Identifying, Evaluating, and Catalyzing Clusters of Research Excellence

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Abstract

Over the last decade, a wealth of empirical evidence has accumulated describing the merits of team-based, collaborative, and interdisciplinary research, including: increased productivity among researchers, greater citation impact, increased multi-sector engagement, and the generation of novel solutions to grand challenges. Funding agencies have accordingly increased the frequency of large-scale collaborative and partnered grant opportunities. However, institutional structures and processes can inadvertently limit team-based interdisciplinary research at universities. Research Clusters [which we define as interdisciplinary networks of researchers who organize to solve key challenges facing society], provide a flexible and adaptable mechanism to enable collaborative research across Faculties and Departments. Versions of research clusters are now commonly a central theme in institutional research strategic plans, but there remain very few resources available to research administrators and leadership to support the development of their internal strategies and processes to support research clusters. Here, we develop a framework for identifying, evaluating, and catalyzing clusters of research excellence and provide specific examples of internal processes and analytical tools that we have developed and implemented to catalyze clusters of research excellence at the institutional level.

Background & Objectives

Interdisciplinary collaboration among researchers generally increases productivity, generates higher impact work (Wutchy et al., 2007), and results in the training of more collaborative researchers (Hampton & Parker, 2011). In light of the mounting evidence of the benefits of collaborative research (e.g., Adler & Stewart, 2010; Beaver, 2004; Jones et al., 2008; Lee & Bozeman, 2009), it is not surprising that collaboration is increasing across all research disciplines (Jones et al., 2008; Wutchy et al., 2007).

Funding agencies and programs are following suit: because research clusters and teams generate high-impact knowledge and research that contribute to solving big open questions, the last 5-10 years has seen an accelerating increase in big-ticket research opportunities for team-science. Canadian examples include: Canada First Research Excellence Fund [$1.25B since 2012 (CFREF, 2017)], Networks of Centres of Excellence [$560M since 2012 (NCE, 2017)], Canada Foundation for Innovation [CFI non-solo grants, $1B since 2012 (CFI, 2017)], and dozens of intermediary team/partnership grants through other federal programs. In all of these granting programs, foundational components of the evaluation and selection process are the level of excellence of the individuals involved [i.e., traditional research metrics] and the strength and the cohesion of the team [e.g., proven track-record of the group’s ability to work together as a team]. The NCE
program goes so far as to require applicants to explicitly justify the synergies of the team that enable the award to have greater impacts than equivalent grants to individual researchers.

The role of institutions in these large-scale programs seems reduced to ensuring compliance, reporting, and providing match for large team grants in the form of cash [e.g., Department, Faculty, and Central funds] and in-kind [administrative and reporting support, space, etc.] contributions. However, for the administration and leadership at an institution to enable faculty to be successful in these competitions, we need to proactively consider how to develop institutional practices that encourage the development and growth of such research clusters years in advance of large-scale team grant competitions.

A recent review of the benefits for, and risks to, individual researchers participating in team grants (CAHS, 2017) called for institutions to increase their support and recognition of team science participants. And indeed, establishing and supporting clusters of research excellence has become central to most institutional research strategic plans, in one form or another. However, despite a wealth of literature providing researchers with motivation to participate in team science and examples of previous successes (e.g., Adler & Stewart 2010; Boardman & Ponomariov 2014; Guise et al. 2017; Reichman 2004; Stokols et al., 2008), minimal guidance is available to institutions on developing policies and processes to support the development clusters of research excellence. In this paper, we share our framework for identifying, evaluating, and catalyzing clusters of research excellence and provide specific examples of internal processes and analytical tools that we have developed and implemented to catalyze clusters of research excellence. We hope that this paper will be useful for other institutions and will spark further dialogue about the roles that institutional administration and leadership can play in supporting research clusters.

**Identifying clusters**

Institutions vary in their definition of research clusters and consequently in their pathway to identifying institutionally recognized or supported clusters of research excellence. Some universities define and organize research clusters by *Grand Challenges*, economic sectors, government priorities, or disciplines of institutional strength [internally or externally determined]. We define clusters of research excellence as interdisciplinary networks of researchers who organize to solve key challenges facing society. Researchers comprising clusters represent leaders in their areas of expertise. Research clusters enable these leading researchers to work closely together as a unit on complex problems that often transcend traditional departmental, institutional, or disciplinary boundaries.

**Bottom-up approaches**

Identifying self-organizing clusters and supporting grassroots collaborative and interdisciplinary research teams are by far our preferred approach. Through bottom-up processes, natural leaders emerge and, in our early experiences, this is crucial for sustained cluster management and growth. Bottom-up approaches also allow creative linkages to develop that administration could never have imagined, and would never design, [e.g., a violinist and a climate data scientist] and these are the linkages that generate truly novel lines of inquiry. Bottom-up approaches may also have an added benefit of increased participation by trainees and graduate students [though still a preliminary
observation, we speculate this may result from organic relationships among researchers]. Finally, supporting self-organizing clusters does not require the extensive proactive background efforts by administration that top-down approaches do [see Top-down approaches below], and the onus of demonstrating research excellence and the merits of collaborative synergies can rest with the clusters themselves.

Nonetheless, bottom-up approaches to organizing research clusters present their own challenges. Firstly, researchers are rarely incentivized, financially or through award recognition, to pursue cluster activities (Van Rijnsoever & Hessels, 2011). Consequently, researchers may choose to pursue activities that lead to immediate recognition (Landry & Amara, 1998) instead of activities required to organize and manage research clusters, which may be perceived as detracting from publications, grant writing, student training, etc. Secondly, securing the type of funding that researchers need to support cluster growth is frequently a challenge: some important cluster-organizing activities may not be eligible in traditional research granting opportunities, grants that might fund cluster activities are often difficult to discover, a researcher may decide a small grant is not worth her/his time and effort, and the necessity to secure separate funding opportunities for cluster development may significantly delay cluster development [e.g., application processing times and constrained funding windows].

The final, and perhaps most frustrating, challenge for supporting grassroots cluster development is that not all interdisciplinary research teams can be institutionally recognized clusters of research excellence and universities simply do not have the resources to fund every developing cluster. Therefore, bottom-up approaches to identifying research clusters require that institutions design robust internal processes for selecting which clusters to promote and support. And while institutions may have well-developed protocols for internal competitions, processes for selecting research clusters have important nuances that require special attention. For instance, traditional research metrics can be discipline-specific, so a metrics-based evaluation system for interdisciplinary research clusters needs to be holistic to be meaningful and include, for example, funding, bibliometrics, partnerships, translation metrics, altmetrics, and impact narrative. We use a combination of these metrics and evidence of collaborative history [e.g., teami-ness] to evaluate and help identify which teams will be recognized by the institution as clusters of research excellence [see Evaluating Research Clusters below].

Top-down approaches

Top-down initiatives to develop clusters and forced marriages among researchers are usually unproductive exercises for administrators and research leadership. And yet, there is often great value [to the researchers, the institution, and society] in facilitating the development of clusters around external priorities or funding opportunities where they are not organically developing otherwise. In this scenario, we see the best role of administration as providing strategic support to help mobilize and support the development of clusters in a given research area. Specifically, administration and leadership can assist with connecting researchers across Departments/Faculties, provide examples of frameworks for collaborative research initiatives, help remove barriers to collaboration identified by researchers, and provide incentives to researchers who wish to develop a research cluster in the area of interest.
The first step is identifying researchers who could meaningfully contribute to and might be interested in participating in an interdisciplinary cluster. In larger institutions with thousands of faculty members, it is not uncommon for researchers working on similar topics in different departments to be completely unaware of one another. A lack of collaborative research initiatives might simply reflect a lack of knowledge of other researchers working in that space in other Faculties and so finding those researchers and providing a venue for networking is crucial. For instance, let’s say that provincial and federal governments announce mental health as a research and health services priority. We recommend starting by devising a series of search terms [in this case, perhaps: “mental” OR “psychological” OR “brain” AND “illness” OR “health” OR “wellbeing” OR “wellness”; “psychology”; “psychiatry”] that can be blasted through internal research record systems to identify a draft list of researchers working in that space. Despite the universal importance of a University’s ability to find context-appropriate researchers, most institutions do not yet have centralized systems that allow administrators to index, and therefore discover, researchers by their research expertise and interests. Examples of systems and databases to search when a centralized search function is not available include: institutional researcher webpages; supervisory records; research funding and application tracking systems; ethics application databases; etc. Recognizing that even the most thorough search process misses key researchers [e.g., recent hires; researchers who use only technical words to describe their work; clinicians; digital ghosts], the draft list of potential researchers should be distributed broadly to help identify any additional researchers.

With a revised list of potential researchers, administrators can then begin to gather evidence of existing research excellence and/or collaboration in the given field. We start by pulling a report of research metrics on the individuals [e.g., research funding, major awards, publications, citation impact, media attention/reach]. Next, we assess pre-existing collaborations within the group of researchers. This exercise [e.g., Figure 1] can inform which and how many researchers currently collaborate and if patterns of collaboration are associated with institutional divisions [i.e., collaborations not happening across Faculties]. Co-publications are a convenient proxy for collaboration because pairwise collaboration data can be scraped freely from Web of Science or through third party paid software. However, collaboration mapping could also incorporate other forms of data, including co-supervised students, co-PI status on grants, or co-produced exhibits or performances.
Figure 1. Collaboration network diagram, showing co-publications in a hypothetical research area [e.g., mental health] area across institutional divisions before and after cluster formation. The diagram on the left depicts a scenario where most collaborations exist within faculties and only a few collaborations exist among faculties. The diagram on the right depicts increased collaboration across faculties after formation of a research cluster.

**Catalyzing Research Clusters**

The catalytic activities necessary to propel a cluster through developmental stages lie outside traditional academic research funding frameworks [e.g., multi-stakeholder partnership development], are not eligible costs in traditional funding models [e.g., hiring innovation development staff], and are not widely recognized in reviews of scholarly performance [e.g., community engagement]. Likewise, without strategic planning and institutional support, clusters are likely to maintain current research trajectories and run the risk of not advancing further. In Figure 2, we present a conceptual view of the catalytic activities needed for clusters to move from emerging clusters to established global leaders in their field. We do not implement a tiering classification system at our institution, but have found this framework helpful for imagining the characteristics of clusters at different development stages.
Figure 2. Conceptual tiered framework for development of research teams from emerging clusters to global leaders. We do not use tiering explicitly, but rather consider the concepts as a useful exercise when imagining the characteristics of clusters at various developmental stages [list to the left of triangle] and the catalytic activities needed to continue on a trajectory to becoming a world-leading research cluster [list to the right of the triangle].

The catalytic activities each cluster undergoes will ultimately vary on the goals and expected outcomes of the cluster and so the list presented in Figure 2 should be considered suggestive and not prescriptive or exhaustive. However, most clusters share a few fundamental needs, including communications support, coordination for networking activities, partnership development, funding intelligence, and strategic guidance from institutional leadership. These support needs can typically be best met [in terms of efficiency and quality] through the provision of centrally managed resources. We have adopted a mixed support model, providing both institutional in-kind support, and cash awards to help each cluster advance. Below, we provide examples of cash and in-kind contributions we provide to our clusters of research excellence.

Support with coordination and communications

Research clusters universally require coordinated activities among cluster members, and with those activities comes increased administrative burden on the researchers. In emerging clusters, this may be limited to organizing quarterly or biannual collaborative working sessions with the larger group and regular meetings with cluster leaders. In these instances, support can be provided by institutional staff who regularly organize meetings and events or graduate students involved in the cluster [who may have more bandwidth than faculty members for coordination]. In established clusters, the coordination activities needed to keep the cluster running productively may require a full-time staff member dedicated to, or hired by, the cluster.

Communications support is crucial to help clusters develop and showcase their internal and external narrative. But, it is unrealistic to expect an employee to work with each cluster separately: institutions will not likely have the resources to fund the development of multiple separate websites from scratch, it is not generally sustainable to bring in a personal communications consultant for each cluster, and there is no guarantee that the web design and
quality will match the institution’s standards. Instead, we provisioned the development of a web template for research clusters from our central IT department and supplied the template to the clusters, saving money and ensuring brand alignment. Our central communications teams then provide communications guidance and support during creation of the clusters’ websites.

**Strategic partnership development**

In large-scale federal competitions, partnerships across sectors are crucial because they ensure that downstream research users co-create research programs, further leverage funding investment, diversify funding sources, and facilitate knowledge mobilization and commercialization activities. For the same reasons, partnerships are essential to the sustainability of cluster activities. However, even the most highly collaborative researchers may work only in the Academic sector. For some researchers that comes as a matter of personal preference, but for many others it may occur because of barriers [actual or perceived] limiting cross-sector exchange.

We plan to hold workshops for both emerging and established clusters to brainstorm their goals and the partnerships and activities needed to realize them. These workshops will provide a venue for institutional leadership to help guide cluster development, for clusters across disciplines to interact and learn from each other’s challenges and successes, and for the administration to hear about barriers that may limit research partnerships. Once clusters have identified their goals and challenges, we can connect them with staff experienced in those areas, for instance: Innovation Development Officers [to help with partnership development, innovation plans, and knowledge mobilization pathways (e.g., Phipps et al., 2017)], Community Engagement Specialists [in situations where community engagement support is required], Research Funding Development Officers, and Government Relations Officers [when provincial or federal partnerships are key]. Established clusters may eventually require their own Strategic Partnerships Officer, but centralized support can get most clusters through the first stages of partnership development [strategic planning and engagement].

**Cash: Grants for Catalyzing Research Clusters [GCRC]**

The centrally-provisioned resources above are essential for most clusters, but each cluster will require funding to undertake additional catalytic activities specific to their goals. Securing funding for these activities can usually limit cluster development when external grant opportunities for smaller, more flexible awards are not easily discoverable, require developed applications, and/or introduce significant time delays before cluster catalyzing activities can occur. Institutions should consider planning to help fund these activities. Because the funds are intended to cover catalytic activities, and not direct costs of research, relatively small awards can have large impacts on the clusters’ development. To distribute these funds, we have established internal funding competitions that we have named Grants for Catalyzing Research Clusters.

**Evaluating excellence of research clusters**

Institutional assessment and evaluation of research clusters are complicated. Traditional research metrics vary across disciplines, and so group metrics are not often meaningful, individually or when being used to compare to other clusters. Secondly, it may not be possible to quantify the
relative contributions of cluster participants when the group includes a wide range of contributions [theoretical, system specialists, network connectors, etc.] and a variety of roles essential for the cluster’s functioning [e.g., leaders vs. coordinators vs. participants]. Furthermore, cluster activities and goals should vary among teams obviating direct comparison of goals and activities among clusters. Despite these challenges, there is increasing need to evaluate clusters, in internal competitions and over the course of their development. Our approach to evaluation of research clusters has been to focus on broadly-defined criteria where clusters can construct their own cases for fit to criteria, using evidence relevant to their cluster.

Example criteria include:

- The cluster addresses one or more complex and key questions facing society;
- Creation or enhancement of the cluster has the potential for transformative impact on the University and on society;
- Proposal leverages cluster funding to attract further funding opportunities;
- Research is interdisciplinary, inter-institutional, and inter-sectoral;
- Demonstrated evidence of excellence in research and/or artistic creation;
- Demonstrated track record of teamwork (e.g., co-publications, co-supervised students, team grants, etc.);
- Evidence of knowledge translation and mobilization activities (e.g., community engagement, policy impact, commercialization); and
- Ability to achieve a sustained funding model.

Inter-disciplinary panels review applications and make decisions based on the cluster’s ability to provide evidence of fit to the criteria and a strong budget justification that aligns specific activities with goals and expected outcomes. In this model, each cluster defines its own expected outcomes and therefore post-award evaluation of their success is based their ability to meet self-identified goals.

**Closing remarks**

Only one year out from its launch, we have already observed impact of our initiatives to support clusters of research excellence to clusters and to our institution. At the cluster level, we have observed successful leveraging of GCRC funds with federal and charitable sources, increased collaborations across organizational units [e.g., Figure 1], the formation of new external partnerships, the creation of novel lines of inquiry, and [to our delight] researchers have reported an increased sense of community belonging and interest in collaborative activities. We view these benefits to the clusters as benefits to our institution, but additional institutional-level benefits include: increased external funding, increased partnerships and community engagement, high return on investment for internal resources, expanded networking opportunities for trainees in clusters, increased communication and outreach, and early evidence of significant impact on research.

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