing staff may be facilitated to work with such centres then return to their department while bringing back something extra. However, if such positions are tied to teaching this will drive people back to disciplines
- IDR by its very nature develops, evolves, perhaps even fades away, so consider whether "sustainability" is always the goal

A "recipe" for sustainability is presented in Figure 1 and summarised below:



Summary of recommendations

- Research:
 - Clear vision of what interdisciplinary entails for your centre
 - Plasticity- branch out to new/extended topics as the centres develop
 - Consider creating a university-wide, managed (and updated) Investigators' Profiles (updated publications, grant support, key words of expertise) as means of identifying other experts/collaborators)
 - Continued support on a yearly basis is contingent upon yearly review and scoring by a panel of investigators
- Education
 - PhD grant support (or a programme) that crosses barriers/faculty is important for the mission of an interdisciplinary centre
- Administration
 - Consider appointing a faculty member (part time) as leader of an Interdisciplinary office to oversee reviews of all centres, performance, help with new initiatives, etc.
 - Centre funding centralised via the university rector and/or deans, to avoid uneven, somewhat changeable distribution of resources
- Resources
 - External funding to support research; some university funding to support seminars, workshops, and in some cases also an Infrastructure (e.g., Server, Instrument) that are not typically funded by external grants
 - Efforts towards partnership with Pharma and industry as source of funding and greater discovery
 - Consider using expertise (e.g., technology, service) developed within a centre to develop a university research cores service as an income source;

Conclusions

The five IRCs have been an ambitious and worthwhile experiment but one that is unlikely to be repeated within the current funding climate at AU. Their legacy has been a wealth of experience in the conduct and management of interdisciplinary research. They have trained and nurtured young talent in the form of PhD students and postdocs who will now continue their career, either as interdisciplinary researchers, or as researchers within more focused single disciplines but bringing with them a greater understanding and appreciation of an interdisciplinary approach. At more senior levels, AU now has a cadre of research leaders who have the skills and experience to mentor colleagues who follow this research route in future. AU is now well positioned to respond to interdisciplinary calls in the international funding arena, such as Horizon2020.

In order to maintain the momentum generated by the IRCs, AU is now funding a series of interdisciplinary networks, as well as select IRCs. The networks provide a potentially more flexible funding instrument and AU should remain responsive to their development should, for example, additional pump priming funds be required to facilitate the growth of some of these initiatives into larger entities/centres supported by the university and/or external grants. Such support could include grants for pilot projects within a centre, professional services to scout funding opportunities and support in grant writing/application, considering the low funding rate and need for repeated grant applications, and professional development through invited seminars and workshops.

As an institution seeking to build an interdisciplinary future, AU should continue to find ways to:

- share among centre and faculty leaders experiences, intelligence and resources in order to foster organisational learning and high impact discovery
- address the administrative barriers and disincentives, internally and more broadly within the research policy and funding community
- encourage contributions to the evaluation of interdisciplinary research (peer review of journals, grant proposals, etc.)
- provide training, mentoring and institutional support for ID researchers, teachers and leaders

Resources and references

Interdisciplinary Wiki (including ten Short Guides to Interdisciplinarity) <http://tinyurl.com/idwiki>

Network for Transdisciplinary Research (td-net) Toolbox for Co-producing Knowledge http://www.naturalsciences.ch/topics/co-producing_knowledge

Team Science Toolkit <https://www.teamsciencetoolkit.cancer.gov/Public/Home.aspx>

Ten Key Readings about Interdisciplinarity https://i2insights.org/2016/10/25/interdisciplinarity-readings/#english-version_vienni

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