Funding University Research Networks for Results: The Canadian Research Councils Approach

Paul J. Thomassin
McGill University
21,1111 Lakeshore Road
Ste. Anne de Bellevue, Quebec, Canada
H9X 3V9
Tel. (514) 398-7956, FAX (514) 398-8130
Paul.Thomassin@McGill.CA

and

L. Martin Cloutier
Department of Management and Technology
School of Management
University of Quebec at Montreal
315 Ste. Catherine East
Montreal, Quebec, H2X 3X2 Canada
Tel. (514) 987-3000, ext. 3732#, FAX (514) 987-3343
cloutier.martin@uqam.ca

Abstract:

The two major research councils in Canada, Natural Science and Engineering Research Council and the Social Science and Humanities Research Council, have both embarked on fostering joint initiative research networks in their respective areas. The university research networks that are formed are dynamic, complex organizations that are based on the collegial interactions between peers that contribute to shared academic commitment to a research area. Funded university networks require a group of academic researchers to transcend both institutional and disciplinary boundaries. Research networks must function in a way to provide a value added output greater than the sum of the individual research projects. Such an organization is both complex by its very nature and changes over time.

Systems dynamics is used to represent the underlying development structure of two networks, one in the social sciences and the other in the natural sciences. Both have developed using different governance structures and feedback mechanisms. The model identifies the drivers and constraints on network development.

Key Words: Research networks, collegiality, funding mechanism, feedback, time delay

Introduction

Research granting councils in Canada, such as the Social Science and Humanities Research Council (SSHRC) and the Natural Science and Engineering Research Council (NSERC), have traditionally allocated research funds in competitions that require individual researchers to develop projects and compete against each other. A peer review process is used by the Councils to identify those projects and individuals who are most productive and put forth projects with the greatest chance of advancing knowledge in their respective areas. Individual projects and researchers are ranked in terms of quality, and suggested budgets for each project are recommended. Every year the number of quality projects outstrips the research funds available and worthy/acceptable projects are not funded by these Councils. This traditional approach of individual researchers submitting individual projects to a peer review process is a competitive process where individual researchers compete against each other.

Recent changes in the Councils' funding strategy have introduced partnered funding and collaborative funding mechanisms. Both of these types of funding mechanisms require that the individual university researcher collaborate with at least one other individual; in either industry, government or other university institution; in the design and execution of the research project. The latest in this type of funding program emphases the development of university research networks to address specific problems. It is expected that the knowledge generated from a research network will be greater than the sum of the individual projects that are components of the network.

This new approach to research funding has changed the environment in which university researchers work from one of competition to collaboration. The requirement that researchers collaborate to be eligible for this funding has created project development, governance, and administrative hurtles. By design, a university research network is a complex organization that is dynamic over time.

This paper investigates and models two different approaches used to develop university based research networks. The models compare the approach used by NSERC and SSHRC to develop the networks in the respective disciplines they fund. A case study approach is used to compare the experience of two university research networks. The models identify the critical variables necessary for the establishment of a network and will investigate the feedback mechanisms necessary for success. The criteria used to evaluate the success of the network will be collegiality, efficiency, timeliness, and effectiveness.

Organizational Design of University Research Networks

Commons (1931, 1961) viewed institutions as collective action that both restricted and expanded individual action. From his perspective, institutions are problem centered where they address conflicts of interest between individuals as they related to situations of scarcity (Rutherford, 1983). Institutions developed working rules that individuals have to abide by. Institutions are evaluated using a criterion of workability. Workability has two dimensions: efficiency and an appropriate distribution of benefits and burdens to individuals. Institutions are dynamic as working rules adjust to the criterion of workability over time through various feedback

mechanisms. University research networks are collectives of researchers who are focused on a particular problem. Granting councils and internal governance structures will provide the working rules of the organization.

University research networks require researchers and professors to work together towards a common goal. Research networks provide a means of coordinating various aspects of the research process so that various individual and group goals can be achieved (de Moor and van der Rijist, 1995). A number of characteristics must be present if research networks are to provide that "value added" that is greater than the sum of the individual projects (Coghlan et al., 2004). These characteristics include collegiality, collaboration and responsibility (Coghlan et al., 2004, Marlow and Nass-Fukai, 2000; Langhorst, 1999; Rose date unknown).

Collegiality is expected amongst academic researchers, however, it is hard to define and often harder to find within organizations (Langhorst 1999, Rose date unknown). Collegiality is often associated with a group of individuals working together towards a common goal (Marlow and Nass-Fukai 2000). In addition to this, collegiality is viewed as an association of equals, where each individual is expected to contribute to the goal. The structure of the network plays an important part in developing the breath and collegiality amongst the participating researchers. For example, within the SSHRC call for proposal for research networks, they require that the network include a range of disciplines and institutions (SSHRC 2002). In order to receive research funds the network must fulfill this objective of bringing researchers together to address a common goal.

Collaboration within the research network requires communication between the various components of the network. This communication should include research planning, joint work, and evaluation (Marlow and Nass-Fukai 2000). This process of communication is important as a means of joint decision-making amongst partners within the network. The ability to communicate plays an essential role in collaborative undertakings.

The final characteristic of importance for a research network is responsibility (Marlow and Nass-Fukai 2000). It is responsibility that takes into account the needs and requirements of other researchers in the network. Responsibility transcends the institutional linkages within the network and works at an individual level. Responding to individual needs is important in order for collegial relationships to be maintained and strengthened.

Development of university research networks that incorporate these various characteristics requires that these networks be viewed as complex organizations (de Moor and van der Rijst, 1995). They illustrate the network organization as containing three levels: a problem domain, human network, and information system. As such, research networks are dynamic and are context sensitive and thus are always in flux (de Moor and van der Rijst, 1995).

The development of university research networks requires that researchers transcend both disciplinary and institutional boundaries. As such, the organizational design of a research network is multi-level and must integrate both intra and inter-organizational coordination (Gittell and Weiss, 2004). This process of coordination is both complex and dynamic. They argue that organizational design can improve both intra- and inter organizational efficiency and output

quality. As a result, overall performance of the organization can be improved with appropriate organizational design. Research networks should be designed to build on coordination and communication strengths that can be found in individual organizations.

Saeed (1999) while investigating innovative organizations recognizes two approaches to develop organizations: mechanistic and organic. Mechanistic approaches include formal ties and rule enforcements while organic approaches include collegiality, de-centralized authority and internal motivation. Using a systems approach, he modeled innovative organizations as a relationship between three subsystems: the production system, the learning system, and the governance system (Saeed 1999). The model contained various feedback loops between the subsystems. One interesting observation was that production and learning growth increases governance which can increase the use of mechanistic approaches (rule based decision making) and decrease collegiality (organic approaches).

Several authors (Saeed, 1999; Coghlan et al., 2004; Akdere, 2003) have used an active learning process as a component in organizational design. Active learning happens in real time and uses data to adjust the ongoing system or organizational design. This active learning process emphases the dynamic nature of research networks, their complexity, and the use of feedback mechanisms to adjust the institutional design to a workability criteria.

University research networks being learning processes will require workability criteria to evaluate their organizational design. The workability criteria used to evaluate university research networks are: collegiality, efficiency, timeliness, and effectiveness. Each criterion provides an indicator of a different dimension of the research network. Collegiality includes the number of individuals, institutions, and disciplines represented in the research network. Efficiency, timeliness, and effectiveness are criteria that evaluate the quality of the output of the research network.

Rodrigues and Williams (1996) used system dynamics modeling as a means of incorporating the human dimension into the interactions and feedbacks mechanisms in software management. System dynamics is used to model the development of two research networks in Canada. The case study illustrates issues of overall organizational design and the various feedback mechanisms involved in the establishment and operation of university research networks.

Case Studies

The case study will analyze the development of two university research networks. The first network was submitted to NESRC and was entitled Green Crop. This was a science-based university research network investigating the role of photosynthesis in a high carbon environment. The second research network was submitted to SSHRC and focused on analyzing the human dimensions of greenhouse gas management. This research network investigates the policy dimensions of using the biosphere for greenhouse gas management.

Green Crop

NSERC's call for research network proposals is a general call for proposals. It is a general call because NSERC will entertain any university research network proposal in the science and engineering area. As a result, the Green Crop university research network proposal was competing with other proposals from various science and engineering disciplines.

The NSERC network grant program follows a three-step process. The first step is the submission of a letter of intent. The letter of intent is a short document that describes the potential research area. At this stage of the process, the success rate for letters of intent is high, approximately 80-90 percent. Once the letter of intent has been accepted, the second step of the process is to submit a seven-page grant summary. The committee to review grant summaries meets every four months. The success rate at the grant summary stage is approximately twelve percent (Smith 2004). The final stage of the process is the submission of a full research network proposal. The full proposal must be submitted to NSERC within six months of receiving acceptance of the grant summary. Researchers have the potential of receiving between $20,000 and $25,000 to assist in the writing of the full proposal. The success rate at the full proposal stage is approximately fifty percent and the adjudication process takes approximately four months from the submission of the full proposal.

University research network grants financed by NSERC are usually for a five-year duration. An annual report on the network activities must be submitted to the Council. NSERC does require all network grants to have a particular governance structure. This includes a board of directors (BOD) and scientific overview committee (SOC). The SOC will evaluate the progress made by the various groups within the research network. There is a mid-term review process, where the SOC will undertake a detailed evaluation of the research groups in the network. They will make recommendations on possible reallocation of research funds into particular areas and discontinuation or scaling back of research in unproductive areas.

The Green Crop Network was initiated by a group of researchers who wanted to investigate the potential implication of higher GHG concentrations on plant production. A letter of intent was submitted and the leaders of the research network received permission to submit a grant summary (step 2). The researchers who were part of the letter of intent approached BIOCAP, a non-profit organization who promotes university research networks related to climate change, to sponsor a one-day workshop for the Network on May 4, 2003. This was done to expand the breadth and depth of the network proposal. After the one day workshop, the leader of the initiative invited researchers from across Canada to submit a two page proposal for work they would be interested in undertaking. Fifty-five proposals were received and the network participants identified a selection committee that chose 25 proposal.

The initial research grant summary was submitted on May 30, 2003. Four other research networks submitted grant summaries and none were selected. Comments on the Green Crop proposal included more detail on the network function and partners. Most participants in the Green Crop proposal had letters of support from partners. It was estimated that approximately $400,000 per year in support had been generated from partners.

In August 2004, the researchers modified their grant summary proposal and re-submitted it to NSERC. Seven applications were submitted at this time, but only one was selected for full proposal submission. Comments from the NSERC committee on the grant summary was that there was a clear indication that it was a network and that they should go back to their partners for additional letters of support for the network and the projects being undertaken.

The grant summary was re-written and re-submitted in December 2003 with additional letters of support. In March 2004, the Green Crop Network was informed that their summary grant proposal had been accepted and they could submit a full network proposal in the next six months. They have submitted the request for funds to write the full proposal and have received $20,000 in March 2004 for this task. During the writing of the final proposal a number of projects have been combined or modified. The final submission should contain 17 projects and this must be submitted to NSERC by September 2004. NSERC has scheduled a site visit to the lead university to talk to the network leaders and to inspect the research facilities. The Green Crop Network expects to have a decision on their full proposal by January 2005. If accepted, funds going to the research network should be allocated by April 2005.

The Green Crop Network has been organized around four theme areas. Each theme area has a leader and co-leader. Each theme area contains three to six projects. In the writing of the full proposal the theme leaders and co-leaders will design the network organization in three major areas: research design, governance, and financial. In the research design area the network leaders will identify the goals of the network, identify the projects undertaken by each theme, coordination between projects, and communication strategies for the network. In terms of governance, the network leaders will identify individuals and receive commitments from these individuals to sit on the Network's BOD and SOC. The final area of concern will be the financial requirements of the network. Each theme area will identify projects to be undertaken and the financial resources required to undertake the research. The annual NSERC financial contribution to the network would be approximately $1.2 million. Approximately $200,000 per year is used for network administrative support and each theme area will receive approximately $250,000 per year. If the Green Crop Network receives funding, it will be approximately two years from the initial proposal to the flow of funds to the research network.

Greenhouse Gas Management Canada

Greenhouse Gas Management Canada is a SSHRC-BIOCAP sponsored university research network investigating the human dimensions of biosphere greenhouse gas management policy. The financing of the network comes from three sources: SSHRC $1.4 million over three years, BIOCAP $1.65 million over three years, and Agriculture and Agri-Food Canada $90,000 over three years. In addition, SSHRC provides approximately $70,000 per year for a research director. In total $3.14 million in research funds will be used over the three-year period.

In the summer of 2002, SSHRC and BIOCAP signed an agreement to sponsor the development of a university research network in the area of biosphere greenhouse gas management. A call for proposals was made to the university research community in October 2002. Full proposals for components, or nodes, of the network were due by the end of January 2003. The adjudication

committee met in March 2003 and funds were allocated to accepted research nodes by March 31, 2003.
The call for the scientific director grant was held simultaneously to the call for node proposals, however, no decision was made on the scientific director at that time and the competition for the director was extended. A new stipulation was added to the scientific director position with this extension. The stipulation was that the scientific director had to be a member of one of the funded research nodes. Submission deadline was in April 2003 and a decision on the scientific director was made in June 2003.

In this case, SSHRC-BIOCAP identified the research network area to be investigated – biosphere greenhouse gas (GHG) management. The university research community was to submit research proposals for nodes, areas of concentration concerning GHG management, to SSHRC. The selection of research nodes by the adjudication committee would constitute the research network. Under the guidelines for proposals, each node would have to include at least two other researchers in addition to the node leader. The following criteria were used to evaluate proposals. First, research proposals must fit the program objectives of addressing the issue of biosphere GHG management. In addition they should address one of the BIOCAP research areas. Second, the research proposed had to be of high quality lead by an individual who had a demonstrated expertise in the area. The research to be undertaken would also have to be of national relevance. The third criterion was the level of collaboration within the node. Collaboration could take the form of cross disciplines, institutions, and geographical regions. Institutes that could be included were other universities, government laboratories, industries or the volunteer sector. The next criterion was the means by which the node proposed to transfer their knowledge and technology. Included in the knowledge transfer criterion was the training of new researchers and graduate students. The final criterion was the appropriateness of the budget submission given the research that was planned by the research node.

A total of eleven node proposals were submitted for evaluation in January 2003. The interdisciplinary review committee recommended eight research nodes for funding, however, the funds available did not cover the budgetary requirements. A total of five research nodes could be fully funded with some funds remaining. Agriculture and Agri-Food Canada put in some additional financial resources to fund the sixth node.

By March 31, 2003 the six successful research nodes had received their funding and each node had its own intra-organizations means of coordination and communication. However, there was no overall network structure that transcended the individual research nodes. The research director was appointed in June 2003. The governance structure of the network includes a governance committee that is chaired by the scientific director and includes all of the node leaders. Since each node leader is in control of their budgetary allocation, the governance committee builds inter-node coordination and communication.

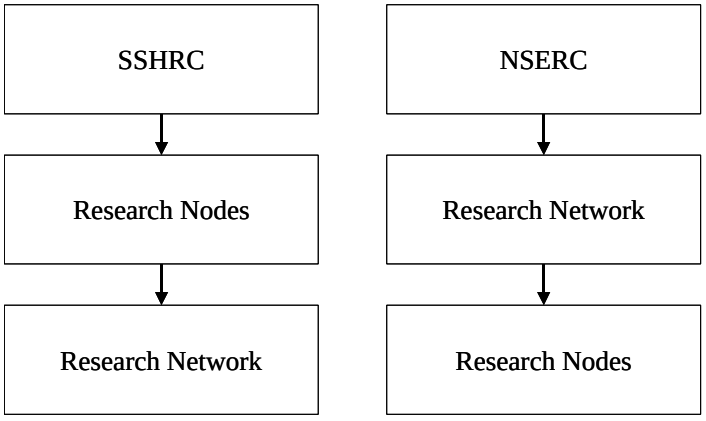
A Comparative Analysis of the Role of Collegiality on Knowledge Generation

In this section, the dynamic interactions that led to the establishment of the networks are presented and described. The focus of this analysis is to show the role of collegiality, or of its

influences, on knowledge generation or spillovers, and ultimately on the underlying approach employed by both councils in the establishment of their respective networks.

The fundamental difference between the organizational building paths of these networks appears to be the emphasis placed on distinct levers to establish these networks. As seen in figure 1, SSHRC's approach is to fund research nodes and to support these nodes in the development of a research network: a bottom-up approach. By contrast, NSERC's approach is to establish a research network first, and then generate nodes of researchers from the network: a top-down approach.

Figure 1. Organizational building paths of networks



In what follows, the two cases are examined using an influence diagram to better illustrate the causal relationships around collegiality. The first network to be examined is Green Crop, using the influence diagram in figure 2. Then Greenhouse Gas Management Canada is analyzed with the feedback interactions shown in figure 3.

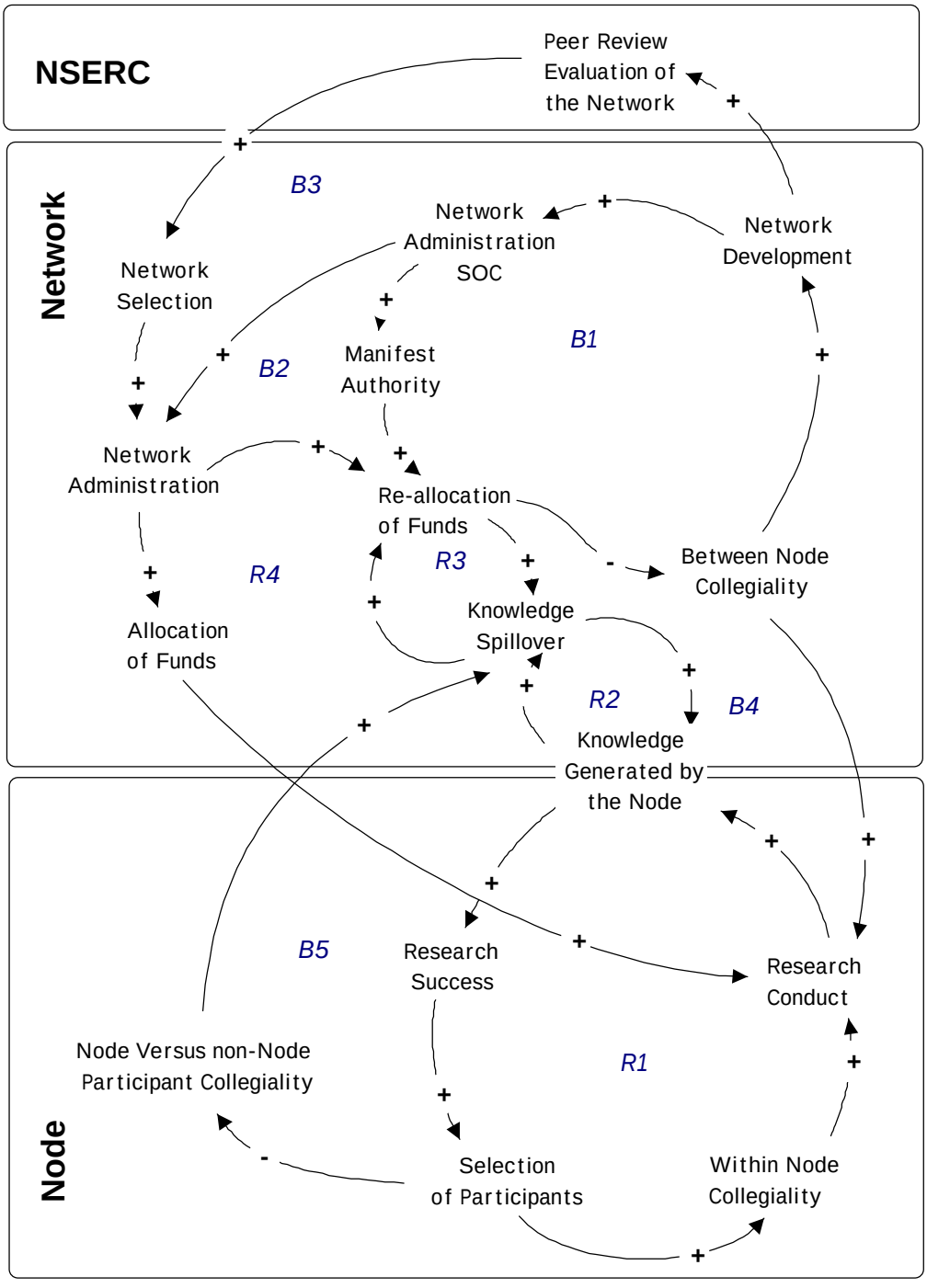
Green Crop

The influence diagram shown in figure 2, contains five (5) balancing feedback loops and four (R) reinforcing ones. The reinforcing loop R1 shows the influence of knowledge generated by the node on research success. Research success leads to the selection of node participants, which in turn help sustain within node collegiality. This within node collegiality supports research conduct and results in the knowledge generated by the node.

The knowledge generated by participants is the result of knowledge spillover, and in turn, as seen in R2, the knowledge generated by a node leads to further knowledge spillover. The knowledge spillover depends on the reallocation of funds from one period to the next, which depends on the network administration. If the allocation of funds is maintained between nodes, knowledge spillovers will be generated. However, if the re-allocation of funds is not maintained between nodes, this will lead to a decrease in between node collegiality. As seen from the balancing feedback loop B4, the between node collegiality has a direct influence on research conduct.

Clearly, the initial selection of participants at the node level has a direct influence on knowledge spillover, as can be seen from the balancing loop B5. This loop is closed by including such influences as the knowledge generated by the node, research success, and back to the selection of participants, already part of feedback loops R1 and R2.

Figure 2. Influence diagram of the Green Crop network-building path



However, the between node collegiality is important for network development, to network administration SOC, and finally, back to network administration to complete this feedback loop, R4.

The network dynamics also includes the balancing loop B1. In this feedback loop the network administration SOC has a positive influence on manifest authority, which has a positive influence on the reallocation of funds. This balancing loop of manifest authority also has an influence on between node collegiality. The link between network administration SOC and network administration creates the feedback loop B2, where network administration is connected to the reallocation of funds.

Finally, between network development influences the peer review evaluation of the network, as defined by the balancing loop B3. The peer review evaluation leads to the network selection, and then to network administration, once more. One potential risk is the possibility that the initial allocation of funds leads to a decrease in collegiality between funded and non-funded networks, as emphasized in the balancing loop B4. Indeed, this reinforcing loop could further steer actions of the reinforcing loop R4, given this possibility that the node versus non-node collegiality could be impacted in the initial allocation of funds.

The influence diagram structure stresses that the research nodes are the product of the a priori network selection by NSERC. Once the network is established, the nodes can be created and research can begin. This network organization appears to be more mechanistic in its management because it is not the result of knowledge spillovers but rather bureaucratically defined.

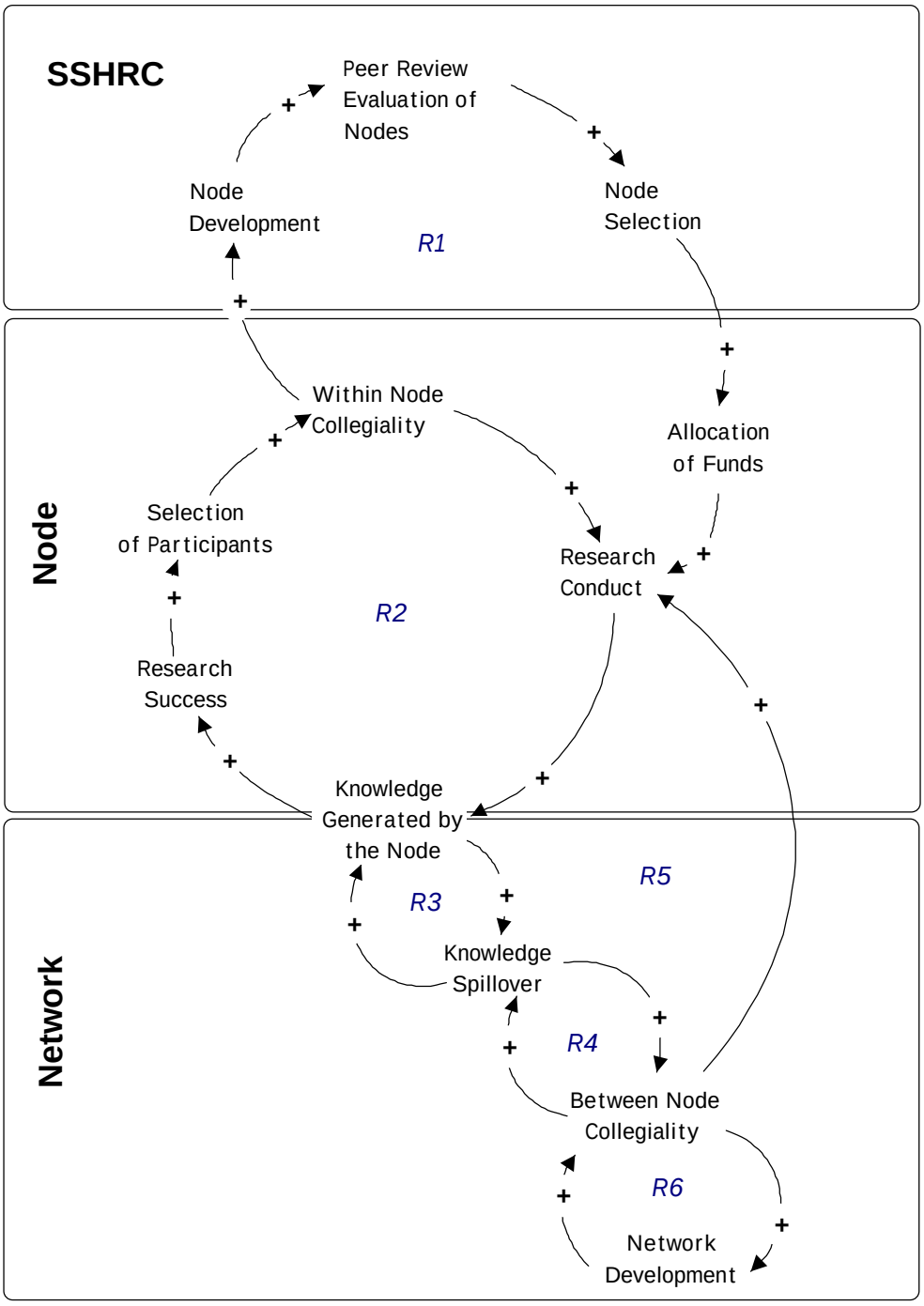
Greenhouse Gas Management Canada

The main structural difference between the Greenhouse Gas Management Canada network and the Green Crop network is the link between the research council and the establishment of nodes. As seen in figure 3, the reinforcing loop R1 shows that the node development led to the peer review evaluation of nodes, of node selection, and of the allocation of funds. The allocation of funds is an additional element to research conduct that leads to knowledge generated by a node. The knowledge generated supports research success. The research success leads to the selection of participants from within a node. Because the participants joined a node, based on perhaps previous joint research success, this leads to more within node collegiality, the initial spark for the node development initially submitted to the peer review process.

There is a direct influence from within node collegiality to research conduct. This influence completes the reinforcing loop R2 that turns out to be a sub-component of the selection process, at the root of the establishment of an individual research node.

The knowledge generated by the node and knowledge spillover lead to higher between node collegiality (see the reinforcing loops R3 and R4). The between node collegiality leads to improve research conduct as part of loop R5. Clearly, in this case, the between node collegiality is at the root of the network development, which helps reinforce collegiality.

Figure 3. Influence diagram of the Greenhouse Gas Management Canada network-building path



It the situation depicted above, the network emerges from the interactions of nodes, which were in the first place, the result of collegiality amongst the researchers that participated in the council's process to obtain research funds. This would indicate that the network development process is more the result of an organic approach, rather than a mechanistic one, as in the case of Green Crop, in which collegiality has a key role.

Conclusion

This paper has examined two alternative network-building paths employed by the Canadian research councils. From the analysis presented, it appears that collegiality plays a key role in both establishing a network and in the speed at which research can begin. Two network cases were presented in the paper: Green Crop and Greenhouse Gas Management Canada. The analysis presented used influence diagrams to show the interactions of feedback loops that defined the structure of both networks.

References

Akdere, Mesut. 2003. The Action Research paradigm: An Alternative Approach to Negotiation. *Systemic Practice and Action Research*. 16(5):339-354.

Coghlan, David, Paul Coughlan, and Louis Brennan. 2004. Organizing for Research and Action: Implementing Action Researcher Networks. *Systemic Practice and Action Research*. 17(1):37-49.

Commons, J.R. 1931. Institutional Economics. *American Economic Review*. 21: 648-657.

Commons, J.R. 1961. *Institutional Economics.* Madison, WI: University of Wisconsin Press .

De Moor, Aldo, and Nardo B.J. van der Rijst. 1995. Towards a Dynamic, Context-Sensitive Research Network Information System Specification Method. Proceedings of the 13th International Association of Management Conference, August 2-5, 1995.

Gittell, J. H., and L. Weiss. 2004. Coordination Networks Within and Across Organizations: A Multi-Level Framework. *Journal of Management Studies.* 41(1):127-153.

Langhorst, Scott Alan. 1999. Relationship of Computer- Mediated Communication Usage and Collegial Behaviors of Faculty at Research Universities: Constructing Virtual Collegiality. Ph.D. Dissertation, Virginia Commonwealth University, May.

Marlow, Michael P., and Jennifer Nass-Fukai. 2000. Collegiality, Collaboration, and Kuleana: Three Crucial Components for Sustaining Effective School-University Partnerships. *Education.* 121(1):188-195.

Rodrigues, Alexandre, and Terry Williams. 1996. *System Dynamics in Software Management: Towards the Developmen of a Formal Integrated Framework.* Management Science Theory, Method and Practice. Management Science, University of Strathclyde, Glasgow, Scotland, Research Paper No. 1996/5.

Rose, Joel A. Date Unknown. Maintaining Collegiality and Accountability Among Partners. Joel A. Rose and Associates, Inc., Management Consultants to Law Offices. Web publication. http://www.joelarose.com/articles/collegiality.html.

Rutherford, M. 1983. John R. Commons's Institutional Economics. *Journal of Economic Issues* 17: 721-744.

Saeed, Khalid. 1999. Public Policy and Organization design Considerations for Science and Technology Development. Paper prepared for the Industry and Technology Division of the United Nations Economic and Social Commission for Asia and the Pacific, Bangkok, October.

Smith, Donald. 2004. Personal Communication.