Institutionalizing Team Science:
Empirical Evidence from Faculty and Lessons from Political Science

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Abstract: Contemporary research often necessitates a collaborative or "team science" approach within universities. Although discussion of such approaches is quite common in the relevant literature, there is a lack of concrete guidance on how to effectively administer and foster team science. Existing analysis tends to run up against "how" and "where" barriers concerning institutional structure. For example, does primary responsibility for incentivizing team science lie at the department level or at the university level? To contribute to this scholarly discussion, we bring multi-level governance (MLG) concepts from political science to bear on the issue of team science administration in universities. That is, we suggest that different levels of university administration can be theorized in a similar manner to different levels of government, allowing us to utilize a variety of theoretical concepts, such as subsidiarity and type-I and type-II MLG. We ask: in what ways are these concepts able to generate practical guidance for team science administration? To answer this, we draw upon qualitative data from focus groups about team science among faculty and research centre representatives at the University of Saskatchewan (UofS). Specifically, we code the responses deductively using MLG concepts in order to extract additional meaning and broader significance. Preliminary results suggest that type-II MLG is a particularly useful concept in the context of team science administration. Our work broadens findings of the team science research at the UofS for potential application in other cases and also demonstrates an innovative application of political science.

(Note – An amendment to the research ethics protocol for this research is pending. In the meantime, it must treat the UofS as an individual case study and not make explicit theoretical claims that could apply to other cases.)

INTRODUCTION AND BACKGROUND

Team science, collaborative work focused on a common purpose among multiple disciplinary scholars, has become increasingly recognized and used in recent decades as an approach for addressing complex societal problems (National Academy of Sciences [NAS] 2005; Stokols et al. 2008; Disis and Slattery 2010; Falk-Krzesinski et al. 2011; Roy et al. 2013). Aspiring to integrate, translate, and apply knowledge in more productive ways for society, team science continues to hold promise, which has been partially realized (Adler & Stewart, 2010; Hall, Stokols, et al., 2012; Roy et al. 2013). Universities have emphasized the importance of collaborative, team science to demonstrate greater relevance to society (Stokols et al. 2008).

While institutions of higher education have encouraged team science, their structures typically are not set up well to support collaborative work (Leischow et al. 2008; American Psychological Association, 2014, National Council for Science and the Environment, 2011; Fitzgerald, 2013). Professional rewards typically skew toward rewarding individual success, and institutional structures reinforce these biases (American Psychological Association, 2014; Disis & Slattery, 2010). The challenges for team science are well documented (NAS 2005; Stokols et al. 2008; Falk-Krzesinski et al. 2010; NAS 2015), including barriers at both the individual and institutional levels.

Barriers at the Individual Level

Faculty at all ranks, but especially early career faculty, perceive risks associated with taking an interdisciplinary, team science path due to funding challenges, non-traditional outputs, publishing biases, and scholarly respect (Rhoten & Parker, 2004; Fischer et al. 2012; Pfirman & Begg, 2012). Contribution to academic fields, outside of one's own, are typically perceived as less valued, and isolating attribution within a larger project can be subjective (Cohen & Siegel, 2005). Finding high-quality places to publish integrative work is also challenging (Robinson, 2008; Fischer et al., 2012; Wagner et al., 2011). Apportioning credit for published work can be difficult due to different publishing traditions in academic departments and disciplines (Shen & Barabási, 2014). Additionally, team research and its outputs can take longer to come to fruition due to relationship building, learning to be interdependent, the intensive work of synthesizing findings and results, coordinating among the sheer number of people involved in the work, and appropriately translating this work for multiple audiences both inside and outside of academia (Robinson 2008; Hall, Vogel, et al., 2012; Armstrong & Jackson-Smith, 2013).

That said, there is evidence that team research can lead to higher annual publication rates over time compared to independent investigators (Hall, Stokol et al., 2012). Some team science involves participants outside of the academy. This transdisciplinary work can have an added benefit of involving key stakeholders affected by the very problems under investigation, but can also have the added costs of involving more people in the work who must be considered at various stages in the research process and who come from different backgrounds with different research expectations (Cash et al. 2006). Finally, engaging in team research can put scholars at cross-purposes with their own units, who may feel they are not getting the teaching, service and research attention they had hoped for when the individual was hired initially.

Barriers at the Institutional Level

Institutions of higher education are notoriously siloed places often relying on a departmental structure and scholarly practices that date back to the medieval ages (Brewer 1997). Conservative cultures permeate the ranks of senior administrators who control decision making about academic reward systems, publishing norms tend to favor narrow disciplinary contributions, and funding agencies are not well structured to facilitate team projects (Cohen and Siegel 2005; Robinson 2008).

Conventional academic reward systems, including tenure, promotion and merit standards, are a major barrier and continue to favor "independent" research (Cohen and Siegel 2005). Administrators at the department, college and university levels worry about upholding rigorous standards and quality of work, especially when collaborative, team science can seem imprecise and immeasurable. Inappropriate academic review processes and procedures meant for independent scholarship shape the evaluative criteria that junior faculty typically face (American Psychological Association, 2014, National Council for Science and the Environment, 2011; J. T. Klein, 2008; Pfirman & Begg, 2012). Criteria for merit, tenure and promotion do not usually support collaborative activity (American Psychological Association, 2014, National Council for Science and the Environment, 2011; Roy et al. 2013). Performance measures have typically focused on the quality and number of peer-reviewed publications, grants, and grant dollars (Stokols et al. 2008)—metrics which can be problematic when considering the shared model of team science (Carew & Wickson, 2010; Derrick et al., 2012; Kueffer et al., 2012; Hall, Stokols et al. 2012). Legitimizing collaborative, team science needs clear authority signals from university leadership as well as processes that back up these pronouncements. This includes ensuring that review committees at all levels—university, college and departmental—in the evaluation process are proficient in collaborative, team science practices and are qualified to evaluate such practices.

Beyond reward systems, institutional financial arrangements also reflect biases toward independent scholarship and siloization. A greater investment of up-front resources to support collaborative, team oriented efforts, especially if they involve partners outside the home institution, can be challenging for university cultures attuned to sole scholar model, which is typically more self-sufficient (Hall et al., 2012). Institutional accounting procedures related to overhead typically revert back to the home unit without the ability to share credit more widely or involve laborious accounting workarounds. Granting agencies and foundations seek to streamline processes for bureaucratic efficiency rather than effective collaborative scholarship.

More research about institutional and organization support for team science has been identified as needed (NAS 2005; Falk-Krzesinski et al. 2010; Roy et al. 2013). To date, most work takes a conceptual approach toward how institutional and organizational structures could change. Structures shape individual action and while barriers are well identified, there is very little empirical research on how institutional structures could and should change and where within these institutions change should take place. Faculty perspectives are underexplored but important because they are the ones who will ultimately be affected by the institutional structures so having a say in what those structures look like is an essential part of shaping an effective system of rules, incentives and processes that influence the institutional potential for team science. In this paper, we leverage political theory and provide empirical evidence from faculty

at a large Canadian university about their insights into and preferences for making collaborative, team science more feasible within their institutional structure.

THEORETICAL FRAMEWORK

Existing relevant literature struggles to provide practical suggestions for fostering team science. Inevitably the analysis encounters "how" and "where" barriers concerning university structure. Even when empirical data is actually collected from faculty through surveys and focus groups (e.g. Tang et al. 2016), it encounters similar "how" and "where" barriers. That is, faculty members can usually identify that there is a problem with how team science is rewarded, and are capable of explaining why certain solutions to that problem might be ineffective or inappropriate from their perspective, but encounter difficulty in arriving at consensus on specific and agreeable solutions (e.g. which level of university governance should bear primary responsibility for rewarding team science, in order to solve the problem?).

This paper proposes a new framework for supporting a deeper dive into such empirical data, based on the political science concept of multi-level governance (MLG), which can provide insight on how administrative levels and structures might coordinate. Also, conceiving of governance vertically in this manner can be instructive for understanding team science, which is ultimately an issue of horizontal integration (i.e. between disciplines and units). For example, horizontal interaction between departments looks different from the college level – in theory, the college can understand the perspectives of multiple departments and "see the forest for the trees" by nature of their perspective (e.g. like a bird's-eye-view of the forest). Thus, we should consider the political science theory around MLG, which privileges the vertical dimension and will allow us to see the problems and data from a different orientation, potentially overcoming the persistent "how" and "where" barriers typical to fostering team science.

Specifically, our framework sees levels of governance in higher education administration as nested tiers, just as there are levels of government in political jurisdictions. For example, departments can be seen as municipalities, colleges as regions (e.g. provinces), and universities themselves as countries. Viewing higher education in this way allows us to draw upon insights from political science concepts related to federalism and MLG (see Hooghe and Marks 2003; Ostrom 2009; Rabe 2007; Stein and Turkewitsch 2008). Table 1 identifies six such concepts, briefly describes them, and then provides a hypothetical practical insight (or normative position) from each, which is applicable to higher education administration for team science. The focus of each concept is different, but the concepts themselves (and the insights) are not necessarily mutually exclusive.

Table 1: Six Multi-Level Governance Concepts and their Potential Relevance to Team Science

CONCEPT	DESCRIPTION	HYPOTHETICAL INSIGHT
Central Authority	Certain policy problems are best addressed by large-scale political jurisdictions with the authority to impose regulations on lower levels. They can internalize externalities, force redistribution	The potential for contradictory team science policies between departments or between colleges is problematic. Guidelines should be imposed at the university level to ensure consistent and

	(i.e. mitigate the negative effects of regions competing with one another or deflecting costs), and exploit economies of scale.	immediate application to the levels below.
Subsidiarity	Responsibility for managing arising problems should default to the lowest level possible. Only when it has been determined that this level cannot effectively address the problem should the next-lowest level be considered. Communities and regions are heterogeneous, so their needs are generally best met by closest level of government, appreciating their individuality.	Departments should be given the first opportunity to develop team science policies. Only if those policies (or attempts at them) prove to be insufficient or problematic should higher level imposition at the college or university level be considered.
Federalism (specifically, Canadian, executive, or competitive federalism)	Different levels are considered to have equal status. No level necessarily has default authority or responsibility. Each level represents itself and negotiates with the other levels. This arrangement has elements of democracy (aggregation of self-interested parties) but can also be chaotic (with conflict or power struggle over certain domains).	There will always be conflicts between high-level administration and individual departments. Each has different interests and it will be difficult to address the concerns of all levels at once. Stable arrangements can only be arrived at organically and democratically, which takes time. It may not be practical to attempt identifying a broad solution in advance of this process.
Type-I MLG	Nested levels of government are necessary for general-purpose political functions. Different types of problems are best addressed by different levels. The key to effective governance is to ensure that the levels cooperate, rather than compete, with each other. This requires setting out a clear division of responsibilities (i.e. power sharing) so that each level can autonomously pursue its own functions.	Distinct parts of a team science policy should be implemented at different administrative levels. For example, the university could set out founding principles and the colleges could interpret those for their own use. The challenge is figuring out where and how to draw the boundaries between the responsibilities of each level (i.e. how much leeway is there in interpreting the principles?)
Type-II MLG	Some policy problems are so complex and/or important that they must be pursued by all levels of government at once, working together. This problem-driven	Each administrative level has a role to play in fostering team science. All levels should be charged with pursuing their own initiatives in pursuit of this goal.

	approach is somewhat flexible and ad-hoc, being less concerned with the formality and clarity of the arrangement between levels.	A certain degree of coordination and cooperation may be possible, but ultimately some overlap, competition, and chaos must be expected within and among the administrative levels.
Low-Level Laboratory	Another way for levels of government to cooperate is for the lowest levels to take the initiative in experimenting with different approaches to a policy problem, which could theoretically scale up to different levels. Low levels benefit from larger numbers, greater diversity, and political cover (i.e. less controversy and media attention), which allows them to perform this function.	Departments should be charged with deliberately taking different approaches to fostering team science. After a certain period of time, they should report back to the higher levels and these approaches should be evaluated. The most successful approaches should inform a broader team science policy at higher levels and could be adapted and diffused more broadly.

In analyzing empirical data from faculty through the lens of the above concepts, we expect to discover some persuasive arguments about which types of arrangements are likely to be most effective for fostering team science (i.e. which of the concepts or structures is most favoured by the focus group participants?). While these arguments might lead to identifying one particular concept as the most useful or appropriate for understanding and/or implementing team science administration, it is more likely that we will develop a framework that suggests which concepts are most useful or appropriate in which situations (i.e. depending on a given university's broad governance structure, internal political culture, and available resources).

CASE DESCRIPTION AND METHODS

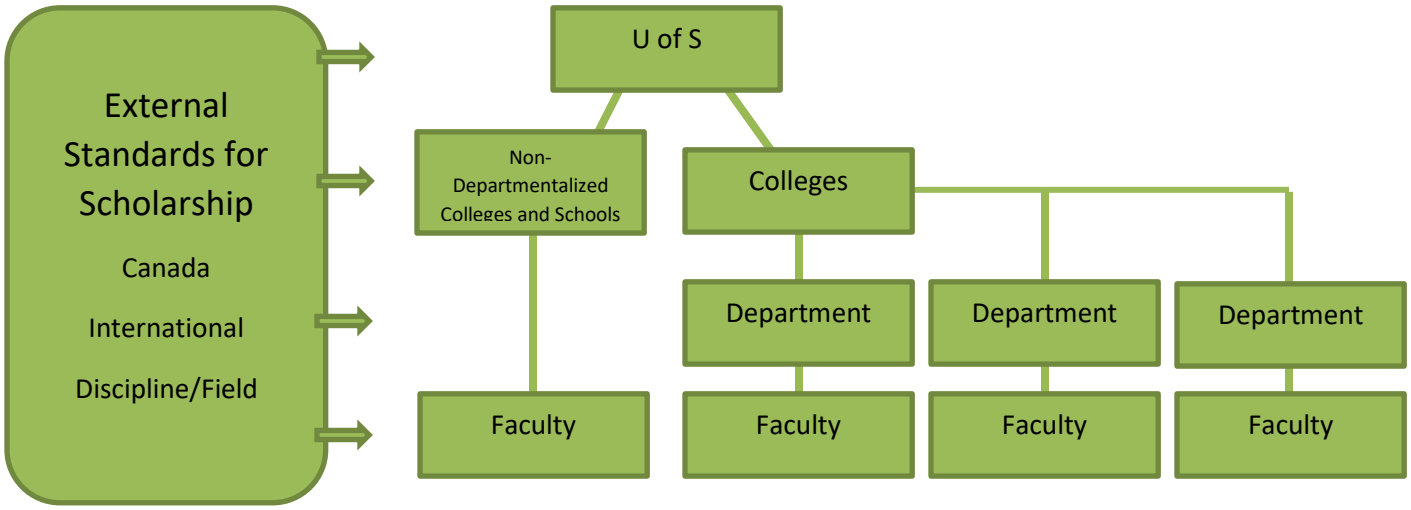
The University of Saskatchewan is a publicly funded, medical-doctoral university with 17 colleges and schools, a student population of 23,000 and 1,100+ faculty. The UofS is one of the top 15 research intensive institutions in Canada and has an institutional structure comprised of departmental and non-departmental colleges and schools (see Figure 1 – Tang et al. 2016).

In 2015, the UofS Office of the Vice-President Research (OVPR) sponsored an internal program evaluation project regarding team science, which was entitled "Building Capacity for Team Science at the U of S: Supports, Rewards, and Recognition" (see Tang et al. 2016). This project involved an e-scan of existing tools and trends for rewarding collaborative research, a survey of faculty on their level of involvement with collaborative scholarship and their opinion about current supports for such work, and two sets of focus groups (i.e. one before the survey and one after the survey). The second set of focus groups was the final research phase, and the other phases fed into it, so it is our focus here.

These focus groups took place in February and March of 2016. Participants were recruited from the survey, which went out to all university faculty and included a question asking if the respondent would be interested in following up through a focus group. A total of 39 tenured faculty, untenured faculty, and research centre representatives participated across five

focus group sessions. The discussions were intended to focus on 1) experience with recognition and reward for collaborative research efforts; 2) how to better measure, recognize, and reward collaborative scholarship activities; and 3) the usefulness and practicality of contemporary tools for supporting collaborative research, such as the annotated CV.

Figure 1: Institutional Structure at the University of Saskatchewan



The authors of this paper were also involved with the original 2016 study. At the time, they noticed that while the focus group discussions were primarily intended to evaluate potential short-term tools for recognizing team science, they naturally evolved into discussions about governance, which is one of the reasons for this subsequent paper and analysis. Our intent is to perform a secondary analysis of the focus group transcripts, this time with a strong theoretical framework based on MLG serving as the lens of inquiry.

Concepts identified in the above framework will serve as "codes" for analyzing the transcript data. The transcripts will be read for quotations or passages that overlap with the pre-existing concepts. That is, this will primarily be a process of "deductive coding" or "coding down" (see Lockyer 2004). A seventh code of "general governance" and an eighth code of "other" will also be used in order to leave some inductive flexibility in the research methodology (i.e. "coding up"). The result will be a strong understanding of how frequently each concept was invoked, but more importantly grouping together all the quotations or passages that were given the same code will allow for the identification of emerging themes (i.e. normative positions) relevant to MLG. We will compare those emerging themes to the recommendations in the original report (i.e. Tang et al. 2016), which were in contrast extracted through non-theoretical analysis.

(Please note that an amendment to the research ethics protocol for this research is pending. In the meantime, it must treat the UofS as an individual case study and not make explicit theoretical claims that could apply to other cases.)

RESULTS

The following are the main themes that emerged from analyzing the team science focus group data through the lens of MLG. Of the original six concepts, only four turned out to be particularly useful (i.e. central authority, subsidiarity, type-I MLG, type-II MLG). The other two (i.e. federalism, low-level laboratory) were used during the coding process, but did not end up matching cleanly with any normative statements made by focus group participants, unlike the rest. A number of quotes were coded under "general governance" (e.g. suggestions of specific metrics for rewarding team science) and "other" (e.g. observations about some of the external standards), but these did not end up being included in the current analysis in order to prioritize the lens of MLG. Table 2 reports the emerging themes under each concept, along with a short summary statement and a sample quotation to illustrate the point (the labels in square brackets are pseudonyms for individual focus group participants).

Table 2: Emerging Themes from Coding the Focus Group Transcripts

CONCEPT	THEME AND SUMMARY	ILLUSTRATIVE QUOTATION
Central Authority	Clear Vision [~7 quotes]: Rewarding team science properly requires leadership from the top level, in the form of a clear vision, along with associated definitions, principles, and standards.	There seems to be a lot of flavors of the month. I mean this is collaborative research. We're also indigenizing. I'm also on a list serve for engaged research. There's an Engaged Scholar Journal we just started. Nobody seems to know what all these things are, or how they put together. I think there could maybe be a clearer statement about how engaged research, collaborative research and indigenous research fit together. [A2]
Central Authority	Low-Level Failure [~9 quotes]: The lower levels of university governance may fail to properly reward team science, as they tend to rely on traditional processes which do not properly accommodate this new form of research.	Deans have a specific kind of character most of them at least, most of them are very resistant. They have their own agenda. They follow their own agenda. They want to shape and knead their colleges in their direction. I don't see any big opportunities in terms of the structure we have here. I think this has to be a totally different process, higher up with other criteria, because otherwise based on this present example of my friend we will lose more and more researchers. That's why this should have higher urgency. [E4]
Central Authority / Type-I MLG	Master List [~10 quotes]: One way for the top level to lead the process is to provide a master list of activities or criteria that should be rewarded of considered, but	I think what I would suggest as a workable solution is for the administration, the University and the College level to set forth a clear set of principles, the principles of acknowledging collaborative research, inter-disciplinary research, community-based research. So those are some basic principles

	implementation of that list could be left to the lower levels.	that need to be recognized in the promotion and tenure process. So a nice statement about that would then be handed down to the unit level- the department levels and say, 'now you put this system in place and if you want the quantitative metrics and then things like that', that respond to these principles. [A1]
Subsidiarity	High-Level Failure [~5 quotes]: The higher levels of university governance may fail to properly reward team science, as they tend to be ignorant of critical factors that can only be appreciated at the lower levels.	Yeah. My hours should only account for 100% of my allotted time. And I'm thinking, yeah but I put in 200%. Normally you can't do that because it doesn't fit the formula. Well your formula is wrong then. It's like they don't understand how much time is put into research. They go home at 3:30 and go to their cocktail parties on whatever it is and they don't understand what the rest of us are doing. So these merit things are very, very important certainly. And I think we should come back to that. [A5]
Subsidiarity	Bottom-Up Approach [~10 quotes]: A bottom-up approach to rewarding team science, which allows the lower levels of university governance to lead the process, is likely to be more effective than a top-down approach.	To me what I see this is important is to send the signal that the University needs to set the direction by saying these standards need to be changed, but they need to avoid the temptation to have a top down approach, like several people have pointed out. This isn't one size that fits all, it really needs to come from the individual units themselves, because there are so many different disciplinary conventions. [B7]
Subsidiarity	Bottom-Up Requirement [~5 quotes]: A bottom-up approach to rewarding team science, which allows the lower levels of university governance to lead the process, is the only option; a top-down approach is not at all viable.	I think the first remark here is that probably the different colleges and departments have very different ways of evaluating this. And I think that if you want to have one standardized way, it won't work. Because different specialties, different cultures. So what might work very well in one department, one college, might not work well in others. And that's why I'm kind of worried about this discussion that's supposed to one-size-fits-all. [B9]
Type-I MLG	Proactive High-Level Support [~7 quotes]: One way for the different levels of university governance to cooperate in rewarding team science is for	I guess for me if this is about rethinking institutional support for collaborative work, individual reward and recognition is not the way to go; that kind of works against the whole collaborative way. So for me I would like to see the university investing in the kind of training and mentorship and research

	the lower levels to be main "site" for related processes, but be proactively supported, or led, by the higher levels.	facilitation that's needed. In my college we have no research facilitator. I've chaired our research committee. I chaired our research ethics committee. I have no supports. [C2]
Type-I MLG	Reactive High-Level Support [~6 quotes]: One way for the different levels of university governance to cooperate in rewarding team science is for the lower levels to be main "site" for related processes, but be supported by processes at the higher levels when necessary.	But I think where the system really falls down is some people who are really innovative, taking risks, trying to do something no one else has done before, and then the department looks and says, we have no idea how to evaluate this process. We don't have the right boxes and things to tick. And so what I would hope is there would be some process where departments could say, help. We can't do it on our own. [A1]
Type-I MLG	General Clear Roles [~3 quotes]: In order for the different levels of university governance to cooperate in rewarding team science, there must be clear and distinct roles for each level, and clear boundaries around those roles.	The University does something, and then the College has to make those constant with the University, and then the Department has to make those constant with the others. So the question is, what does the OVPR want to do in terms of the University standards, creating a couple of additional boxes if that's what's required, and two encouraging the Colleges to create a couple of boxes that captures this. And then what will the departments do to actually operationalize this? This is a discussion for the department. [B6]
Type-II MLG	Multi-Level Committee [~4 quotes]: One way for the different levels of university governance to collaborate in rewarding team science is to establish a multi-level committee that could synthesize and make available best practices and tools.	We keep talking about interdisciplinary. We keep talking about the idea of changing the discussion. Well how about mandate who's on those committees a little bit. I don't know why, but people seem to be afraid of the idea of having physicists around table, or a health sciences researcher. I think that's insane, because I hear this sometimes, especially at humanities, is that we only want humanities things to be decided by the humanities people. I don't know about you, but I find that actually works to my detriment. [E5]
Type-II MLG	Coordination [~7 quotes]: In order to reward team science effectively, we must think strategically about the different levels of university	I think university has a lot of opportunity at the front end of it, for example, working with a community collaboratively. Identify the issues to be tackles and then naturally the issues raised by the community will probably require more than one individuals to solve it. So unless

	governance. There must be constructive synergy, and not arbitrary conflict or passive neutrality, between the processes at each level.	you are really influential in your field and individual professors are probably difficult to assemble a large interdisciplinary team to solve the issues. But the university has the capability to work with the government and work with the communities. [D5]

DISCUSSION

In order to arrive at some practical suggestions for facilitating team science within the institutional structure of the UofS, the primary focus of this section will be compare the above positions (i.e. themes) to the recommendations made in the original report on the focus groups. Similarities between the two may illustrate the relevance of MLG theory for higher education administration (i.e. could some of the recommendations have been predicted by MLG concepts prior to the empirical data being collected?). Differences between the two may represent a meaningful contribution or addition to the overall understanding of team science supports at the UofS, including specific recommendations that were not present in the original report. To begin with, below is a paraphrased list of those very recommendations from Tang et al. (2016):

At the department level:

1. Reconsider merit, tenure, and promotion standards. Make them clear.
2. Establish one or more diverse committees to do #1. Each committee should represent a range of disciplines, ranks, demographics, etc.
3. Committee members should also be familiar with team science and the relevant tools for measuring and recognizing it.
4. In doing #1, consider questions that arose from the focus groups.
    -e.g. What does the department value most? Process, outcomes, or impact?
    -e.g. What are reasonable measures and metrics for the field?
5. Consider novel tools (e.g. MOUs, annotated CVs) to help with #1.
6. State explicit collaborative standards when soliciting external tenure letters.

At the college level:

7. College-level committees should have members who are familiar with team science and the relevant tools for measuring and recognizing it.
8. Message the importance of team science. Set the tone for departments.

At the university level:

9. University-level committees should have members who are familiar with team science and the relevant tools for measuring and recognizing it.
10. Message the importance of team science. Encourage culture change and set clear expectations for how collaborative scholarship is valued.
11. Establish new awards to recognize collaborative research.
12. Harvest and celebrate best practices from colleges, schools, and departments.
13. Create workshops to build collaborative competencies

Implicit in this set of recommendations, and explicit in other parts of the report, is an overall acknowledgement that effectively fostering team science requires a system-wide approach involving the department, college, and university levels. However, in response to the

skepticism towards a top-down approach, which was apparent in the focus groups, the recommendations privilege the department level as the primary point of intervention.

In terms of similarities between these initial recommendations and the themes emerging from the current MLG-based analysis, there are several of note. First, the report's emphasis on system-wide change and the three levels of governance is a clear match to the focus of MLG theory, which suggests that the former has clear relevance to the broader issue at hand. Second, there is overlap between recommendation #12 and the low-level laboratory concept, although the former does not go so far as to suggest active experimentation within the departments and colleges. Third, the separation of recommendations by level matches with the general theory behind type-I MLG, as well as the associated theme of "general clear roles" that emerged from the transcript analysis. These similarities suggest that it may have been possible to predict some of the original project's outcomes ahead of time, if a MLG-proficient political scientist had been brought on to the project team.

Further similarities include the parallel of recommendation #10 and the "clear vision" theme, as well as the common observation of skepticism towards top-down approaches, but the secondary analysis is capable of more nuance when it comes to competing 'directions' of governance and types of MLG. That is, the MLG analysis was partially based on the diametrically opposing concepts of "central authority" and "subsidiarity", which sensitized it to skepticism toward bottom-up approaches in the focus groups (i.e. the emerging "low-level failure" theme). This was far less common than the opposing skepticism toward top-down approaches (i.e. the "high-level failure", "bottom-up approach", and "bottom-up requirement" themes), but was still significant, and was essentially overlooked or overshadowed in the initial analysis. Likewise, the secondary analysis was sensitized to the two different types of MLG, whereas the original analysis only seemed to embody type-I (distinct) MLG and not type-II (collaborative) MLG. Indeed, it is interesting that there are no system-wide recommendations; rather, similar recommendations are repeated at different levels (e.g. #'s 5, 7, and 9; #'s 8 and 10) as if they are distinct roles.

Thus, the novel recommendations arising from the secondary analysis are associated with nuance and specificity around the concepts of central authority, type-I MLG, and type-II MLG. First, the theme of "master list" reflects one way for the university to take some leadership, which is more specific than the general messaging recommendation (i.e. #10) from the original report. Second, one way to avoid conflict between the levels is for the higher levels to take on more of a support role for the lower levels, as represented by the emerging theme of "proactive high-level support". While the original recommendations include the creation of awards and workshops (i.e. #'s 11 and 13), the focus group quotations under this theme suggest more active and substantial involvement, such as providing (collaborative) research facilitation services or funding. Third, the theme of "reactive high-level support" suggests that while departments may be the main operational level for determining merit, tenure, and promotion, the higher levels could make processes available for exceptional situations (e.g. appeals, researchers whose good work does not match well with the department-level criteria). This could be initiated by a request from the department or from an individual faculty member, the latter (if allowed) being more controversial in terms of governance.

Moving on, recommendations stemming from type-II MLG may be the most important, as that concept received the least attention in the original report. A fourth recommendation is reflected in the theme of "multi-level committee". Such a construct would essentially combine original recommendation #'s 2, 7, 9, and 12 into a more collaborative initiative that could be

more at arms-length from the individual departments and reflect greater interdisciplinarity. Fifth, the higher levels could use their "birds-eye view" to initiate and facilitate new collaborative research endeavours. This would take some of the burden off of individual faculty and departments. There would be no governance overstep, either, because recruited partners could decline to participate if necessary.

Ultimately, the secondary MLG analysis was able to be cognizant, from the outset, of the potential tensions between top-down (e.g. central authority) and bottom-up (e.g. subsidiarity) approaches, as well as the different types of MLG. This allowed it to acknowledge skepticism and barriers identified by faculty without dismissing any substantial normative position. The nuanced analysis on the types of MLG allow for novel recommendations that are unlikely to overstep predominant governance preferences. They are not based on a strict top-down approach, nor do they simply leave departments entirely to their own devices. Essentially, the sensitization of the secondary analysis to MLG concepts opens up the possibility for overcoming or sidestepping the omnipresent tension between bottom-up and top-down approaches.

CONCLUSION

In conclusion, the secondary analysis performed in this paper facilitated a greater understanding of governance for team science at the University of Saskatchewan, evidenced, in particular, by the emergence of novel recommendations. This more sophisticated understanding addresses some of the "how" and "where" barriers typical in literature on team science. As a whole, this project demonstrates that political science theory, MLG concepts in particular, can be effective applied in the context of higher education administration.

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