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Mapping social structures for sustainability transformation at McGill University, Canada

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Table I: interviewed groups with their EI for the core network (middle column) and the affiliated network (right column).

Groups	EI in core network	EI in affiliated network
A10	0.5	1
A14	0.6	0.636
A2	0.412	0.4
A3	0.647	0.619
A4	0.143	0.143
A5	0.6	0.5
A6	0	-0.143
C1	0.6	0.6
C2	0.2	0.333
C4	0.714	0.6
E1	1	0.846
E2	1	1
E3	1	1
O1	0.333	0.333
O12	0	0.077
O2	-0.077	0.125
O3	0.222	0.222
O4	0.25	0.4
O5	0.059	0.111
O6	0.429	0.556
O7	0.143	0.158
O8	0	-0.091
O9	0.167	0.077
R1	-1	-0.75
R10	0	-0.259
R11	-0.294	-0.217
R12	-0.556	-0.5
R2	-0.286	-0.053
R3	-0.167	-0.167
R4	0.333	0.231
R5	0.222	0.333
R6	0.5	0.6
R7	0	-0.3
R8	0	-0.12
R9	0.176	0.2
S1	-0.2	0.111
S2	0.333	0.143
S3	0.333	-0.273

S4	0.333	-0.2
S5	1	0.5
S6	0.556	0
S7	0	0
S8	0.077	-0.2
S9	0.6	0.455

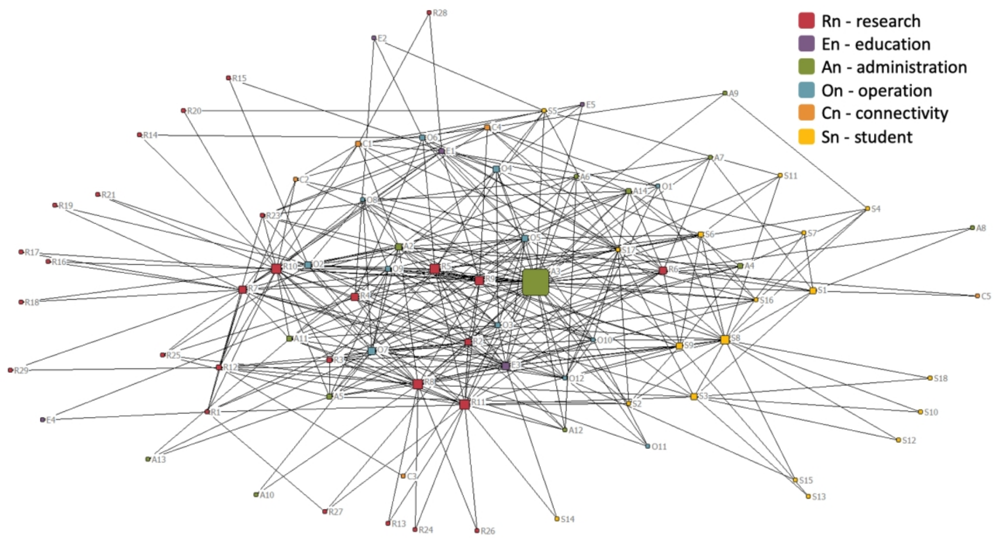

Figure 1: Affiliated social network. Size of nodes illustrates relative betweenness values of nodes. Color and first letter of code indicate domain. Red – R: research; purple – E: education; green – A: administration and governance; blue – O: operations; orange – C: connectivity; yellow – S: student.

675x379mm (72 x 72 DPI)

Groups	Domain	EI Index	Between
A10	3	0.5	4.135
A14	3	0.6	52.337
A2	3	0.412	63.017
A3	3	0.647	601.735
A4	3	0.143	63.644
A5	3	0.6	15.6
A6	3	0	0.758
C1	5	0.6	6.227
C2	5	0.2	9.947
C4	5	0.714	34.727
E1	2	1	13.685
E2	2	1	0.833
E3	2	1	87.445
O1	4	0.333	3.297
O12	4	0	6.749
O2	4	-0.077	19.373
O3	4	0.222	36.167
O4	4	0.25	72.65
O5	4	0.059	108.329
O6	4	0.429	34.211
O7	4	0.143	154.561
O8	4	0	8.315
O9	4	0.167	17.293
R1	1	-1	0.577
R10	1	0	159.707
R11	1	-0.294	105.617
R12	1	-0.556	9.036
R2	1	-0.286	23.957
R3	1	-0.167	26.647
R4	1	0.333	98.048
R5	1	0.222	116.605
R6	1	0.5	52.787
R7	1	0	5.908
R8	1	0	142.818
R9	1	0.176	74.236
S1	6	-0.2	45.996
S2	6	0.333	8.943
S3	6	0.333	13.16
S4	6	0.333	1.4
S5	6	1	20.75
S6	6	0.556	44.033
S7	6	0	2.592
S8	6	0.077	122.499
S9	6	0.6	57.647

group	Domain	EI Index	Between
A10	3	1	0
A11	3	0.091	31.717
A12	3	-0.333	0
A13	3	-0.333	0
A14	3	0.636	38.448
A2	3	0.4	122.454
A3	3	0.619	1073.205
A4	3	0.143	67.972
A5	3	0.5	41.124
A6	3	-0.143	4.606
A7	3	-0.2	0
A8	3	1	0
A9	3	1	0
C1	5	0.6	48.706
C2	5	0.333	10.393
C3	5	1	0
C4	5	0.6	34.939
C5	5	1	0
E1	2	0.846	36.819
E2	2	1	1.667
E3	2	1	148.406
E4	2	1	0
E5	2	0.5	0
O1	4	0.333	5.223
O10	4	0	18.781
O11	4	-0.5	0
O12	4	0.077	0
O2	4	0.125	98.669
O3	4	0.222	47.446
O4	4	0.4	109.169
O5	4	0.111	128.534
O6	4	0.556	57.851
O7	4	0.158	183.504
O8	4	-0.091	9.122
O9	4	0.077	29.501
R1	1	-0.75	2.894
R10	1	-0.259	275.025
R11	1	-0.217	263.167
R12	1	-0.5	62.8
R13	1	-1	0
R14	1	0	0
R15	1	1	0
R16	1	-1	0
R17	1	-1	0
R18	1	-1	0

R19	1	0	0
R2	1	-0.053	131.087
R20	1	0	0
R21	1	0	0
R23	1	0	0
R24	1	-1	0
R25	1	-0.2	0
R26	1	-1	0
R27	1	-1	0
R28	1	1	0
R29	1	-1	0
R3	1	-0.167	51.417
R4	1	0.231	166.681
R5	1	0.333	277.424
R6	1	0.6	155.033
R7	1	-0.3	153.012
R8	1	-0.12	288.574
R9	1	0.2	188.861
S1	6	0.111	99.862
S10	6	-1	0
S11	6	-0.5	0
S12	6	-1	0
S13	6	-1	0
S14	6	1	0
S15	6	0	0
S16	6	0.5	0
S17	6	0.222	0
S18	6	-1	0
S2	6	0.143	14.619
S3	6	-0.273	129.19
S4	6	-0.2	0
S5	6	0.5	18.475
S6	6	0	39.229
S7	6	0	3.581
S8	6	-0.2	212.865
S9	6	0.455	103.946

Appendix B

Core network:

Density: 0.156
Re-scaled E-I index: -.069
Group level E-I index:

Research:	-.034
Education:	1.000
Administration:	.511
Operations:	.130
Connectivity:	.529
Students:	.355

Affiliated network

Density: 0.064
Re-scaled E-I index: 0.141
Group level E-I index:

Research:	-.105
Education:	.905
Administration:	.389
Operations:	.141
Connectivity:	.600
Students:	.024

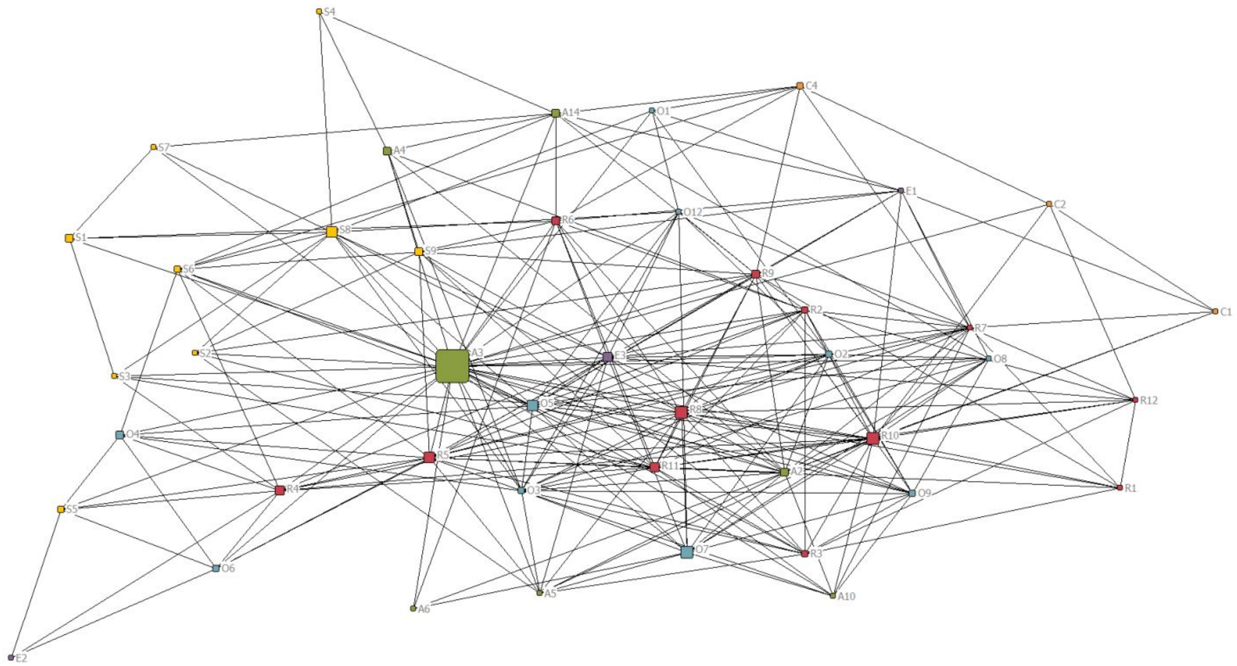

Figure A1:

illustration of the network of groups in the core group (n=44). Size of node indicates betweenness: the bigger, the higher the betweenness value. First letter in node name indicates domain: R – research, E – education, A – administration and governance, O – operations, C – connectivity, S – student.

Formulas to calculate betweenness and E-I index

Betweenness is defined by the following equation:

$$C_b = \sum \frac{g_{jk}(\mathrm{N}_i)}{g_{jk}} \;;$$

where g_{jk} *is the number of geodesic paths between the two nodes i and j and* $g_{jk}(N_i)$ *is the number of geodesics between j and k that contain node i.*

E-I index is defined by the following equation:

$E - I_{index} = \frac{E_L - E_I}{E_L + E_I}$; *where* E_L *is the number of external exchanges and* E_I *is the number of internal exchanges.*

Mapping social structures for sustainability transformation at McGill University, Canada

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ABSTRACT

Purpose: For a university to be a prime mover for sustainability transformation, all units of the university should contribute. However, organizational change in educational institutions is often studied by examining specific domains such as research or operation in isolation. This results in a less-than-complete picture of the potential for university-wide change. In contrast, we examine the network of social relations that determine the diffusion and sustainability of change efforts across a university. We use McGill University (Canada) as a model system to study the network of actors concerned with sustainability to learn how this network influences the penetration of sustainability throughout the university.

Design/ methodology/ approach: To explore the existing social structure, we use an innovative approach to illuminate the influence of social structure on organizational change efforts. Using a mixed methods approach combining social network analysis with qualitative interview data, we examine the influence of the social structure on sustainability transformation at McGill University. We conducted 52 interviews between January and April 2019 with representatives of different sustainability groups at the university across six domains (research, education, administration, operations, connectivity, students).

Findings: We find that McGill University has a centralized system with a low density. The network is centralized around the Office of Sustainability. The limited cross-domain interaction appears to be a result of differences in motivation and priorities. This leads to a network that has many actors but only a limited number of connections between them. The quality of the relationships is often utilitarian, with only a few relationships aiming for support and mutual growth.

Originality: This study brings together social network analysis, sustainability transformation, and higher education in a new way. It also illustrates the complexity of guiding a large organization, such as a university, towards a sustainability transformation. Furthermore, it reveals the importance of considering each part of the university as part of an interconnected network rather than as isolated components.

Keywords: transition, leverage point, complexity, relation, network

INTRODUCTION

Universities are important societal actors, as they educate future leaders, conduct research, are trusted entities in society, and in many countries, have significant endowments and own properties. Worldwide, universities have acknowledged their responsibility in society, noting that the generation and provision of knowledge is not enough to move society towards a sustainable future (Peer and Stoeglehner 2013). Making this acknowledgement a reality is sometimes called the ‘third academic revolution,’ reflecting universities’ moral obligation to move beyond the objective of academic excellence to actively address urgent societal sustainability topics (Crow 2010, Wright and Horst 2013). For a university to be part of this revolution, it needs to actively transform itself.

A sustainability transformation is a fundamental change in the interaction between humans and the environment (Olsson et al. 2014). Different to other ideas discussed in relationship with sustainability, the emphasis in sustainability transformation is on the *fundamental* nature of the change, which is required due to an untenable situatƒion of ecological and social conditions (Walker et al. 2004). While sustainability transformation is a comprehensive idea, we focus for the sake of this paper on aspects of a sustainability transformation in the context of a large organization (i.e., university). In order for a sustainability transformation to take place, people must engage with their norms, values, and power to (re)align them with sustainability, rather than focus on easy, ‘shallow’ fixes like reducing waste (Meadows 1999, Abson et al. 2017).

Change in large organizations is complex. The complexity is created by the number of individuals and sub-groups in an organization who pursue their own objectives and act along their own reasoning (Greenwood et al. 2011). Sustainability can only function as a long-term objective. It is unable to function as a short term objective despite attempts to do so in many organizations (Etzion 2018). Large organizations have the highest level of complexity if they are highly fragmented and moderately centralized. Fragmentation is a reaction of an organization to competing reasonings and objectives with the potential consequence of creating compartmentalized identities, which in turn exacerbate a transformation of the whole organization (Kraatz and Block 2008). Organizational strategy and structure are two aspects to manage organizational complexity (Greenwood et al. 2011).

Most large organizations have sustainability strategies. However, knowledge about the implementation of sustainability strategies is limited because most research has concentrated on the creation and content of these strategies (Engert et al. 2016). Organizational structure and organizational culture are factors influencings the implementation of sustainability strategies (Engert and Baumgartner 2016). Organizational structure is important because sustainability is a holistic topic concerning all units of an organization (Engert and Baumgartner 2016, Casarejos et al. 2017). As such organizational structures that promote and support the collaboration across existing (unit) boundaries help to foster the implementation of sustainability rather than creating frictions due to unclear competences and missing communications. Organizational culture puts an emphasis on organizational sense-making including underlying values and norms, and organizational learning rather than the content or number of sustainability activities. The lived and promoted values by members on all levels of an organization must align with the objectives of the sustainability strategy, otherwise other objectives are weighted as more important and sustainability objectives are dropped (Benn et al. 2018). Reflexive processes (organizational learning) can change knowledge and values and result in behavioural change in organizations, which in turn can help to align values, objectives, and activities (Siebenhüner and Arnold 2007).

Organizational structure is a network of units and people interacting with each other. Strategies and plans tend to reduce social action to the individual actor while organizational structure bring our attention to the fact that “a more likely source is the network of interactions and relations in which each actor is embedded" (Crossley and Edwards 2016). Change processes, including organization change, tend to be supported, constrained, and maintained through networks of social relations (Kolleck 2019). Connections within and across the units of an organization influence the agency of every individual unit and facilitate opportunities for knowledge sharing and knowledge transfer for the purposes of organizational change (Tenkasi and Chesmore 2003, Daly and Finnigan 2010). Lasting change is supported by interpersonal relationships rather than by specific plans and events (Mohrman et al. 2003). Both the individual relationships and the network impact the kind and trajectory of sustainability projects within an organization.

Scholarship on sustainability transformation also emphasizes the importance of social structures and norms and values to enable a transformation. The complexity of sustainability and the identification of pathways necessitates the involvement of as many people in an organization as possible who can shape and implement the change (Westley et al. 2011, Moore et al. 2015). The activities are either 'shallow' or 'deep' leverage points (Meadows 1999, Abson et al. 2017). While shallow activities (e.g., waste reduction) contribute to setting the stage (Fischer and Riechers 2019), a sustainability transformation requires people to act as moral entrepreneurs upholding norms as a moral compass for the transformation (Olsson et al. 2017). The relationships among people should not only exist but encourage the engagement with values and norms that motivate transformative activities (Lam et al. 2020). Fundamental change can only occur by engaging with values and norms. However, more research on sustainability transformation is needed to explore the interaction of multiple individuals and the consequences of the implementation of strategies (Olsson et al. 2014).

In the context of universities, research on organizational change has concentrated on the content and development of plans and strategies rather than on how organizational structure and culture influence the implementation of plans and strategies (Kezar 2014). Many universities have formulated university-level strategies and plans which need to be implemented on campus (Lozano et al. 2015, Dagiliūtė et al. 2018). Nevertheless, universities are often hindered by strategies or activities that focus on other objectives (e.g., economic development) (Bieler and

McKenzie 2017). In addition, universities that implement 'sustainability', often focus on either operations (e.g., waste management) or curricula (e.g., courses or programmes) (Dagiliute and Liobikiene 2015). However, the intentionality and holism of sustainability, requires that all domains of a university (operations, teaching, research, administration, outreach) pursue the same objective for a sustainability transformation (Alshuwaikhat and Abubakar 2008, Casarejos et al. 2017). At the same time, the network of interactions and relations found at universities tend to be invisible webs of influence hidden from the people embedded in them (O'Reilly et al. 1991).

A more in-depth investigation is needed to reveal how the structure of a university and the resulting culture influence its potential to undergo organizational change for a sustainability transformation (Hoover and Harder 2015). In this paper, we set out to understand how organizational structure and culture affect the possibility of a university to join the 'third academic revolution' and transform towards sustainability. We conduct a social network analysis of sustainability groups (sustainability actors) at McGill University (Canada). To not only reveal the existing organizational structure, but also the organizational culture, interviews conducted during the data collection help us to understand how the network and the promoted culture influence the penetration of sustainability throughout different units, activities, and members of the university (and beyond).

THEORY

In a social system, the quality of the ties between groups and individuals creates a structure to constrain or support opportunities for social capital transactions (Granovetter 1973, Lin 2001, Putnam 2002, Daly and Finnigan 2010). Social capital in this context can be defined as an actor's access to resources such as knowledge, advice, innovation, and the ability to mobilize these resources to effect change (Lin 2001). Social network theory assumes an actor's attributes alone cannot explain behavior or social capital. It is an understanding of the connections between actors that has the potential to illuminate the behavior and social capital of individual actors and reveal the possibilities of the overarching network (Borgatti et al. 2009). Using a social network theory approach, these social relations can be examined and measured in a variety of ways to help understand what the social structure is and how it influences the activities of the overall network.

An actor's centrality in a network describes a measure of power because of their position in the network. A count of the number of times an actor is positioned between two otherwise disconnected actors is called *betweenness centrality*. Thus, an actor with a high betweenness centrality bridges groups that are not directly connected which can result in the sharing of knowledge and practices across the network. Forming bridges with those who have previously been disconnected can increase trust and group cohesion and flatten hierarchies. An actor with a high betweenness measure can broker with actors from different affiliation groups to their own. This position not only provides access to information and resources, but also provides the opportunity to either control or gatekeep the penetration of sustainability ideas and resources between separate parts of the network or between networks. A high betweenness measure tends to indicate a position of power or control.

The penetration of ideas or resources across a boundary can be initiated by an actor interacting across a boundary, the broker. The boundary may be an affiliation boundary such as membership in a particular group. The penetration of ideas or resources is not only dependent on the broker's number of relations, but also on the position of the broker. An actor with many ties outside of their own domain (group of similar actors) will have greater access to non-redundant information. An actor with many internal ties will have a greater flow of ideas, but much of the information will be redundant (Burt 2001). A measure of the degree to which a network is more externally or internally focused can be attained using the *E-I index* to compare the number of ties between groups and within groups. Networks with an external focus have demonstrated a capacity for successful organizational change (Krackhardt and Stern 1988, Daly and Finnigan 2010). University groups with a greater ratio of external ties to internal ties will be better positioned to support the introduction and sharing of non-redundant ideas and practices (Burt 2001) regarding sustainability. The E-I index can theoretically range between -1 (all ties internal to own domain) and +1 (all ties external to domain). However, number of domains, number of groups in each domain, and number of ties restrict the possible values of the E-I index. For this reason, we used the re-scaled E-I index which takes the restricting factors into consideration.

Additional measures can be calculated for an entire network, such as the density of the network. *Density* is a measure of the number of ties in the network as a fraction of the total possible number of ties (Carolan 2014). Within dense networks the multiple ties between each node result in the flow of redundant resources. In addition, dense networks tend to demonstrate social cohesion. Social cohesion may include feelings of trust and security among member (Moolenaar and Sleegers 2010), but it may also result in enforced norms of conduct (Burt 2001).

METHODS and CASE STUDY

CASE STUDY

For over twenty years, McGill University (Canada) has been working on different aspects of sustainability. Early work focused on its own environmental policy, operations, and environmental education, and left out aspects such as inter-university collaboration, interdisciplinary curricular, and public outreach (Wright 2002). Over the last decade, the university has taken major steps towards an integrated sustainability approach through all domains and is nowadays a 'progressive' university in Canada concerning sustainability (Bieler and McKenzie 2017). McGill has committed to a Sustainability Strategy with two major goals: (1) to achieve the AASHE Platinum Status in 2030 and (2) carbon-neutrality in 2040. In addition, the university has founded the McGill Office of Sustainability (MOOS) which coordinates, among other things, the largest university sustainability project fund (SPF) in Canada (annual budget of around 980,000 CAD). In research, in addition to many individual faculty members, groups, and projects on sustainability-related topics, the university has invested around 10 million CAD into the McGill Sustainability Systems Initiative (MSSI) with the aim to coordinate, initiate, and amplify sustainability research throughout all faculties. These activities, commitments, and investments have created a sustainability scene at McGill University.

We use McGill University as a model organization, in which the university has publicly committed to sustainability. Sustainability activities are well-established and consequently this university is a suitable context for studying the network of sustainability actors and how this network influences the penetration of sustainability throughout domains, activities, and members of the university (and beyond) to join the 'third academic revolution' and promote a sustainability transformation.

DATA COLLECTION AND ANALYSIS

To study the network of sustainability actors, we conducted 52 interviews between January and April 2019 with representatives from different sustainability groups at the university. We use the term (sustainability) group for different types of entities at the university including student groups, administrative or operational units, faculties, departments. We used snowball sampling to select our interviewees and started our interview series with representatives of MOOS and MSSI. Two persons declined our interview requests, but we succeeded in recruiting other members of their groups for an interview. We continued to do interviews until we reached no new names were suggested. Interviews took thirty to sixty minutes and were conducted in a location suggested by interviewees. All interviews were taped and transcribed with the written consent of the interviewees allowing us to identify the group they were representing. For this publication, we decided to only identify MOOS in the following sections. An anonymous code was used for smaller groups in which it would have been easier to identify individuals.

McGill University defines five domains for its sustainability work: (1) research, (2) education, (3) governance and administration, (4) operations, (5) connectivity (MOOS 2017). We added a sixth domain 'students' as we identified them as key sustainability actors whose work does often not fit into the five other domains because students' status poses own opportunities and challenges. We assigned all interviewed groups to one of the six domains based on the focus of their work. Certain groups (e.g., departments, faculties) fit in multiple domains (e.g., research and education). We conducted multiple interviews within some groups because either multiple people in the group were working on sustainability or because during the interview of the first person, it became obvious that we should talk with another person who had more or additional insights. For the network analysis, we merged the information of these representatives as our network analysis is on the group level. For example, we conducted two interviews with representatives of the Faculty of Science and in our analysis the information is combined as Faculty of Science without a differentiation of interviewee. In the following sections, we refer to the interviewed groups with a code consistent of a letter based on their domain (e.g., A for administration) and a number to differentiate between groups, i.e., A2 is the second administrative unit in our list.

During the interviews, we collected information about with whom and how interviewees were interacting on issues related to sustainability. We digitalized this information and created network visualizations using the software Netdraw (Borgatti et al. 2002). We used the UCINET software (Borgatti et al. 2002) to calculate the betweenness centrality, the re-scaled external-internal (E-I) index, and the density of the network (Appendix B).

We built two networks: the 'core network' and the 'affiliated network'. The core network contains only groups that we interviewed. Since we interviewed until saturation, we call this group 'core network'. During the interviews, our interviewees named additional groups they were working with on sustainability-related issues but did not suggest that we interview them. In our 'affiliated network', we included all groups from the core network and all groups that were named at least twice, but never suggested as potential interviewee partners.

RESULTS

Our 52 interviews can be organized into 44 groups in the six domains (Appendix A): 12 in the research domain, 3 in education, 7 in governance and administration, 10 in operations, 3 in connectivity, and 9 in students. Our interviewees named almost 200 groups on and off campus with whom they were working on sustainability issues of all kinds. About 75% of the other groups that our interviewees identified, were part of the university. There were 81 groups that were named by at least two interviewees independently (Figure 1). These 81 groups make up the affiliated network, while the 44 interviewed groups are the core network (Appendix B).

Around 50,000 people are affiliated with McGill which provides a big potential ground for engaged actors. However, an interviewee summarized that the actual amount of people working on sustainability issues is much smaller, saying *"[…] you're going to find a lot of the same people […] it's really this much smaller network"* (R8). Another interviewee confirmed the perception by stating, *"I keep running into a lot of the same people on the various sustainability initiatives on campus. So, I might work with someone on one thing, and then see them working on a completely different initiative"* (O2). While this situation might allow actors, who are deeply engaged to get to know each other, it limits the penetration of sustainability throughout the whole university.

Network influence on sustainability penetration

We find a centralized system with a low density. The network is centralized around the Office of Sustainability (MOOS – A3). The E-I indices suggest that the domains in the core network tend to be separated and maintain many connections within their domain and fewer outside it. This leads to a network that has many actors but only a limited number of connections between them and thus a low density.

Betweenness centrality

MOOS has by far the highest betweenness values (Figure 1, Appendix A, B). The high values suggest that MOOS has a large influence in the university concerning sustainability. MOOS is aware of its role as the center of sustainability activities at the university: *"We are kind of the central hub to solidify this network"* (MOOS). The central role of MOOS is also recognized by superior units to which MOOS reports. For example, a member of such a unit stated that all sustainability projects at McGill have been spearheaded by MOOS. This central role of MOOS means other groups in the network rely heavily on MOOS. They mainly turn to MOOS for financial support or knowledge to start and execute their own projects and activities on sustainability:

> *"We had initial support from [MOOS] to get all this going, which believe me, I would not have done if it wasn't for them" (O6)*

> *"So, she [member of MOOS] actually came and helped our office develop our sustainability plan…" (A5)*

> *"[…] a lot of the funding that we've gotten for past projects came from them [MOOS]" (S5)*

The high betweenness values make MOOS the ideal broker or gatekeeper of the network. According to our interviews, MOOS is the central for information and support: *"MOOS connects with all the people in the university […]. They [MOOS] share knowledge"* (R11). Nevertheless, only a few interviewees had experienced MOOS as a facilitator to help the interviewee's group to build relationships with other groups. In one case, an interviewee referred to the endeavor of MOOS to coordinate different gardening projects: *"It's basically to coordinate all of them [urban gardens], see what their needs are through the Office of Sustainability"* (O3). However, most of the time our interviewees talked about their connection with MOOS as a one-to-one connection in which they connect with MOOS about a certain topic, but beyond that with no other groups.

> "*And in this [project], I collaborated with the Office of Sustainability*." (O9)

> "*Actually, my only partner now is the Office of Sustainability*." (O1)

> "*We have a good relationship with them [MOOS] and try and work on as many projects that we can together*." (O4)

Only one interviewee remembered that MOOS facilitated to connect them with other groups working on similar topics: "*So, when somebody has something that touches on [focus of job description] that I'm working on, they will often approach MOOS, who will then facilitate and link it up with me*" (O10). This indicates that MOOS, despite its central position, does not always act as a broker and bridge, but as a gatekeeper which might be unintentionally.

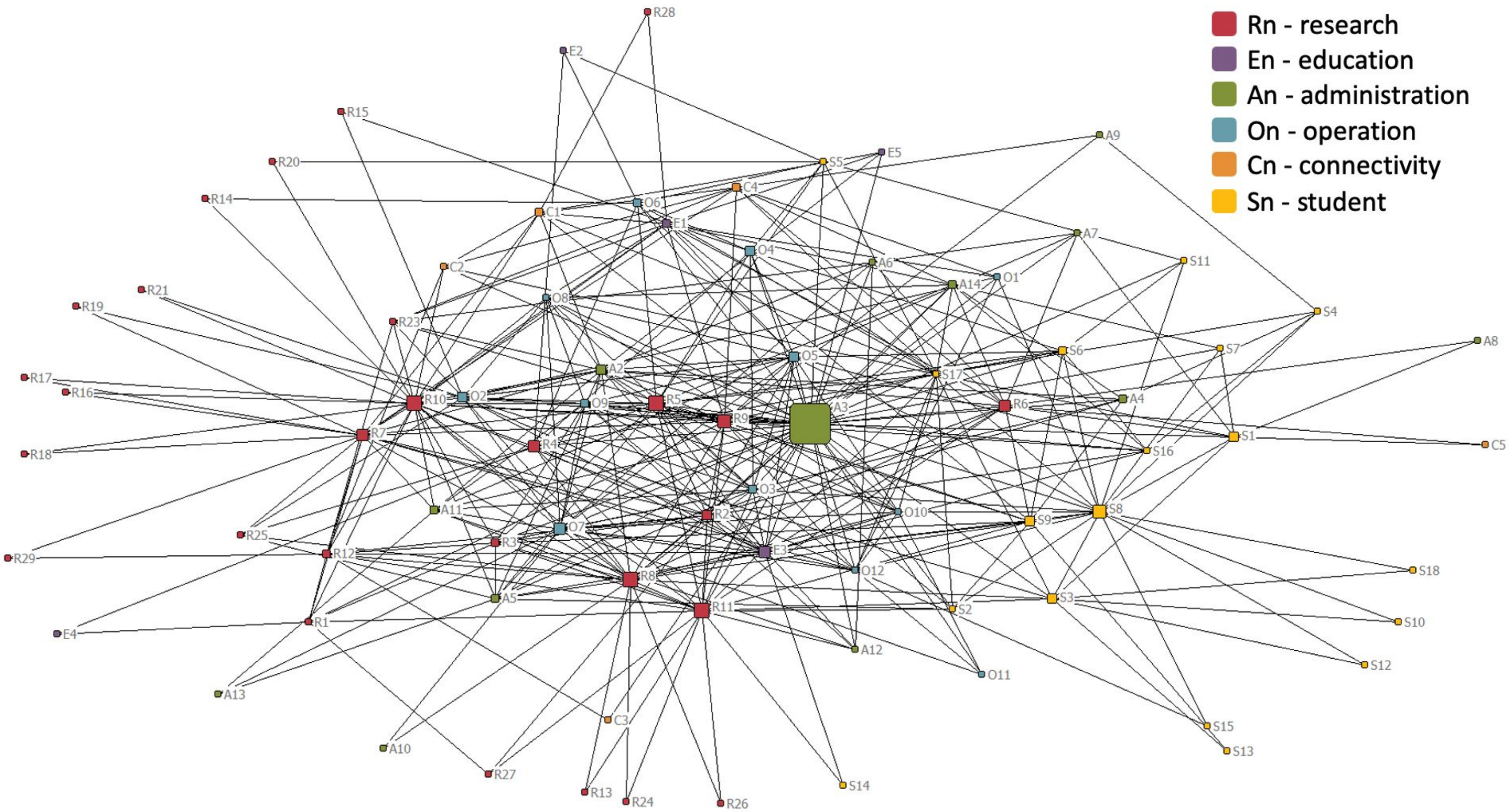

Figure 1: Affiliated social network. Size of nodes illustrates relative betweenness values of nodes. Color and first letter of code indicate domain. Red – R: research; purple – E: education; green – A: administration and governance; blue – O: operations; orange – C: connectivity; yellow – S: student.

Looking at the other groups and their betweenness values, multiple faculties, R11, S8, and O7 have high betweenness values compared to the rest of the network, but low betweenness values compared to MOOS. All these groups except O7 act as umbrella organizations to bring together a variety of others so the higher betweenness values are not surprising. For example, the objective of the R11 is to create a network of sustainability researchers *("[…] one of the things that we want to do is create this network.")*. The betweenness value of R11 is higher in the affiliated network as they work with researchers who work on sustainability related research but not in the context of the university. Thus, R11 is in the position to connect to researchers at the edge of the sustainability network. O7's betweenness values can be explained by the working philosophy of the person in charge, who actively strives for collaboration with other people and even created an own committee on sustainability within their working topic which meets *"like three or four times a year"* (O7). This is remarkable as we could not identify other actors in the sustainability network who actively strive to create and maintain a network of actors across the university around their topic.

Groups in various domains have very low betweenness values which shows that they are not connecting to the broader network of sustainability actors. There are multiple possible reasons for this lack of connection, including: a) sustainability is not the main concern of their activities (A6), b) their activities and objectives are focused, and they do not feel the need to connect with other groups (O1, O10), or c) their activities focus more outside McGill University (S4).

E-I index

The re-scaled E-I index for the core network is -0.069 (p < .01) which indicates that the overall structure shows a compartmentalisation of the individual domains. All domains have a positive E-I index except of the research domain which has an E-I index of -0.034. The three domains education, governance and administration, and connectivity all have an E-I index between 1.0 and 0.5 (1.000, 0.511, and 0.529 respectively) indicating that these domains are the backbone of the sustainability network as they connect across domains. More than two thirds of the groups in the core network have a positive E-I index (Table 1) - having more relationships with groups outside their domain than within their domain. Four groups have an E-I index of +1.0 which means that they have only ties with groups in other domains. Remarkably, three of them (E1, E2, E3) are groups in the education domain. All three groups work in different ways and on various aspects of sustainability, but they do not connect with each other. This might have to do with their physical location and institutional affiliation. Seven groups in the core network have a negative E-I index - mainly working with groups in their domain. Five of the seven are associated with research (R1, R2, R3, R11, R12).

Table 1: interviewed groups with their EI for the core network (middle column) and the affiliated network (right column).

Groups	EI core network	EI affiliated network
A10	0.5	1
A14	0.6	0.636
A2	0.412	0.4
A3	0.647	0.619
A4	0.143	0.143
A5	0.6	0.5
A6	0	-0.143
C1	0.6	0.6
C2	0.2	0.333
C4	0.714	0.6
E1	1	0.846
E2	1	1
E3	1	1
O1	0.333	0.333
O12	0	0.077
O2	-0.077	0.125
O3	0.222	0.222
O4	0.25	0.4
O5	0.059	0.111
O6	0.429	0.556
O7	0.143	0.158
O8	0	-0.091
O9	0.167	0.077
R1	-1	-0.75
R10	0	-0.259
R11	-0.294	-0.217
R12	-0.556	-0.5

R2	-0.286	-0.053
R3	-0.167	-0.167
R4	0.333	0.231
R5	0.222	0.333
R6	0.5	0.6
R7	0	-0.3
R8	0	-0.12
R9	0.176	0.2
S1	-0.2	0.111
S2	0.333	0.143
S3	0.333	-0.273
S4	0.333	-0.2
S5	1	0.5
S6	0.556	0
S7	0	0
S8	0.077	-0.2
S9	0.6	0.455

The calculated E-I indices in the affiliated network reflect the findings in the core network. All domains have a positive E-I index except research which has an E-I index of -0.105. Particularly, the education and the connectivity domain have high positive E-I indices (0.905 and 0.600 respectively) showing that groups in these domains are more likely to connect with groups outside their own domain. Almost 40% of the groups have a negative E-I index of which seventeen groups are part of the research domain and eight groups in the student domain.

The E-I index results suggest that research groups are poorly positioned for disseminating their resources and ideas outside their domain. It seems that researchers are more isolated than actors in other domains. The knowledge and practices of researchers appear to be limited to a closed group at the university. In our interviews, many of the interviewed researchers confirm our finding by elaborating that they entertain a *"network of scholars"* (R1) and a "*collaboration with researchers"* (R12). The relationships seem to be built on similar behavioural patterns and outcome interests. One interviewee explains when asked how relationships are created *"It can sometimes just be at the level of going to the same talks, chatting afterwards, talking about the research, they are my colleagues […] but these are people I interact with pretty commonly" (R8)*.

The quality and purpose of the relationship is clearly expressed *"I have a paper – so these are true collaborators – not just people I have coffee with" (R10)*.

Density

Both the core and the affiliated network have low densities. In the affiliated network only 6.4% of all possible ties in the network are reported. The density of the core network is higher (15.6% of all possible ties occurred), but still low enough to suggest that relatively few sustainability-oriented interactions take place. One of the interviewees reflected, *"I think that anyone of those institutes [on sustainability] or any of those units, anyone of those projects or programs could probably punch above its weight a lot more if there were more connective tissue among them"* (R8). Occasionally, interviewees talked about coordination or networking meetings, but these meetings were never regular or aiming to reach out to additional groups. Most relationships that people reported were one-to-one relationships in which they work with one other group to exchange information, develop policies, or realize a project.

Umbrella organizations like R11 understand that they had a good position to build their own network (*"that really provides me with a great base for networking"* R11), but they worked with individuals (*"we really connect with individuals"* R11) rather than trying to build connections across the network and thus making themselves less central. Many of the umbrella organizations have annual meetings that bring together groups within their domain, but these annual meetings are mainly to share information, rather than to work together. We find the same pattern in S8 that describes itself *"as a liaison"* (S8) sharing and gathering information highlighting that *"the biggest thing is the ability to bring different groups together"* (S8). The most obvious umbrella organization, MOOS, mentions its objective *"to solidify this network"* (MOOS). Nevertheless, they work a lot with individual groups and do not appear to create spaces where groups can meet and initiate collaboration.

Our interviewees described mainly relationships with a utilitarian character used for information sharing and usage of specific resources (e.g., facilities, knowledge, funding).

"They [other group] use our garden." (S3)
"We're just three different clients under one contract." (O10)
"They use them [fellowship group] for seed money." (R2)
"They [MOOS] have resources that we really appreciate." (O8)

It is remarkable that only groups with low betweenness values talked about relationships to other groups and people that have an explicit value or learning aspect:

"[…] and really explicitly trying to learn from each other" (S1)
"It's really meant to be creating a robust support" (A6)
"[…] to think about how we can support each other […]" (C1).

This sense of trust and community might be missing in the more utilitarian relationships. This in turn might hinder the engagement with values and norms and 'deeper' change. The predominately utilitarian relationships might impede the stability of the existing sustainability network and inhibit the growth of the network as certain actors will look for relationships that are built on commonality rather than opportunity.

The relatively few interactions of groups to develop together sustainability ideas and practices suggest room for growth, however, the low densities also suggests that each group is connecting with diverse audiences (inside and outside the university) to convey complex ideas by spanning multiple communities of practice (Reagans and McEvily 2003).

DISCUSSION

Our results show that McGill's sustainability network has the characteristics of a centralized system with a low density, meaning that many sustainability groups work on their own, and most relationships with others have a utilitarian character (e.g., when in need of resources or information). Through the interviews, we learned that each domain has their own objectives, motivations, and reasonings. Overall, sustainability activities are mainly related to environmental sustainability as opposed to social sustainability. Finally, and importantly many networking events have the purpose of information sharing rather than creating common understandings and objectives, limiting the university's ability to undertake deeper change that engages values and culture.

While the literature on sustainability transformation indicates that deeper engagement with culture and norms is required for transformation, most sustainability activities described in the interviews aim for sustainability fixes (e.g., energy saving) rather than engaging with values and norms. An array of groups works on different aspects of sustainability; however the organizational culture seems to encourage more 'shallow' activities than fundamental changes. For example, most urban gardens appear to be motivated by food production without engaging with questions around food insecurity. This corresponds with research on sustainability activities, showing that many sustainability activities and initiatives are limited in their contribution to a sustainability transformation as they aim for tangible fixes which do not generally change the root causes of the problem (Abson et al. 2017). This is not to say that these activities might not initiate a deeper change in engaged individuals, but their primary objective is more mechanistic (Fischer and Riechers 2019). In this sense, McGill University has prepared the system for a sustainability transformation.

A few initiatives have tried to change institutional structures and objectives but have thus far met limited success. To overcome this situation, organizational learning could be encouraged. This includes creating opportunities to reflect on norms, values, and one's own activities (Siebenhüner and Arnold 2007). Such learning could be promoted with events that encourage reflection on one's own norms and values and how they align with the objectives of the university. External or internal crises or changes could create a window of opportunity allowing the university to change fundamental structures, rules, and norms (Herrfahrdt-Pähle et al. 2020). During the COVID-19 pandemic, the university was predominately in an online teaching and telework mode. However, no major policies or strategies have been published that would allow us to suspect a sustainability transformation to be initiated, or a fundamental reconsideration of values and objectives of the organization.

Another part of the organizational culture, the weak intensity of collaboration between different groups working on sustainability, is reflected in the low density of the network and the betweenness centrality of MOOS being much higher than the centrality of any other group. This means that the resilience of the network is limited as it relies heavily on MOOS. More links between groups who are not currently connected would increase the density and balance the betweenness centrality. Higher density values indicate more trust and cohesion in the network since more direct interaction and communication is possible. To this end, O7 stands out as it is actively striving to maintain relationships with other sustainability groups inside and outside the university. While many groups look to MOOS for guidance, O7 demonstrates that it is possible for individual groups to increase the density of the network, connect across domains, and create their own role in the network. In this way, a common understanding and shared responsibility for the sustainability of the organization can be built.

The limited number of connections between the sustainability groups is also reflected in the fragmentation of the university into domains with own reasonings and objectives, as is the case at most large organizations. Here, organizational culture and structure work together to enforce the complexity of the university. The internal reasonings of each domain are a challenge to increasing the number of connections in the network. That is, each domain has its own objectives and ways of operating that make collaboration across domains challenging. For example, researchers expressed a desire to produce scientific publications as an outcome. The interest in publications makes it harder for groups in other domains to be relevant for the research domain. It is typical for large organizations to experience fragmentation since objectives are not aligned between individuals, subgroups, and the organization (Greenwood et al. 2011). These multiple reasonings foster the identity of individual domains, but also hamper organizational change (Kraatz and Block 2008). In order to implement fundamental change, the current fragmentation would need to be overcome by aligning objectives (Hoffman et al. 2011).

Organizational culture seems to hamper engagement with fundamental change at McGill University, where we find many sustainability activities and public commitment to sustainability, but little engagement with values and norms that could contribute to more fundamental changes. So how to move the university as a large organization into a space where fundamental change can happen? Activities both in the sustainability network of the university but also in the leadership of the university could help to initiate a sustainability transformation at the university.

The groups in McGill's sustainability network might benefit from interactions to foster engagement with values and norms, thereby progressing beyond information and resource sharing. Such interactions could also bring groups with low betweenness from the periphery into the core of the network by pursuing relationships that aim at support, learning, and value-sharing. As such the interactions could strengthen the sustainability of the network, bringing in additional groups, and engaging with aspects crucial for a fundamental change. Engaging with values might also encourage more interactions with issues of social sustainability in the network. Lastly, such interactions could identify moral entrepreneurs who are vocal about the values and norms which contribute to a sustainability transformation (Olsson et al. 2017).

If the university wants to join the 'third academic revolution', it must embrace the values of this revolution (i.e., redefine what a university is) and immunize itself from external identity pressures by bringing different reasonings and objectives together (Kraatz and Block 2008). A first step would be to include sustainability in its mission statement which currently focuses on research. Another possible activity could be to facilitate and encourage connections with the surrounding communities in the city. We find only a few connections between the sustainability groups and local groups in the city. McGill University is often seen as an entity destined for higher, bigger, and better (hampton 2020). Little contact to the world outside the university is not a unique phenomenon to McGill University. While universities are seen as potential role models for society, outreach is often neglected in the sustainability activities of a university (Shawe et al. 2019). Overall, Canadian universities have shown a lack of engagement with the local, but also wider community concerning sustainability (Bieler and McKenzie 2017). Clear incentive systems such as recognition in grades, performance reviews, and tenure packages are ways for university leadership to show that the connection of the university to its surrounding are important and encouraged.

We see two major avenues for future research coming out of our work. One concerns the use of social network analysis to understand how sustainability transformation takes place especially in large organizations. Future research can contribute to an understanding of which structures in large organizations are beneficial for promoting a sustainability transformation, rather than fostering shallow activities that fail to question fundamental norms and values. Another avenue for future research is an exploration of sustainability activities at universities and other educational organizations. So far, there is no ready-to-apply scheme to classify sustainability activities as shallow or deep sustainable leverage points (and more refined). We have used our qualitative understanding of these concepts for our analysis. However, such a scheme could help to standardize and create more comparable findings.

CONCLUSION

Based on the existing literature on sustainability in higher education and the broader literature on organizational change for sustainability, we can assume that McGill University is not alone in making a commitment to sustainability and taking on many sustainability-oriented activities, while simultaneously missing the opportunity to make more fundamental changes in the form of a sustainability transformation. Our social network analysis with the interview material afforded an understanding of the organizational structure and culture and their effect on the penetration of sustainability through the university.

Universities can join the third academic revolution by analyzing the alignment of the values and objectives currently held by individuals and groups within the university to the values and objectives needed for a sustainability transformation. In addition, already active sustainability groups should collaborate to not only prepare the ground with well-intended, tangible sustainability activities but also to create possibilities to engage with values and align them with sustainability objectives. These interactions will require time and resources but are necessary for a sustainability transformation. Rather than a focus on activities such as research excellence, a fundamental change of norms and values is needed to pave the way for prioritizing the activities that are crucial to our quest for a just and sustainable future. In this way, universities can be the crucial societal actors for the sustainability transformation they aim to be.

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REFERENCES

Abson, D. J., J. Fischer, J. Leventon, J. Newig, T. Schomerus, U. Vilsmaier, H. von Wehrden, P. Abernethy, C. D. Ives, N. W. Jager, and D. J. Lang. 2017. Leverage points for sustainability transformation. *Ambio* 46(1):30–39.

Alshuwaikhat, H. M., and I. Abubakar. 2008. An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices. *Journal of Cleaner Production* 16(16):1777–1785.

Benn, S., M. Edwards, and T. Williams. 2018. *Organizational Change for Corporate Sustainability*. 4th edition. Routledge, Abingdon, Oxon; New York, NY.

Bieler, A., and M. McKenzie. 2017. Strategic planning for sustainability in Canadian higher education. *Sustainability* 9(2):1–22.

Borgatti, S. P., M. G. Everett, and L. C. Freeman. 2002. *UCINET for Windows: Software for Social Network Analysis*.

Borgatti, S. P., A. Mehra, D. J. Brass, and G. Labianca. 2009. Network Analysis in the Social Sciences. *Science* 323(5916):892–895.

Burt. 2001. Structural holes versus network closure as social capital. Page *in* N. Lin, K. Cook, and R. S. Burt, editors. *Social Captial: Theory and research*. Walter de Gruyter, New York.

Carolan, B. 2014. *Social Network Analysis and Education: Theory, Methods & Applications*. SAGE Publications, Inc., Thousand Oaks.

Casarejos, F., M. N. Frota, and L. M. Gustavson. 2017. Higher education institutions: a strategy towards sustainability. *International Journal of Sustainability in Higher Education* 18(7):995–1017.

Crossley, N., and G. Edwards. 2016. Cases, Mechanisms and the Real: The Theory and Methodology of Mixed-Method Social Network Analysis. *Sociological Research Online* 21(2):217–285.

Crow, M. M. 2010. Organizing Teaching and Research to Address the Grand Challenges of Sustainable Development. *Bioscience* 60(7):488–489.

Dagiliute, R., and G. Liobikiene. 2015. University contributions to environmental sustainability: Challenges and opportunities from the Lithuanian case. *Journal of Cleaner Production* 108:891–899.

Dagiliūtė, R., G. Liobikienė, and A. Minelgaitė. 2018. Sustainability at universities: Students' perceptions from Green and Non-Green universities. *Journal of Cleaner Production* 181:473–482.

Daly, A. J., and K. S. Finnigan. 2010. A bridge between worlds: understanding network structure to understand change strategy. *Journal of Educational Change* 11(2):111–138.

Engert, S., and R. J. Baumgartner. 2016. Corporate sustainability strategy – bridging the gap between formulation and implementation. *Journal of Cleaner Production* 113:822–834.

Engert, S., R. Rauter, and R. J. Baumgartner. 2016. Exploring the integration of corporate sustainability into strategic management: a literature review. *Journal of Cleaner Production* 112:2833–2850.

Etzion, D. 2018. Management for sustainability. *Nature Sustainability* 1(12):744–749.

Fischer, J., and M. Riechers. 2019. A leverage points perspective on sustainability. *People and Nature* 1:115–120.

Granovetter, M. S. 1973. The Strength of Weak Ties. *American Journal of Sociology* 78(6):1360–1380.

Greenwood, R., M. Raynard, F. Kodeih, E. R. Micelotta, and M. Lounsbury. 2011. Institutional Complexity and Organizational Responses. *Academy of Management Annals* 5(1):317–371.

hampton, rosalind. 2020. *Black racialization and resistance at an elite university*. University of Toronto Press, Toronto.

Herrfahrdt-Pähle, E., M. Schlüter, P. Olsson, C. Folke, S. Gelcich, and C. Pahl-Wostl. 2020. Sustainability transformations: socio-political shocks as opportunities for governance transitions. *Global Environmental Change* 63:102097.

Hoffman, B. J., B. H. Bynum, R. F. Piccolo, and A. W. Sutton. 2011. Person-Organization Value Congruence: How Transformational Leaders Influence Work Group Effectiveness. *Academy of Management Journal* 54(4):779–796.

Hoover, E., and M. K. Harder. 2015. What lies beneath the surface? The hidden complexities of organizational change for sustainability in higher education. *Journal of Cleaner Production* 106:175–188.

Kezar, A. 2014. Higher Education Change and Social Networks: A Review of Research. *The Journal of Higher Education* 85(1):91–125.

Kolleck, N. 2019. The emergence of a global innovation in education: diffusing Education for Sustainable Development through social networks. *Environmental Education Research* 25(11):1635–1653.

Kraatz, M. S., and E. S. Block. 2008. Organizational Implications of Institutional Pluralism. Pages 243–275 *The SAGE Handbook of Organizational Institutionalism*. SAGE Publications Ltd, London.

Krackhardt, D., and R. N. Stern. 1988. Informal Networks and Organizational Crises: An Experimental Simulation. *Social Psychology Quarterly* 51(2):123.

Lam, D. P. M., B. Martín-López, A. I. Horcea-Milcu, and D. J. Lang. 2020. A leverage points perspective on social networks to understand sustainability transformations: evidence from Southern Transylvania. *Sustainability Science*.

Lin, N. 2001. *Social Capital: A Theory of Social Structure and Action*. First edition. Cambridge University Press.

Lozano, R., K. Ceulemans, M. Alonso-Almeida, D. Huisingh, F. J. Lozano, T. Waas, W. Lambrechts, R. Lukman, and J. Hugé. 2015. A review of commitment and implementation of sustainable development in higher education: Results from a worldwide survey. *Journal of Cleaner Production* 108:1–18.

McGill Office of Sustainability (MOOS). 2017. *Vision 2020 - Climate & Sustainability Action Plan 2017 - 2020*.

Meadows, D. H. 1999. *Leverage points: Places to intervene in a system*. The Sustainability Institute, Hartland.

Mohrman, S. A., R. V. Tenkasi, and A. M. Mohrman. 2003. The Role of Networks in Fundamental Organizational Change: A Grounded Analysis. *The Journal of Applied Behavioral Science* 39(3):301–323.

Moolenaar, N. M., and P. J. C. Sleegers. 2010. Social networks, trust, and innovation: The role of relationships in supporting an innovative climate in Dutch schools. Pages 97–114 *in* A. J. Daly, editor. *Social network theory and educational change*. Harvard Univ. Press, Cambridge, MA.

Moore, M.-L., D. Riddell, and D. Vocisano. 2015. Scaling Out, Scaling Up, Scaling Deep: Strategies of Non-profits in Advancing Systemic Social Innovation. *Journal of Corporate Citizenship* 2015(58):67–84.

Olsson, P., V. Galaz, and W. J. Boonstra. 2014. Sustainability transformations: A resilience perspective. *Ecology and Society* 19(4).

Olsson, P., M. L. Moore, F. R. Westley, and D. D. P. McCarthy. 2017. The concept of the Anthropocene as a game-changer: A new context for social innovation and transformations to sustainability. *Ecology and Society* 22(2).

O'Reilly, C. A., J. Chatman, and D. F. Caldwell. 1991. People and Organiyational Culture: A Profile Comparison Approach to Assessing Person-Organization Fit. *Academy of Management Journal* 34(3):487–516.

Peer, V., and G. Stoeglehner. 2013. Universities as change agents for sustainability-framing the role of knowledge transfer and generation in regional development processes. *Journal of Cleaner Production* 44:85–95.

Putnam, R. D. 2002. *Democracies in Flux*. Oxford University Press, Oxford; New York.

Reagans, R., and B. McEvily. 2003. Network Structure and Knowledge Transfer: The Effects of Cohesion and Range. *Administrative Science Quarterly* 48(2):240.

Shawe, R., W. Horan, R. Moles, and B. O'Regan. 2019. Mapping of sustainability policies and initiatives in higher education institutes. *Environmental Science & Policy* 99:80–88.

Siebenhüner, B., and M. Arnold. 2007. Organizational learning to manage sustainable development. *Business Strategy and the Environment* 16(5):339–353.

Stephens, J. C., M. E. Hernandez, M. Román, A. C. Graham, and R. W. Scholz. 2008. *Higher education as a change agent for sustainability in different cultures and contexts*.

Tenkasi, R. V., and M. C. Chesmore. 2003. Social Networks and Planned Organizational Change: The Impact of Strong Network Ties on Effective Change Implementation and Use. *The Journal of Applied Behavioral Science* 39(3):281–300.

Walker, B., C. S. Holling, S. R. Carpenter, and A. Kinzig. 2004. Resilience, Adaptability and Transformability in Social-ecological Systems. *Ecology & Society* 9(12):art5.

Westley, F., P. Olsson, C. Folke, T. Homer-Dixon, H. Vredenburg, D. Loorbach, J. Thompson, M. Nilsson, E. Lambin, J. Sendzimir, B. Banerjee, V. Galaz, and S. Van Der Leeuw. 2011. Tipping toward sustainability: Emerging pathways of transformation. *Ambio* 40(7):762–780.

Wright, T., and N. Horst. 2013. Exploring the ambiguity: What faculty leaders really think of sustainability in higher education. *International Journal of Sustainability in Higher Education* 14(2):209–227.

Wright, T. S. A. 2002. Definitions and frameworks for environmental sustainability in higher education. *International Journal of Sustainability in Higher Education* 3(3):203–220.

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